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Emotion-Related Impulsivity and Rumination Predict the Perimenstrual Severity and Trajectory of Symptoms in Women with a Menstrually Related Mood Disorder

Danyelle N. Dawson, M.A.^{a,*}, Tory A. Eisenlohr-Moul, Ph.D.^{b,*}, Julia L. Paulson, B.S.^c, Jessica R. Peters, Ph.D.^d, David R. Rubinow, M.D.^e, and Susan S. Girdler, Ph.D.^f

^aDepartment of Psychiatry, University of North Carolina at Chapel Hill, 2218 Nelson Highway, Suite 3, Chapel Hill, NC 27517

^bDepartment of Psychiatry, University of North Carolina at Chapel Hill, 2218 Nelson Highway, Suite 3, Chapel Hill, NC, USA 27517

^cDepartment of Psychiatry, University of North Carolina at Chapel Hill, 2218 Nelson Highway, Suite 3, Chapel Hill, NC, USA 27517

^dDepartment of Psychiatry and Human Behavior, Warren Alpert Medical School of Brown University, Providence, RI, USA 02912

^eDepartment of Psychiatry, University of North Carolina at Chapel Hill, Campus Box 7160, Chapel Hill, NC, USA 27599

^fDepartment of Psychiatry, University of North Carolina at Chapel Hill, 2218 Nelson Highway, Suite 3, Chapel Hill, NC, USA 27517

Abstract

Objectives—Women with menstrually-related mood disorders (MRMDs) demonstrate clinically significant distress during the premenstrual week that remits with the onset of menses. Relatively little is known about psychosocial mechanisms of MRMDs. Given the core affective and behavioral symptoms of MRMDs, dysfunctional responses to emotion (e.g. difficulties with awareness and regulation of emotion; rumination and impulsive or maladaptive behavior in response to emotion) may be important factors to explore as cognitive and behavioral mechanisms in MRMDs. The purpose of the present study was to examine the associations of various dysfunctional responses to emotion (as measured using the Difficulties in Emotion Regulation Scale—DERS and brooding on the Ruminative Responses Scale—RRS) with premenstrual symptom severity and trajectory.

Design—Fifty-four women (Mean Age = 38.11; 65% Caucasian) with prospectively-confirmed MRMDs completed the DERS and RRS, and provided 2–4 menstrual cycles of daily symptom reports.

* Shared First Authorship.

Results—Only the emotion-related impulsivity subscale of the DERS was robustly associated with premenstrual symptom severity. Brooding rumination predicted a more rapid premenstrual increase and slower postmenstrual remission of some symptoms.

Conclusions—Both rumination and emotion-related impulsivity may be important treatment targets in cognitive behavioral interventions aimed at reducing symptom severity and cyclicity in MRMDs.

Keywords

premenstrual dysphoric disorder; menstrual cycle; emotion regulation; rumination

Introduction

Women with menstrually related mood disorders (MRMDs) suffer from the emergence of clinically significant emotional, behavioral, and physical symptoms during the luteal phase of the menstrual cycle that resolve quickly following menstrual onset (Halbreich, Borenstein, Pearlstein, & Kahn, 2003). Because retrospective self-reports of premenstrual symptoms are prone to false positive reporting (Cohen et al., 2002; Marván & Cortés-Iniestra, 2001), accurate diagnosis of MRMDs requires several menstrual cycles of daily symptom ratings (Rubinow & Roy-Byrne, 1984). MRMDs are associated with significant distress as well as difficulties in interpersonal and occupational functioning among the estimated 10–15% of women affected (Epperson et al., 2012; Halbreich et al., 2003). This cyclical reoccurrence of affective symptoms can result in a degree of premenstrual impairment similar to that experienced in major depression, panic disorder, and post-traumatic stress disorder (Halbreich et al., 2003; Pearlstein, 2008). However, MRMDs are unique from these chronic conditions in that they are characterized by a predictable monthly remission of symptoms in the follicular phase. Epidemiological studies have shown that MRMDs affect women across the reproductive life span (ages 18–55) with consistent phenomenology and prevalence across cultures (Epperson et al., 2012; Halbreich et al., 2003). In response to accumulating evidence for the validity and burden of MRMDs, DSM-5 includes Premenstrual Dysphoric Disorder (PMDD), a severe form of MRMD in which at least 5 different symptoms demonstrate the cyclical pattern, as a full diagnostic category (Epperson et al., 2012).

