

When sex hurts, anxiety and fear orient attention towards pain

Kimberley A. Payne^{a,*}, Yitzchak M. Binik^{a,b}, Rhonda Amsel^a, Samir Khalifé^c

^a Department of Psychology, McGill University, 1205 Dr. Penfield Avenue, Montreal, QC, Canada QC H3A 1B1

^b Sex and Couple Therapy Service, Department of Psychology, McGill University Health Center (Royal Victoria Hospital)

^c Faculty of Medicine, McGill University, and the Department of Obstetrics and Gynecology, Jewish General Hospital

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Abstract

Hypervigilance for pain-relevant stimuli has been associated with anxiety, fear of pain and anxiety sensitivity. This attentional bias has been primarily investigated in heterogeneous pain groups or pain-free controls, but has not been examined in pain conditions where anxiety and fear are likely to play a central role. Due to the intimate and interpersonal nature of genital pain experienced during sexual intercourse, Vulvar Vestibulitis Syndrome (VVS) constitutes an ideal sample in which to investigate the role of cognitive and affective factors in pain perception and maintenance. Seventeen women suffering from VVS and an equal number of age and education matched control women completed an emotional Stroop and memory recall task in addition to a series of questionnaires assessing pain-hypervigilance, state and trait anxiety, fear of pain, and anxiety sensitivity. VVS sufferers reported hypervigilance for coital pain and also exhibited a selective attentional bias towards pain stimuli on the emotional Stroop task as compared with controls. This effect was predicted by state and trait anxiety and fear of pain. According to these data, treatment strategies for VVS should target anxiety and fear in addition to sensory systems.

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1. Introduction

Vulvar Vestibulitis Syndrome (VVS) is believed to be the most common form of pre-menopausal dyspareunia (Meana et al., 1997a; Harlow and Stewart, 2003) and is characterized by severe pain upon vestibular touch or attempted vaginal entry, exquisite tenderness to cotton-swab palpation of the vulvar vestibule, and physical findings limited to vulvar erythema (Friedrich, 1987). Gynecologists commonly diagnose VVS via a cotton-swab palpation of the vulvar vestibule during which affected women report experiencing intense pain. How-

ever, with the exception of non-specific inflammation in some sufferers, no obvious organic pathology is typically evident during these assessments or subsequent laboratory tests. To date, possible underlying mechanisms have been explored but a clear etiology remains uncertain (Binik et al., 1999).

It is surprising that research to date has focused primarily on underlying physiological mechanisms when cognitive and affective factors likely play an important role in VVS. Because of the location of the pain, VVS directly interferes with sexual intercourse, which is for many a highly valued activity. Not surprisingly, women affected report; lower frequencies of intercourse and self-stimulation, lower levels of desire, pleasure, arousal, and self-stimulation, less success at achieving orgasm through intercourse and oral stimulation, and more

* Corresponding author. Tel.: +1 514 398 5323; fax: +1 514 398 4896.

E-mail address: kimpayne@ego.psych.mcgill.ca (K.A. Payne).

negative attitudes towards sexuality than matched controls (Meana et al., 1997b; Reissing et al., 2003). For many VVS sufferers, the inability to experience sexual pleasure may represent a threat to their femininity and relationship satisfaction as well. Similarly, women who suffer from VVS report more catastrophizing in relation to pain experienced during intercourse as opposed to other regularly experienced pains (Pukall et al., 2002). They also report more anxiety (Nunns and Mandal, 1997; Gates and Galask, 2001; Granot et al., 2002) and depression than pain-free controls (Jantos and White, 1997; Dunn et al., 1999). Given the multiple important, cognitive, affective and interpersonal factors associated with VVS, this would seem an ideal population in which to investigate the role of cognition and affect on pain perception.

Central to both the cognitive processing of sensory pain information and sexual stimuli, is the role of attention and anxiety in stimulus selection and awareness. Specifically, the experience of pain demands attention (Eccleston and Crombez, 1999), and manipulations of attentional focus are known to influence pain perception as exhibited in the efficacy of distraction (McCaul and Malott, 1984) and other cognitive pain-coping strategies (Fernandez and Turk, 1989). Furthermore, some chronic pain patients have been shown to exhibit an attentional bias (otherwise known as hypervigilance) for pain stimuli believed to play a role in the development and maintenance of chronic pain (Pearce and Morley, 1989; Asmundson et al., 1997; Crombez et al., 2000; Beck et al., 2001; Keogh et al., 2001). The tendency to attend to painful stimulus has obvious evolutionary advantages in alerting the organism to possible injury, however, in the case of chronic pain, the concept of hypervigilance has been attributed to symptom misinterpretation and amplification (Watson and Pennebaker, 1989).

