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The role of anxiety sensitivity in the experience of menstrual-related symptoms reported via daily diary

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Abstract

The current study examined the interactive effects of Anxiety Sensitivity (AS) and menstrual cycle phase in the experience of menstrual-related symptoms. Participants were 55 community women who completed prospective tracking of menstrual-related symptoms across at least one full menstrual cycle using the Daily Record of Severity of Problems (DRSP) and completed the Menstrual Distress Questionnaire (MDQ) once in their premenstrual and follicular cycle phases. Results revealed that women with higher levels of AS reported greater menstrual-related symptoms, regardless of cycle phase, as compared to women with lower levels of AS. These findings suggest that AS may be an important psychological factor involved in the experience of psychological and somatic symptoms across the menstrual cycle. Results are consistent with previous literature documenting the role of AS in menstrual-related symptoms as well as in other physical health conditions.

Keywords

Anxiety sensitivity; Menstrual symptoms; Menstrual cycle; Premenstrual symptoms

1. Introduction

The premenstrual phase of the menstrual cycle is associated with a variety of psychological (e.g., anxiety, sadness) and bodily (e.g., fatigue) symptoms (Freeman, 2003). Approximately 50–80% of women report that they experience at least some symptoms during the premenstrual phase (Halbreich et al., 2003). Premenstrual syndrome (PMS) is defined as a recurring pattern of symptoms that occur during the premenstrual phase and decline soon

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after the start of menses. Premenstrual Dysphoric Disorder (PMDD) is an extreme variant along the continuum of premenstrual symptoms, consisting of at least one psychological symptom (i.e., depressed mood, anxiety/tension, marked affective lability, or anger/irritability) and at least four other psychological or physical (e.g., fatigue) symptoms that cause significant impairment and occur during most menstrual cycles (APA, 2000). Epidemiological studies estimate that 3–8% of women meet DSM-IV-TR criteria for PMDD, whereas 13–19% of women report that they experience premenstrual symptoms associated with personal distress and impairment (Halbreich et al., 2003). Specifically, significant premenstrual symptoms have been linked with decreased productivity at work (Chawla et al., 2002) and relationship impairments that are comparable to impairments associated with depression and other physical health conditions (Dean and Borenstein, 2004). Notably, PMDD frequently co-occurs with other mood and anxiety disorders (Kim et al., 2004), suggesting that there may be shared etiological and/or maintenance factors. For example, neuroticism-related personality traits are greater among women with PMDD as compared to healthy controls and show a positive correlation with severity of premenstrual symptoms (Gingnell et al., 2010).

Anxiety sensitivity (AS), or the fear of the physiological symptoms of anxiety and its physical, psychological, and social consequences (McNally, 2002), is one potential factor that may make women more vulnerable to experience menstrual-related symptoms. AS has been conceptualized as a trait-like cognitive risk factor for a variety of psychological disorders (see Olatunji and Wolitzky-Taylor, 2009 for a review), implicating this construct as a transdiagnostic mechanism. Although AS is generally conceptualized as a trait level vulnerability factor arising from a combination of genetic factors and learning experiences (Olatunji and Wolitzky-Taylor, 2009), recent research has suggested that AS is malleable with treatment (Smits et al., 2008). Despite its role in many disorders, AS has been most strongly linked to the etiology and maintenance of anxiety disorders, particularly panic disorder and posttraumatic stress disorder (Feldner et al., 2008; Li and Zinbarg, 2007). The menstrual reactivity hypothesis proposes that women high in AS are hypervigilant to the physical sensations they experience during the menstrual cycle and, consequently, develop a negative expectation and attentional bias towards these bodily sensations that affects their symptom reports (Sigmon et al., 2004). A small body of literature has supported the role of AS in the experience of menstrual-related symptoms. For example, higher levels of menstrual distress have been found among women who score high on AS in comparison to women who score low or medium on AS (Sigmon et al., 1996, 2000a, 2000b). Specifically, women high on AS tend to report more severe symptoms on the Menstrual Distress Questionnaire (MDQ) as compared women low on AS when asked to report on either their current premenstrual (days 5 to 1) or intermenstrual (days 8–22) cycle phases (Sigmon et al., 2000a, 2000b). Of note, these studies did not find an interaction effect between AS and menstrual cycle phase, indicating that women high on AS reported more menstrual-related symptoms than women low on AS, regardless of current menstrual cycle phase (Sigmon et al., 1996, 2000a, 2000b).