Interestingly, the allocation of attention towards threatening stimuli during sexual activity is also linked to sexual dysfunction (Barlow, 1986; Dove and Wiederman, 2000; Van den Hout and Barlow, 2000) and a strong relationship has been established between anxiety and hypervigilance in both anxious and sexually dysfunctional patients (Van den Hout and Barlow, 2000). Therefore, given the distracting and threatening nature of pain, in addition to the pattern of sexual dysfunction and psychological distress observed in women with VVS, hypervigilance-to-pain represents a likely candidate involved in the etiology and/or maintenance of this condition.

The question of whether chronic pain patients are hypervigilant to pain stimuli has been empirically investigated using such experimental paradigms as the emotional Stroop (Williams et al., 1996) and Dot-Probe tasks (MacLeod et al., 1986). In the emotional Stroop task, participants are presented with stimulus words in

different colours, and are asked to name the stimulus colour as quickly as possible while ignoring the word itself. Longer response times are taken as an index of attentional interference between the colour-naming response and word meaning. In the Dot-Probe task, two words are presented vertically on a computer screen followed by a small dot appearing in the location of one of the words. Participants are required to indicate via a key-press whether the dot appeared in the upper or lower portion of the screen. Faster response times to dots appearing in target stimuli locations as compared to opposite-target locations are taken as a measure of selective attention.

To the best of our knowledge, Pearce and Morley (1989) were the first to use an emotional Stroop task as a measure of pain-hypervigilance. This paradigm was used in order to experimentally analyze the construct validity of the McGill Pain Questionnaire (Melzack, 1975) in a sample of 16 chronic pain patients and 16 pain-free controls. As predicted, pain patients displayed more interference to sensory and affective pain-related words than pain-free controls. Not all chronic pain patients demonstrate hypervigilance to pain stimuli however, as affective distress also seems to play an important role (Eccleston et al., 1997). Specifically, pain-hypervigilance has not been consistently found in studies that failed to evaluate the contributory role of anxiety (Duckworth et al., 1997). Pincus et al. (1998) for example, failed to find group differences between chronic pain patients and controls participants on an emotional Stroop task, yet found anxiety scores correlated to pain-word latency for both groups. In addition to anxiety, fear of pain and anxiety sensitivity (a predictor of fear of pain; Asmundson and Taylor, 1996), have also been identified as possible predictors of hypervigilance to pain-related stimuli. Keogh et al. (2001) examined hypervigilance for pain-related stimuli in pain-fearful individuals using a computerized Dot-Probe task and found that participants high in fear of pain exhibited significantly greater hypervigilance towards pain-related information as compared to those low in fear of pain. The authors concluded that individuals with high fear of pain may be particularly susceptible to negative pain experiences due to biases in attentional processing. Asmundson et al. (1997) also found a link between anxiety sensitivity and pain-hypervigilance in chronic pain patients. In their study, 19 chronic musculoskeletal pain patients and 22 healthy control participants completed a computerized Dot-Probe task where target stimuli consisted of pain and injury-related words. Results indicated that patients low in anxiety sensitivity shifted their attention away from pain-related stimuli, whereas patients high in anxiety sensitivity did not. These findings were replicated in healthy individuals with low fear of pain (Keogh et al., 2003) where attention to masked stimuli

was also examined. When stimulus pain words were masked, those low in fear of pain failed to orient away from the stimuli suggesting this ability to be under conscious control.

Taken together, these results suggest that chronic pain patients display a hypervigilance to pain stimuli whereby affective states such as anxiety, fear of pain and/or anxiety sensitivity also play a role. However, other data have failed to find an association between hypervigilance to pain and fear of pain, anxiety, depression, or catastrophizing in both chronic pain patients and pain-free samples (Roelofs et al. 2002; Roelofs et al., 2003). Current mixed findings may be attributable to variations in methodology. To date, pain-hypervigilance has largely been investigated in heterogeneous groups of chronic pain patients, or by comparing pain patients or controls who are high or low on some affective variable of interest (i.e., fear of pain, anxiety sensitivity). These studies have also typically relied upon a single unidimensional measure of hypervigilance (e.g., emotional Stroop or Dot-Probe paradigms). However, attention to threat may operate in a variety of different ways (Eysenck, 1997) at multiple levels of the cognitive processing system (Chaiken and Trope, 1999). Furthermore, the study of attentional processes in chronic pain patients may actually be confounded by the experience of pain during the actual testing session, particularly when reaction times are used as the dependent measure. In contrast, the present study represents the first multidimensional investigation of pain-hypervigilance in a recurrent-acute pain sample where anxiety and fear are hypothesized to play a central role. It was hypothesized that women with VVS would exhibit hypervigilance for pain-related stimuli on three tasks; an emotional Stroop task designed to assess initial and implicit allocation of attention to novel stimuli, a self report measure to assess latter stage explicit allocation of attention, and a memory recall task. This last measure was included as it was hypothesized that a bias in the allocation of attentional resources during the encoding phase would also be reflected in a subsequent memory recall bias for pain stimuli (Bower, 1981; Beck et al., 1986), consistent with previous findings in chronic pain patients (Edwards et al., 1992; Pincus et al., 1993; Edwards et al., 1995; Pincus et al., 1995; Pauli and Alpers, 2002). Hypotheses further predicted that group differences on pain-hypervigilance would be predicted by anxiety, fear of pain and anxiety sensitivity.

2. Methods

This study was reviewed and approved by the McGill University Faculty of Medicine Institutional Review Board.

2.1. Participants

Participants were recruited via media advertisements and screened during a semi-structured telephone interview. All subjects were required to be native English speakers and in good general health. Inclusion criteria for women suffering from VVS were: (1) pain during intercourse occurring on more than 50% of occasions for a minimum of 6 months; (2) pain limited to intercourse and other activities involving vestibular pressure and/or vaginal insertion. Participants in the control group were included if they reported pain-free intercourse. Women suffering from VVS were matched (+ or –2 years) on age and years of education to an equal number of control women. Exclusion criteria for both groups were pelvic and/or vaginal pain attributed to organicity (e.g., vaginal atrophy), a history of remitted dyspareunia, major medical and/or psychiatric illness, other chronic pain(s), taking medication that could influence reaction time, current pregnancy, and/or previous experience on a Stroop task. Following the telephone screening, participants underwent subsequent testing at a private medical office where they were examined by a participating gynecologist to determine diagnostic status and further suitability for the study. The study took approximately 2–2½ h to complete and participants were reimbursed \$50 CDN to cover any expenses incurred.

2.2. Procedure

After arriving at the gynecologist's office, the study was explained to participants in greater detail and informed consent was obtained. They then completed the procedures in the following order; Part 1 of a semi-structured interview, the State subscale from the State-Trait Anxiety Inventory (Spielberger et al., 1970), an emotional Stroop task, Part 2 of a semi-structured interview, a series of self-report measures, and lastly, a gynecological examination. The State Anxiety Scale was administered just prior to the emotional Stroop task in order to get an accurate measure of the influence of state anxiety on task performance. Part 2 of the semi-structured interview, the self-report measures and the gynecological examination were all conducted after the emotional Stroop so as not to bias participant response on this task by previous exposure to pain stimuli. However, all subjects were informed that they would undergo a gynecological examination prior to the emotional Stroop task so as to prime context-specific hypervigilance.

2.2.1. Interview

The semi-structured interview was administered in two parts. Part 1 administered prior to the emotional Stroop task inquired about socio-demographic

information in addition to general relationship, gynecological and medical history. Part 2 of the semi-structured interview inquired more specifically about pain history. Women with VVS provided details regarding their coital pain history, while control subjects were asked to identify a pain they experience regularly (at least once a month, e.g., headache, menstrual cramps, etc.).