These preliminary AS and menstrual distress studies conducted to date should be considered within the context of their limitations. First, past work has utilized a cross-sectional design whereby women were randomly assigned to complete measures in one specific cycle phase

as opposed to completing measures across multiple cycle phases (Sigmon et al., 1996, 2000a, 2000b). Therefore, it is unclear how individual women may vary on menstrual symptom reports across different menstrual cycle phases. Second, previous studies compared the premenstrual phase to the intermenstrual phase (i.e., follicular, ovulatory, and early to midluteal phases combined). Combining cycle phases may neglect natural cycle variation in symptom reports as the follicular, ovulatory, and midluteal phases represent distinct hormonal fluctuations (Rubinow et al., 1988). Thus, the comparison of symptom reports in the intermenstrual phase to the premenstrual phase is difficult to interpret. Third, cycle phase of assessment was measured by day count only, which typically only holds 50% agreement with more precise measurement techniques (e.g., salivary assay of progesterone; Shirtcliff et al., 2001). Therefore, it is possible that women were not necessarily assessed in the cycle phase intended.

The aim of the current study was to address the key limitations of past work in the examination of the interactive effects of AS (treated as a continuous variable) and menstrual cycle phase on prospectively reported menstrual symptom severity across the follicular and premenstrual cycle phases. We employed a prospective design and assessed menstrual symptom severity using daily tracking (Daily Record of Severity of Problems; DRSP) throughout the study duration (one full cycle), as well as the prospective version of the MDQ (Form T) to capture how the participant feels on the day of their visit, one day during the premenstrual phase and one day during the follicular phase. Cycle phase verification was completed with at-home ovulation detection kits and a progesterone salivary assay. It was hypothesized that women higher on AS would report more severe menstrual-related symptoms in their premenstrual phase as compared to their follicular phase, and in comparison to women lower on AS in either cycle phase.

2. Methods

2.1. Participants

Participants were 55 normally menstruating (i.e., average cycle length of 25–35 days that did not regularly vary in length month-to-month by 7 days) women ($M_{age}=26.18$ years, $S.D.=8.9$) recruited from the greater Burlington, Vermont area.¹ The current study utilizes data collected as part of a larger investigation examining panic reactivity across the menstrual cycle (Nillni et al., 2012). Exclusionary criteria were: (a) use of hormonal birth control methods (e.g., birth control pill, patch, implant, injection, or vaginal ring), (b) postmenopausal (e.g., ending of menstrual period) or perimenopausal (e.g., hot flashes) status, (c) pregnancy (based on self-report) or trying to become pregnant, (d) current generalized anxiety disorder, posttraumatic stress disorder, specific phobia, social phobia, and obsessive compulsive disorder, (e) current or past panic disorder with or without agoraphobia diagnosis, (f) current alcohol or substance dependence, (g) acute and serious suicidal intent, (h) psychosis, (i) cardiovascular disorders (e.g., myocardial infarction), (j)

¹A total of 49 women attended both menstrual cycle phase visits and a total of nine women attended only one cycle phase visit. Of the women that attended only one cycle phase visit, three were excluded because cycle phase could not be confirmed. Of the women that attended both menstrual cycle phase visits, 11 premenstrual cycle phase visits were excluded because cycle phase was not confirmed. Thus, 55 women were retained in the study due to attending at least one lab visit and confirmation of at least one cycle phase. Of the 55 women enrolled in this study, a total of 49 completed the DRSP.

seizure disorder, (k) asthma or respiratory problems, and (l) current use of medications used to block or modulate anxiety and/or panic (e.g., Beta blocker, anxiolytics). Due to the aims of the larger investigation (i.e., to isolate the role of AS on panic reactivity), we excluded women with a current anxiety-related diagnosis.

2.2. Measures

2.2.1. Structured clinical interview for DSM-IV Axis I disorders-non patient version (SCID-NP)—The SCID-NP (First et al., 1994) is a structured diagnostic interview that was administered at the screening visit to assess the presence of current and past Axis I diagnoses and current suicidal ideation. Only the PI and one other clinical graduate student with SCID training and experience administered the SCID-NP. A random selection (10%) of SCID-NP ratings were later verified by an independent rater (clinical graduate student with SCID training and experience), and there were no disagreements between raters.

2.2.2. Anxiety Sensitivity Index (ASI)—The ASI (Reiss and McNally, 1985; Reiss et al., 1986) is a 16-item, self-report assessment that measures fear of bodily sensations related to anxious arousal in general that was administered at the screening visit. Individuals rated statements (e.g., “It scares me when I feel shaky”) on a 5-point Likert scale (0=very little to 4=very much), indicating the degree to which they worry about possible consequences of anxiety symptoms. Items were summed to calculate the total score, ranging 0–64. Prior research has demonstrated acceptable test–retest reliability (ranging from 0.71 to 0.75), validity (Reiss et al., 1986), and internal reliability ($\alpha=0.88$; Peterson and Heilbronner, 1987). The ASI is well-represented as a single factor structure (Reiss et al., 1986). ASI was examined continuously and internal consistency of the total score in the current sample was good ($\alpha=0.78$).

2.2.3. Daily Record of Severity of Problems (DRSP)—The DRSP (Endicott and Harrison, 1997; Endicott et al., 2006) is a 14-item daily questionnaire (11 symptom items and three impairment items) that measures severity of symptoms (e.g., “felt angry, irritable”) on a 6-point Likert scale (1=“Not at all” to 6=“Extreme”) across the menstrual cycle, including three impairment items. The DRSP has been shown to be a reliable and valid measure of premenstrual symptoms and impairment (Endicott et al., 2006). Participants completed this questionnaire daily throughout the study (one full menstrual cycle) and all items were summed to create a daily score.

2.2.4. Provisional Premenstrual Dysphoric Disorder (PMDD) assessment—A provisional PMDD assessment using DSM-IV PMDD criteria was conducted at the screening visit via a standardized interview. In accordance with DSM-IV criteria, daily data on the DRSP was utilized to confirm the provisional PMDD diagnosis. Although 2 months of daily data are required to confirm a diagnosis of PMDD, for some of the participants there was only 1 month of DRSP data available. Of the eight women identified with provisional PMDD at the screening visit, three (38%) were confirmed following examination of the daily data. Following the method described in Borenstein and colleagues (2007), a diagnosis of PMDD required: (1) five symptoms, including one emotional symptom (i.e., depressed, anxious, affect lability, and irritability), with a rating as 43 during the premenstrual phase

(Day 5 to 1), (2) an average daily score of 03 in the follicular phase (Day 6–12), and (3) at least a 30% change from follicular to premenstrual phase. Individuals who met criteria for clinically relevant PMS within the entire sample despite whether they met a provisional PMDD diagnosis at the screening visit were also identified, following the method described in Borenstein et al. (2007). Specifically, clinically relevant PMS required: (1) one or more symptoms on the DRSP that were 5 during the premenstrual phase, and (2) a mean premenstrual phase score that was greater than the follicular phase score.

2.2.5. Menstrual Distress Questionnaire – prospective version (MDQ – Form T)—The MDQ – Form T (Moos, 1968) is a 47-item self-report measure that was administered to assess current symptom severity on a 4-point Likert scale (0=“no experience of symptom” to 4=“present, severe”) at both the premenstrual and follicular laboratory visits. For each symptom, respondents were instructed to select which rating best describes “how [they] are feeling today.” Internal consistency of MDQ total scores in the current sample were excellent (premenstrual: $\alpha=0.92$; follicular: $\alpha=0.92$).