2.2.2. *The emotional Stroop task*

Stimuli for the emotional Stroop task consisted of 4 sets of ten words in the following categories: pain, social-threat, positive, and neutral words. Social-threat, positive, and matched neutral words were randomly chosen from previously generated lists (Keogh et al., 2001) and included to assess interference due to general negativity and emotionality, respectively, rather than a specific pain-related attentional bias per se. Pain words were taken from three sources; descriptors endorsed by VVS women on the McGill Pain Questionnaire in 2 previous studies (Bergeron et al., 2001; Pukall et al., 2002), and a survey of sex therapists experienced in the treatment of VVS. In this survey, therapists were asked to report what words women with VVS use to describe their pain. From the total list of descriptors gathered, only those that were endorsed 30% of the time within one source and appeared on two or more sources were chosen (a methodology similar to that used in the development of the McGill Pain Questionnaire). An additional 2 words were randomly selected from these sources to complete the total list of 10 words. A list of neutral words matched to pain words on frequency of occurrence in the English language and word length was also generated yielding the following pain stimulus-matched list; burning/dressed, hurt/gate, stabbing/armchairs, ache/loaf, shooting/concrete, searing/tarnish, lacerate/overheat, cutting/setting, sting/wash, throbbing/detergent. Ten words in each category were presented randomly on a computer screen 4 times in 4 different random colours (red, blue, green, yellow), with no identical stimulus colour repeated in succession so as not to prime subsequent responses.

Participants were introduced to the task and completed one practice trial consisting of 4 stimulus words (pencil, board, paper, desk) presented in similar fashion to the experimental stimuli. They were instructed to name the word colour as quickly as possible while ignoring the word itself. With the help of a microphone headset, the stimulus word remained on the computer screen until the participants' verbal response triggered its removal from the display monitor. Any response other than the correct colour was coded as incorrect and deleted from further analysis. Once the emotional Stroop was completed, participants engaged in a filler task; counting backwards from 100 by 3s for a period of one minute. They were then tested for memory of previ-

ously presented emotional Stroop stimuli on a free recall task.

2.2.3. *Questionnaires*

Participants completed both State and Trait subscales of the State-Trait Anxiety Inventory and the Anxiety Sensitivity Index (Peterson and Reiss, 1992). The Anxiety Sensitivity Index assesses fear of anxiety symptoms and the belief that these will have negative consequences. This scale demonstrates adequate test-retest reliability ($r = 0.75$) and internal consistency. The Pain Anxiety Symptom Scale (McCracken et al., 1992) was also administered as a measure of fear of pain. This questionnaire is composed of four subscales; (1) Cognitive Anxiety, (2) Escape/Avoidance, (3) Fearful Appraisal, and (4) Physiological Anxiety; each demonstrating good internal consistency (Cronbach's α ranging 0.81–0.89) and designed to measure fear of pain across cognitive, behavioural and physiological domains. These subscales were therefore considered separately during the analyses. The Pain Vigilance Awareness Questionnaire (McCracken, 1997) was administered as an additional measure of hypervigilance to pain. This scale assesses awareness, vigilance, preoccupation, and observation of pain; displays good internal consistency (Cronbach's $\alpha = 0.86$) and test-retest reliability ($r = 0.80$); and has been validated for use in chronic pain and non-clinical samples (McWilliams and Asmundson, 2001).

The Pain Anxiety Symptom Scale and the Pain Vigilance Awareness Questionnaire were administered twice to separately examine how participants respond to a recurrent pain experience vs. to pain in general. VVS participants referred to their VVS pain for recurrent pain ratings while control subjects chose a regularly experienced pain (established during Part 2 of the semi-structured interview). VVS participants also completed the McGill Pain Questionnaire with reference to their coital pain. Finally, section B of the Mill Hill Vocabulary Scale (Raven, 1965) and the Beck Depression Inventory (Beck et al., 1961) were administered to control for effects due to verbal intelligence and negative affect, respectively. Question 21 of the Beck Depression Inventory was omitted because it inquires about loss of interest in sexual activity, from which VVS women may be suffering due to their pain. All questionnaires, with the exception of the State Anxiety Scale, were administered in a control-matched randomised order to control for possible response biases due to fatigue.

2.2.4. *Gynecological examination*

The gynecological examination consisted of a standard bimanual palpation of the vagina, uterus, and adnexae, followed by a cotton-swab palpation of 6 randomly ordered, control-matched, vestibular sites (1 o'clock, 1–3 o'clock, 3–6 o'clock, 6 o'clock, 6–9 o'clock, 9–12 o'clock). During this examination, a female re-

searcher recorded pain ratings as reported at each location on a Likert scale ranging from 0 (no pain at-all) to 10 (worst pain ever). These ratings were averaged across locations to create a vestibular pain index.