2.3. Procedure

Participants were recruited via newspaper advertisements placed in local newspapers and flyers in the greater Burlington, Vermont area. Interested participants, who provided informed consent, completed a screening visit to determine eligibility. During this visit they completed the SCID-NP and the ASI. Eligible participants were given a packet of symptom tracking questionnaires (i.e., DRSP) and asked to complete them daily at home from the first day of menstruation through at least one full menstrual cycle. During this same menstrual cycle, participants also completed the MDQ once in their follicular (Days 6–12) and once in their premenstrual (Days 5 to 1) cycle phases. For the MDQ measurement, participants were counterbalanced with random assignment to determine cycle phase order of assessment. The premenstrual phase is typically defined as the 5 days prior to the start of menses (Endicott et al., 2006) and this period of time is marked by the decline of progesterone (Rubinow et al., 1988). The follicular phase is typically defined as starting 6 days after the onset of menses and ending prior to the LH surge (~day 12), where progesterone levels are low and stable.

Scheduling and confirmation of cycle phase of assessment procedures are described fully elsewhere (Nillni et al., 2012). Briefly, cycle phase of assessment for the administration of the MDQ was initially estimated with day count and later verified with at-home ovulation testing and progesterone salivary assay. All available data (as described above) were utilized to confirm or disconfirm cycle phases of assessment for each participant. Follicular cycle phase was considered verified if: (1) women reported an LH peak following their follicular phase visit or (2) progesterone level fell within one standard deviation of the follicular phase mean for normally menstruating women (80.35 pg/ml S.D.=34.8; Salimetrics, 2010). For the premenstrual phase visit, premenstrual cycle phase was considered verified if: (1) women reported an LH peak prior to their premenstrual phase visit, (2) women reported a menstrual cycle start date within 5 days following their premenstrual phase visit, or (3) progesterone level fell within one standard deviation of the premenstrual phase for normally menstruating women (136.30 pg/ml S.D.=82.3; Salimetrics LLC, 2010). Given the interindividual differences among women regarding hormone level, hormone level was used as a secondary

way to confirm cycle phase if all other means (i.e., LH peak, cycle start dates) were not available. In some instances LH peak date was not available because participants did not complete the procedures necessary to detect the LH peak or did not adhere to the procedure for LH peak detection (i.e., skipped days of testing). However, this only occurred in a minority of individuals ($n=4$). Participants whose current menstrual cycle phase could not be verified according to the steps outlined above were excluded from the analyses.

2.4. Data analytic procedure

A series of linear mixed models (LMM) analyses were conducted examining the interactive effects of AS (continuous variable) and menstrual cycle phase (premenstrual vs. follicular) on current menstrual symptom severity (MDQ – Form T score) and prospectively tracked menstrual symptom severity (DRSP). AS and menstrual cycle phase were entered as fixed effects and participant was entered as a random effect to control for the correlation between measurements obtained from the same person at repeated times during the menstrual cycle. All available prospectively tracked DRSP data were averaged within the respective cycle phases to determine average daily follicular and premenstrual symptom severity scores. MDQ scores represent the total scores obtained at the follicular and premenstrual visits.

Two models were tested examining the main effect of a time-invariant or between-subject factor (AS), a time-varying or within-subject factor (cycle phase), and their interaction on the two measures of menstrual symptoms (MDQ and DRSP). The model included AS, cycle phase, and the AS cycle phase interaction. After fitting the model with several covariance structures, the unstructured covariance structure provided the best fit based on the AIC and BIC fit statistics (i.e., lower numbers indicate better fit). For example, the AIC and BIC fit statistics were 655.342 and 662.972, respectively, using the unstructured covariance structure, whereas they were 673.558 and 678.645 using the variance components covariance structure. Partial correlation coefficients (r) were used as estimates of effect size for each coefficient. As suggested by Kirk (1996), we used 0.10, 0.24, and 0.37 as descriptors of small, medium, and large effect sizes.

3. Results

See Table 1 for complete demographic information. In terms of psychopathology, 9.1% ($n=5$) of the sample met criteria for one or more current Axis I diagnosis: 1.8% ($n=1$) met criteria for Anxiety Disorder NOS, 1.8% ($n=1$) for Bulimia Nervosa, 5.4% ($n=3$) for Dysthymia, and 5.4% ($n=3$) for Major Depressive Disorder. In addition, 52.7% ($n=29$) of the sample met criteria for a lifetime history of psychopathology: 14.4% ($n=8$) met criteria for Alcohol Abuse, 5.4% ($n=3$) for Alcohol Dependence, 7.2% ($n=4$) for Anorexia Nervosa, 1.8% ($n=1$) for Bulimia Nervosa, 1.8% ($n=1$) for Generalized Anxiety Disorder, 39.6% ($n=22$) for Major Depressive Disorder, 1.8% ($n=1$) for Obsessive Compulsive Disorder, 3.6% ($n=2$) for Other Substance Stress Disorder, and Dependence, 3.6% ($n=2$) for Posttraumatic 1.8% ($n=1$) for Specific Phobia. There were no significant differences on AS level between individuals with and without a history of past psychopathology. On the DRSP, a total of 5.5% ($n=3$) of the sample met criteria for Premenstrual Dysphoric Disorder (PMDD) and an additional 22% ($n=12$) met criteria for clinical significant Premenstrual

Symptoms (PMS). These prevalence rates match those reported in the general population for PMDD and clinically significant PMS (Angst et al., 2001; Halbreich et al., 2003).

Zero-order correlations were computed among study variables. AS total scores were significantly positively correlated with follicular DRSP daily average scores ($r=0.42$, $p<0.01$), premenstrual DRSP daily average scores ($r=0.43$, $p<0.01$), and follicular MDQ total scores ($r=0.34$, $p<0.05$), but not with premenstrual MDQ total scores ($p>0.05$). See Table 2.

The LMM analysis revealed that only the main effect of AS significantly predicted menstrual symptoms on the MDQ, regardless of cycle phase of assessment ($F(1, 51.6)=5.32$, $p<0.05$). There was neither a significant main effect of cycle phase, nor a significant interactive effect of AS cycle phase on MDQ scores ($p>0.05$). Similarly, the main effect of AS significantly predicted menstrual symptoms on the DRSP, regardless of cycle phase of assessment ($F(1, 47)=12.98$, $p<0.01$). There was no main effect of cycle phase when AS was included in the model. Cycle phase was a significant predictor of DRSP scores ($p<0.001$) only when AS was removed from the model. There was no significant AS cycle phase interaction on DRSP scores ($p>0.05$). See Table 3 LMM results for menstrual symptoms.

Exploratory analyses were conducted within the subsample of women who met criteria for clinically significant PMS ($n=15$). Individuals who met criteria for clinically significant PMS exhibited a trend level difference in greater AS scores ($M=16.5$, $S.D.=7.1$) as compared to individuals who did not meet criteria for clinically significant PMS ($M=13.0$, $S.D.=6.4$; $F(1, 47)=3.04$, $p=0.09$). Regarding the LMM analyses within this subsample, AS significantly predicted menstrual symptoms on the MDQ ($F(1, 12.78)=15.99$, $p<0.05$) and DRSP ($F(1, 13)=12.13$, $p<0.01$), regardless of cycle phase. There were no significant main effects of cycle phase for either outcome ($ps>0.05$) when controlling for AS. However, there was a trend level significance for the AS cycle phase interaction for both the MDQ ($F(1, 10.67)=4.57$, $p=0.06$) and DRSP ($F(1, 13)=4.66$, $p=0.05$). Post-hoc probing of these interactions revealed different patterns of interactions for each outcome. For the DRSP, women with clinically significant PMS who were higher on AS reported greater premenstrual symptoms than follicular symptoms, whereas women with clinically significant PMS who were lower on AS did not exhibit as great a difference between their follicular and premenstrual symptom scores. Regarding the MDQ, women with clinically significant PMS who were lower on AS reported more premenstrual symptoms than follicular symptoms, whereas women with clinically significant PMS who were higher on AS reported more follicular symptoms than premenstrual symptoms.