2.2.5. Data analysis

Stroop interference effects were computed by subtracting mean reaction times of matched neutral words from the corresponding semantic category. Group differences on measures of hypervigilance (Stroop interference, Pain Vigilance Awareness Questionnaire, and memory recall) were analysed in separate MANOVAs to control for inflated Type I error. Group differences on measures of affective distress (depression, state and trait anxiety, fear of pain, and anxiety sensitivity) were performed using MANOVA to control for inflated Type I error where appropriate, and independent sample *T*-Tests. Following this analysis, Pearson *r* correlations were conducted between measures of affective distress and measures of hypervigilance in order to identify possible covariates of hypervigilance. These, in turn, were covaried out of the hypervigilance multivariate analysis.

3. Results

3.1. Sample characteristics

Seventeen women suffering from VVS (mean age 22.76, SD = 3.01) were successfully matched to an equal number of control women (mean age 22.65, SD = 3.76). There were no significant differences between groups with respect to religion, place of birth, income, relationship status χ^2 (all $P > 0.10$), or reading level as indicated by scores on the Mill Hill Vocabulary Scale. Gynecological examinations revealed that all participants had hymeneal remnants, mobile uteri and adnexae, and vaginal tissue rated as excellent in condition. Evidence of cervical ectropions, polyps, fibroids, or prolapsed uteri was not found. Women with VVS reported experiencing vulvar pain for a mean duration of 3.5 years

(SD = 2.57), obtained a mean vestibular pain index of 5.44 (SD = 2.04) upon cotton-swab palpation of the vulvar vestibule, and a pain rating index on the McGill Pain Questionnaire of 29.47 (SD = 10.62), a pain severity similar to that of chronic back, cancer, or phantom limb pain (Melzack and Katz, 1992).

3.2. Measures of hypervigilance

Means, standard deviations, and intercorrelations on measures of hypervigilance are displayed in Table 1. A multivariate analysis of variance was conducted on all four measures of pain hypervigilance; Stroop interference effect for pain (see Fig. 1), the Pain Vigilance Awareness Questionnaire for recurrent pain, the Pain Vigilance Awareness Questionnaire for general pain (see Fig. 2), and memory recall of pain words. A multivariate group main effect was found ($F(4,29) = 2.76$, $P < 0.05$). Examination of univariate effects revealed that VVS women exhibited higher levels of Stroop interference on pain stimuli ($F(1,32) = 4.70$, $P < 0.05$; $\eta_p^2 = 0.13$), and scored higher on the Pain Vigilance Awareness Questionnaire for recurrent pain $F(1,32) = 4.55$, $P < 0.05$; $\eta_p^2 = 0.12$) than controls. A separate analysis was conducted on remaining Stroop interference effects (i.e., social threat and positive words; see Fig. 1), and memory recall data where no effect was found.

Test-retest reliability was calculated on Stroop data. The first and second presentation of stimulus words were averaged and correlated with the mean of the third and fourth presentations. No significant correlations were obtained indicating that the Stroop task did not correlate with itself (Pain stimuli $r = -0.14$, Social Threat stimuli $r = 0.16$, Positive stimuli $r = -0.24$). The different measures of hypervigilance were also uncorrelated.

3.3. Measures of affective distress

Means, standard deviations, and intercorrelations on measures of affective distress are displayed in Table 2. No group difference was found on the Beck Depression

Table 1
Means (*M*), standard deviations (SD), and intercorrelations on measures of hypervigilance

	VVS <i>M</i> (SD)	Control <i>M</i> (SD)	2	3	4	5	6	7	8
<i>N</i>	17	17							
1. Pain Stroop	18.55 (24.41)	-1.10 (28.30)*	-.36*	-.19	-.08	-.14	-.15	-.16	-.22
2. Social Threat Stroop	-11.28 (31.68)	-9.83 (37.23)	-	-.26	.39*	.50**	-.07	.11	-.06
3. Positive Stroop	-6.05 (27.33)	2.13 (26.38)	-	-	-.16	-.18	-.18	-.07	-.07
4. Pain Vigilance Awareness Questionnaire recurrent pain	52.35 (9.33)	44.92 (10.91)*	-	-	-	.86**	-.12	.03	-.31
5. Pain Vigilance Awareness Questionnaire general pain	46.23 (9.22)	40.61 (12.37)	-	-	-	-	-.08	.02	-.18
6. Pain Recall	1.47 (1.62)	1.88 (1.80)	-	-	-	-	-	.36*	.41*
7. Social Threat Recall	.88 (.93)	1.23 (1.52)	-	-	-	-	-	-	.02
8. Positive Recall	.41 (.62)	1.00 (1.06)	-	-	-	-	-	-	-

* $P < 0.05$.

** $P < 0.01$.

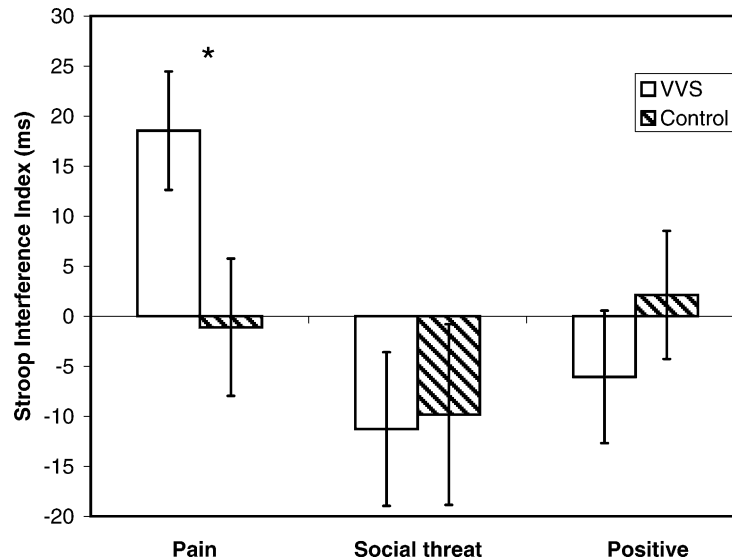


Fig. 1. Stroop interference effects for pain, social threat, and positive words by group (see file KPayne Figure 1).

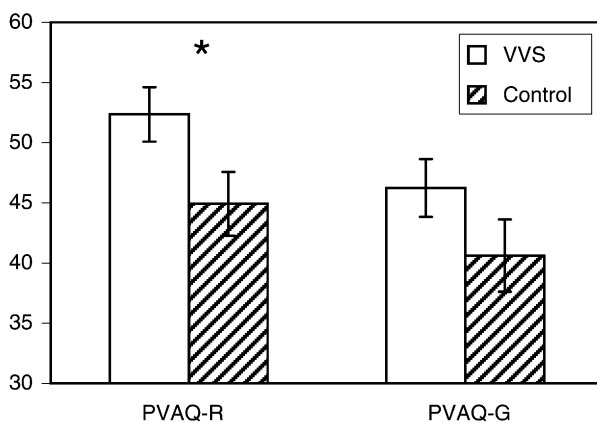


Fig. 2. Pain Vigilance Awareness Questionnaire for specific (PVAQ-P) and general pain (PVAQ-G) experiences by group (see file Kpayne Figure 2).

Inventory however, a multivariate main effect was found on measures of anxiety ($F(2,31) = 7.63, P < 0.01$), with VVS subjects displaying higher levels of both State ($F(1,32) = 10.83, P < 0.01$) and Trait anxiety ($F(1,32) = 9.90, P < 0.01$). A group main effect was found on subscales of the Pain Anxiety Symptom Scale for recurrent pain ($F(4,29) = 3.74, P < 0.01$), however examination of univariate tests revealed only a trend for cognitive anxiety ($F(1,32) = 2.80, P < 0.10$). No group differences were found on the Pain Anxiety Symptom Scale for general pain subscales or the Anxiety Sensitivity Index.

3.4. Covariates of hypervigilance

In an attempt to identify possible covariates of pain-related hypervigilance, correlation analyses were conducted between measures of depression, anxiety, fear

of pain, anxiety sensitivity, and pain-hypervigilance measures (Table 3). Measures of state and trait anxiety correlated with Stroop interference on pain stimuli, and when entered into the above Manova as covariates, the multivariate main effect was no longer significant ($F(4,27) = 1.75, P = 0.17$). The univariate effect for Pain Stroop was also no longer significant ($F(1,30) = 0.214, P = 0.65$), while an effect on the Pain Vigilance Awareness Questionnaire for general pain became significant ($F(1,30) = 4.32, P < 0.05$). Univariate tests on the Pain Vigilance Awareness Questionnaire for recurrent pain also remained significant ($F(1,30) = 5.84, P < 0.05$).

In order to limit the number of fear of pain factors to be examined as covariates, only those subscales on the Pain Anxiety Symptom Scale ($N = 4$) that correlated with at least two measures of hypervigilance were considered (see Table 3). When Cognitive Anxiety, Fearful Appraisal, and Physiological Anxiety for recurrent pain were entered as covariates into the analyses, the multivariate group main effect was no longer significant as were all univariate tests. As anxiety sensitivity also correlated with the Pain Vigilance Awareness Questionnaire for recurrent pain and Pain recall measures, it too was separately entered as a covariate into the analysis, however the original pattern of results remained unchanged.