4. Discussion

The purpose of this study was to examine the interactive effects of anxiety sensitivity (AS) and menstrual cycle phase in predicting prospectively reported menstrual-related symptoms. Contrary to prediction, there were no interactive effects of AS and menstrual cycle phase in predicting prospectively reported menstrual-related symptoms when measured by either the prospective version of the Menstrual Distress Questionnaire (MDQ) or the Daily Record of Severity of Problems (DRSP). In other words, women did not prospectively report

differences in menstrual symptom severity across the follicular and premenstrual cycle phases, per either the MDQ or the DRSP, as a function of AS level. However, degree of AS was a significant independent predictor of menstrual symptom severity, regardless of cycle phase of assessment, whereby individuals with higher AS scores reported more psychological and somatic symptoms in both the follicular and premenstrual phases, as indexed by both symptom measures. This overall pattern indicates that AS is related to how a woman feels regardless of menstrual cycle phase, not that AS is associated with her cyclicity of symptoms across the menstrual cycle.

This finding is consistent with previous cross-sectional accounts that found that women high on AS reported greater menstrual-related symptoms, regardless of cycle phase of assessment, as compared to women low on AS (Sigmon et al., 1996, 2000a, 2000b). It is noteworthy to point out that correlations between AS and MDQ/DRSP range from 0.26 to 0.43, suggesting they are related, yet reflect different constructs.

Exploratory analyses examining the interactive effects of AS and menstrual cycle phase in the sub sample of women who met criteria for clinically significant PMS revealed trend level interaction effects. However, the interaction revealed different patterns for each of the outcomes. On the DRSP, individuals higher on AS reported more severe premenstrual symptoms as compared to their follicular symptom reports, whereas individuals lower on AS reported a less severe split between their premenstrual and follicular symptom reports. On the MDQ, individuals higher on AS reported more severe follicular symptoms as compared to premenstrual symptoms, whereas individual lower on AS reported more severe premenstrual symptoms as compared to follicular symptoms. The pattern using the DRSP is in line with what we would expect. That is, those higher in AS are more likely to report greater symptoms in the premenstrual phase vs. the follicular phase. The unexpected pattern of MDQ results is difficult to interpret. One potential explanation for the discrepant results across measures of menstrual symptoms is the timing of assessment. Women completed the DRSP daily and premenstrual and follicular scores were averaged for all available data, therefore, scores took into account the experience of several days within the same cycle. Alternatively, the MDQ was given on the day of each laboratory visit within the context of the larger investigation and women were told to report on how they felt that day. Therefore, the MDQ scores only reflect one vs. multiple days within a cycle phase. Additionally, this exploratory analysis was limited by the small sample size ($n=15$) available, therefore, these results should be interpreted with caution and future research should examine this within a larger sample of women with clinically significant PMS and PMDD in order to better understand the interaction of AS on symptom reports within this specific population. The primary study results suggest that menstrual symptom severity is more heavily influenced by AS level than by current menstrual cycle phase. Theoretically, women higher on AS would be more likely to notice bodily changes throughout the entire menstrual cycle and to catastrophize about their meaning, further increasing experienced intensity of these symptoms. These results are consistent with the extant literature and suggest that AS is an important cognitive vulnerability factor in the experience of menstrual-related symptoms. It should be noted that not all of the symptoms assessed by the MDQ and DRSP are specific to menstrual cycle symptoms (e.g., irritability), therefore, the null interaction finding could suggest that AS simply predicts how a woman feels on a particular day rather than