4. Discussion

These results suggest that women suffering from VVS display hypervigilance for pain relevant information. Specifically, VVS women displayed greater Stroop interference for pain words as compared with control women, and also reported experiencing more hypervigilance to pain during intercourse on a self-report

Table 2
Means (*M*), standard deviations (*SD*), and intercorrelations on measures of affective distress

Variable	VVS	Control	2	3	4	5	6	7	8	9	10	11	12
<i>N</i>	17	17											
1. Beck Depression Inventory	9.76 (4.56)	7.12 (4.70)	.25	.46***	.39**	.15	.41**	.38**	.30	.27	.36**	.39**	.37**
2. State Anxiety Inventory	41.71 (12.84)	30.65 (5.20)***	–	.48***	.42**	.13	.38**	–.11	.38**	.24	.54***	–.05	.23
3. Trait Anxiety Inventory	47.12 (7.90)	39.29 (6.52)***		–	.42**	.13	.38**	–.11	.38**	.24	.54***	–.05	.23
<i>Pain Anxiety Symptom Scale for recurrent pain</i>													
4. Cognitive anxiety	28.00 (10.02)	22.41 (9.43)†			–	.62***	.71***	.51***	.79***	.60***	.39**	.45***	.39**
5. Escape/Avoidance	18.18 (7.22)	21.47 (8.67)				–	.54***	.49***	.58***	.84***	.36**	.46***	.35**
6. Fearful Appraisal	14.88 (7.03)	11.82 (6.80)					–	.53***	.60***	.48***	.62***	.49***	.34**
7. Physiologic Anxiety	12.65 (8.94)	13.06 (9.33)						–	.36**	.48***	.13	.84***	.41
<i>Pain Anxiety Symptom Scale for general pain</i>													
8. Cognitive anxiety	25.35 (8.15)	24.29 (9.28)							–	.68***	.61***	.44***	.46***
9. Escape/Avoidance	21.41 (7.43)	22.53 (9.91)								–	.50***	.55***	.50***
10. Fearful Appraisal	14.06 (7.90)	13.06 (5.28)									–	.31	.32
11. Physiologic Anxiety	14.88 (7.57)	15.53 (9.01)										–	.41**
12. Anxiety Sensitivity Index	21.82 (7.74)	21.47 (9.44)											–

** $P < 0.05$.

*** $P < 0.01$.

† $P < 0.10$.

Table 3
Correlations between attentional bias indexes and questionnaire measures^a $N = 34$

	Pain Stroop	PVAQ-R	PVAQ-G	Pain Recall
Beck Depression Inventory	.20	.23	.15	–.31
State Anxiety Inventory	.39*	–.01	.00	.17
Trait Anxiety Inventory	.51**	.09	–.12	.00
<i>Pain Anxiety Symptom Scale for recurrent pain</i>				
Cognitive anxiety	.22	.40*	.41*	–.10
Escape/Avoidance	.09	.04	.09	.01
Fearful Appraisal	.24	.48**	.46**	–.17
Physiologic Anxiety	.03	.28	.34*	–.36*
<i>Pain Anxiety Symptom Scale for general pain</i>				
Cognitive anxiety	.24	.30	.36*	.04
Escape/Avoidance	.19	.01	.12	.00
Fearful Appraisal	.35*	.21	.28	.20
Physiologic Anxiety	–.04	.10	.27	–.13
Anxiety Sensitivity	.21	.34*	.33	–.40*

^a PVAQ-R, Pain Vigilance Awareness Questionnaire for recurrent pain; PVAQ-G, Pain Vigilance Awareness Questionnaire for general pain.

* $P < 0.05$.

** $P < 0.01$.

measure. Further analyses provided evidence in support of a mediating role for anxiety and fear of pain according to the criteria outlined by Baron and Kenny (1986). Firstly, the groups differed on measures of hypervigilance, state and trait anxiety, and multivariate fear of pain; secondly, measures of anxiety and fear of pain correlated with hypervigilance; and finally, when controlling for anxiety and fear of pain, the group differences on hypervigilance disappeared.