predicting her experience of menstrual cycle-related symptoms, specifically. However, the trend level interactions between AS and menstrual phase in the small sample of women with clinically significant PMS suggest that AS may be implicated in increasing the experience of premenstrual symptoms in clinical populations, and future research is needed on this topic. AS has been primarily investigated as a cognitive risk factor for panic attacks and panic disorder (e.g., Li and Zinbarg, 2007), as well as for other anxiety disorders (e.g., Feldner et al., 2008). However, AS has also been linked to a variety of physical syndromes other than the premenstrual syndrome, including asthma (Carr et al., 1994), chronic pain (Asmundson, et al., 1999), and HIV/AIDS (Gonzalez et al., 2012). Thus, AS may be a common mechanism involved in the etiological and/or maintenance of multiple anxiety and physical disorders by increasing reactivity and negative interpretation to the meaning of somatic symptoms.

The discrepant patterns of symptom reports across measures (i.e., DRSP vs. MDQ) are important to note. When AS is not included in the model, there were no significant cycle phase differences on the MDQ, whereas there were significant cycle phase differences on the DRSP (i.e., greater symptoms in the premenstrual vs. follicular phase). This finding suggests that the DRSP may be more sensitive to identifying cycle phase differences. Even among the sub sample of women with clinically significant PMS, there were no significant phase differences in MDQ total scores. There are two potential explanations for this discordance: (1) the MDQ measures some of the same symptoms as the DRSP (e.g., irritability), but also includes other physical symptoms not captured by the DRSP (e.g., dizziness, cold sweats), and (2) it is possible that completing the MDQ only one day within a cycle phase will not provide enough information to fully capture a women's experience during a certain cycle phase. AS scores and DRSP scores exhibited much higher correlations ($r_s=0.42, 0.43$) than AS scores and MDQ scores ($r_s=0.26, 0.34$), which is unexpected given that they are presumed to assess the same construct. However, correlations between follicular MDQ and DRSP and premenstrual MDQ and DRPS were 0.58 and 0.63 respectively, suggesting that they assess similar, but not identical constructs. Our results suggest that the DRSP may more accurately reflect the unique experience of premenstrual symptoms, whereas the MDQ may reflect PMS symptoms plus other symptoms characteristic of "general distress." Given that the MDQ has been frequently used in the assessment of premenstrual symptoms, it would be important to understand the concordance between this measure and the DRSP, which is typically used for confirming diagnosis of PMDD, and future research in this area is warranted.

Several study limitations should be noted. First, the sample consisted of a relatively homogenous group of highly educated, primarily Caucasian women. Future research would benefit from examining more diverse samples in order to increase general-izability of the findings. Second, the sample was a relatively healthy group of women with lower levels of AS. Future research would benefit from inclusion of more individuals with clinical levels of AS. Third, although women were asked to complete the DRSP daily, it is unknown whether they actually did this regularly as the measure was collected at the end of the study period. Therefore, it is possible that some of the data is still subject to recall bias. Future research using more advanced methods of daily monitoring such as ecological momentary assessment would help to ensure ecological validity. Fourth, this study only compared the premenstrual

and follicular cycle phases and future research would benefit from including other cycle phases of comparison. Fifth, it is unknown if AS levels vary across the menstrual cycle and because this measure was given at the screening visit, it is not known what menstrual cycle phase women were in when they completed it. Menstrual cycle phase has been implicated as a vulnerability factor in the exacerbation of anxiety symptoms. For example, women report increased panic and anxiety symptoms during the premenstrual cycle phase as compared to other cycle phases (Kaspi et al., 1994). Therefore, it is possible that AS and menstrual cycle phase may reciprocally influence one another. Future research should examine changes in AS across different phases of the menstrual cycle over recurrent menstrual cycles and relate this trajectory to the development of anxiety and menstrual-cycle related symptoms over the same time frame. Finally, we found medium effect sizes for the interaction of AS and cycle phase on the MDQ ($pr=0.25$) and DRSP ($pr=0.22$), therefore, it is possible that our small sample size ($N=55$) may have diminished our ability to detect significant effects.