Effect sizes on group differences for pain hypervigilance were small, particularly regarding Stroop interference data. This is less than that reported in a recent meta-analysis by Roelofs et al. (2002) that found a mean

interference effect of 26.7 ms (vs. 19.65 in this study) in chronic pain patients for sensory pain words across five studies. It is however important to note that due to the methodological constraints of the Stroop task, women were excluded from participating in this study if taking medications that could influence reaction time (such as antidepressants, anxiolitics, or analgesics). Therefore, by excluding VVS sufferers with greater psychological and somatic distress, the current results may actually underestimate the true effect. In addition, the selection of Stroop words may have rendered the pain stimuli relevant only to the VVS group. However, this does not undermine the evidence for pain hypervigilance or its

implications for pain processing, but rather speaks to the source of this bias which was not the focus of this investigation.

Our multimodal approach to the measurement of hypervigilance yielded some interesting findings. Specifically, different measures of hypervigilance were uncorrelated. This is perhaps reflective of a methodological problem given that the Stroop task failed to correlate with itself and therefore may not be expected to correlate with other measures as well. Alternatively, these measures are tapping different constructs or the allocation of attention can operate independently at different stages of processing. Stroop interference effects were predicted by measures of anxiety, while self-report measures of hypervigilance were predicted by fear of pain (see Table 3). It is possible that anxiety orients pre-attentive processing of the threatening stimulus, while fear orients subsequent explicit allocation of attentional resources towards the threatening stimulus. Similarly, anxiety is traditionally conceptualized as a generalized state of non-specific distress whereas fear is considered to be a response to a specific and identifiable threat. Empirical support exists for this distinction (Davis, 1998; Lang et al., 2000). Also consistent with our findings, research on the emotional Stroop task has shown a reliable relationship between anxiety and Stroop interference, and has even found Stroop-interference for subliminally presented stimuli (Williams et al., 1996). This suggests a limited role for fear-of-pain, which requires the conscious perception of the feared stimulus. Alternative hypotheses suggest that it is the disengagement from stimuli which is influenced by threat versus stimulus detection per se (Fox et al., 2001; Fox et al., 2002). Further research is needed in order to explore the role of disengagement from threat in women with VVS.

No between-group or covariate effect was found for anxiety sensitivity replicating the findings of Keogh et al., 2001. Between-group differences in memory recall of pain words were also lacking, replicating similar unsuccessful attempts to demonstrate a memory bias towards threat stimuli in anxious states (Mathews and MacLeod, 1985; Mogg et al., 1987; Mogg et al., 1989). These results are consistent with cognitive models of anxiety that predict a dissociation between attention and memory biases (Eysenck, 1997; Mogg and Bradley, 1998). Not surprisingly, state anxiety can affect the encoding and later retrieval of information. Future research is needed to examine different levels of attentional pain processing, and the relative contributions of anxiety, fear of pain, and anxiety sensitivity to each.

The implications for an attentional bias towards pain stimuli in women suffering from VVS is clear. Hypervigilance to pain can increase the stimulus salience and perceived intensity, becoming an important factor in altered pain perception and maintenance. In order to treat VVS, our data suggests that anxiety and fear should be tar-

geted in addition to sensory systems. Unfortunately, current standard medical practice relies largely on the use of a variety of topical creams and surgery in the absence of controlled clinical trials (Bergeron et al., 1997). The existence of a hypervigilance mechanism involved in VVS is also important for the understanding of sexual functioning in women suffering from this disorder. Specifically, if attention is preferentially allocated to pain processing during activities such as sexual intercourse, then theoretically, fewer attentional resources will be available for the processing of sexually arousing or pleasurable stimuli. This bears striking resemblance to Barlow's model of Inhibited Sexual Excitement (Barlow, 1986) where anxiety is believed to produce a focus on task irrelevant behaviour that in turn interferes with performance. Whereas Barlow's work has focused on erectile dysfunction, one could argue that a functional similarity with VVS exists whereby both groups have difficulty with vaginal penetration or sexual 'performance'. What role sexual arousal might play in VVS pain perception is yet unknown. While the influence of sexual arousal on genital sensation has never been explicitly examined, some have demonstrated an analgesic effect produced by pleasurable genital stimulation in women believed to play an adaptive role in reducing potentially aversive stimulation experienced during coitus (Komisaruk and Wipple, 2000). Therefore, hypervigilance to pain stimuli in women with VVS may result in both a heightened awareness of pain and a distraction away from sexual stimuli resulting in impaired sexual arousal, which itself may potentially exacerbate the pain experience.

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