Clinically significant PMS or PMDD is most often treated with pharmacotherapy (e.g., SSRI) or birth control. However, these interventions have limited success with only 60% of women showing clinically significant improvement (Pearlstein and Steiner, 2008). Our results demonstrate that AS, and possibly other psychological factors, are involved in the experience of psychological and somatic symptoms in general among a sample consisting largely of women with nonclinical PMS symptoms. Although further research is needed, our exploratory analyses suggest that AS may influence premenstrual symptom reports specifically among women with clinically significant PMS. If replicated in a larger clinical sample, psychological treatments may be indicated for women who experience significant PMS symptoms. There is a very small literature investigating psychological treatments for PMS symptoms (e.g., cognitive therapy, relaxation, diet and exercise changes; Pearlstein and Steiner, 2008). The present findings, along with earlier reports (Sigmon et al., 1996, 2000a, 2000b), suggest that anxiety-related interventions (e.g., brief interventions for AS; Vujanovic et al., 2012) may be relevant for women who experience distressing premenstrual symptoms; however, further research is needed among women with clinically significant PMS before applying these interventions.

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Table 1Participant demographics ($N=55$).

Age, mean (S.D.)	26.18 (8.90)
Ethnicity, number (%)	
Hispanic/Latino	4 (7.3%)
Non-Hispanic	51 (92.7%)
Race, number (%)	
Caucasian	47 (85.5%)
Other	7 (12.7%)
Marital status, number (%)	
Single	38 (69.1%)
Married/Cohabiting	13 (29.1%)
Divorced	1 (1.8%)
Education, number (%)	
Less than college	2 (3.6%)
Currently in college	30 (54.5%)
College or above	23 (41.8%)
Body mass index, mean (S.D.)	23.80 (4.93)

Table 2

Zero-order correlations among predictor and criterion variables.

Variable	1	2	3	4	5	Mean	(S.D.)
1. ASI total	1	0.42 **	0.43 **	0.34 *	0.26	14.31	(6.64)
2. Foll DRSP daily average		1	0.67 **	0.58 **	0.50 **	21.26	(6.51)
3. Pre DRSP daily average			1	0.58 **	0.63 **	26.68	(10.44)
4. Foll MDQ total				1	0.68 **	22.64	(17.40)
5. Pre MDQ total					1	22.03	(13.49)

Note: ASI total=Anxiety Sensitivity Index total score (Reiss and McNally, 1985; Reisset al., 1986); Foll DRSP daily average=average daily follicular score on the Daily Record of Severity of Problems (Endicott et al., 2006), Pre DRSP daily average=average daily premenstrual score on the Daily Record of Severity of Problems; Pre MDQ total=Menstrual Distress Questionnaire (Moos, 1968) in the premenstrual phase,Foll MDQ total=Menstrual Distress Questionnaire in the follicular phase.

*
 $p < 0.05$.

**
 $p < 0.01$.

Table 3

Linear mixed modeling results for menstrual symptoms.

	<i>b</i>	S.E.	<i>t</i>	<i>p</i>	<i>pr</i>
DV: MDQ					
ASI	0.88	0.34	2.60	0.01	0.34
Phase	7.24	4.66	1.56	0.13	0.23
Phase × ASI	−0.48	0.29	−1.66	0.11	0.25
DV: DRSP					
ASI	0.41	0.13	3.20	0.002	0.42
Phase	1.77	2.59	0.69	0.50	0.10
Phase × ASI	0.26	0.17	1.56	0.13	0.22

Note: ASI=Anxiety Sensitivity Index total score (Reiss and McNally, 1985; Reisset al., 1986); Phasepremenstrual vs. follicular.