Experiments demonstrate that normal fluctuations in the ovarian steroids estradiol and progesterone trigger emotional symptoms in women with MRMDs, but do not trigger symptoms in women without the disorder (Schmidt, Nieman, Danaceau, Adams, & Rubinow, 1998). Unfortunately, interventions aimed at stabilizing these fluctuations with oral contraceptives have failed to demonstrate robust effectiveness (reviewed in Freeman et al., 2014). Interventions that eliminate ovarian activity altogether (i.e., GnRH agonists such as leuprolide) are effective for many women, but are not safe for long-term use without the add-back of steroids, which causes a resurgence of symptoms (Wyatt, Dimmock, Ismail, Jones, & O'Brien, 2004). Further, although SSRIs resolve symptoms for many women with MRMDs, non-response rates are as high as 40% (Freeman et al., 1999; Halbreich, 2008; Steiner et al., 1995; Wyatt, Dimmock, Ismail, Jones, & O'Brien, 2004).

Given the limitations of current pharmacologic treatments for MRMDs, there is a need for the development of empirically-supported behavioral approaches that treat the specific cognitive and behavioral factors that mediate the expression of MRMDs symptoms. Some evidence suggests that *generic* cognitive behavioral treatments for mood disorder may reduce the severity of symptoms in MRMDs (*reviewed in* Brandon, Crowley, Gordon, & Girdler, 2014). Unfortunately, however, little basic research is available on the specific cognitive behavioral mechanisms of MRMDs, which prevents the development of specialized treatments for these women. Therefore, more work is needed to clearly define the key cognitive and behavioral mechanisms of distress and impairment in MRMD so that efficient and effective behavioral treatments can be developed.

The Role of Dysfunctional Responses to Emotion in MRMD

Dysfunctional responses to emotion are defined broadly as a set of maladaptive cognitive and behavioral responses to negative emotion that generally predict a worsening of that negative emotion. Examples include difficulties with awareness, labeling, and regulation of emotion; rumination or excessive self-focus in response to emotion; and impulsive or maladaptive behavior in response to emotion. Individual trait tendencies towards these dysfunctional responses to emotion are promising candidate factors to explore as cognitive and behavioral mechanisms of MRMD symptoms because they have already been shown to increase risk for the development and persistence of many different emotional disorders (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008; Peters, Smart, & Baer, 2015). Given that MRMDs are characterized by low baseline negative emotion (during the follicular phase) and high negative emotion in the luteal phase (Schmidt et al., 1998), we expect that higher trait tendencies toward *rumination* (as measured using an index of brooding rumination) and *difficulties with emotion regulation* (as measured using the Difficulties with Emotion Regulation Scale or DERS; Gratz and Roemer, 2008) will serve to further *amplify the severity of premenstrual emotional symptoms* in women with MRMDs.

A small but growing body of work does begin to indicate that rumination and other dysfunctional responses to negative emotion amplify risk for MRMDs or the severity of premenstrual symptoms among women with MRMDs. Compared with controls, women with prospectively-confirmed MRMDs report higher trait levels of brooding rumination and avoidant behavioral responses to negative affect (Craner, Sigmon, Martinson, & McGillicuddy, 2014). Women with MRMDs also report greater global difficulties with emotion regulation and behavioral impulsivity than women without MRMDs (Petersen et al., 2016). In response to laboratory-induced negative affect, women with prospectively-confirmed MRMDs report greater self-focused attention, a trait associated with rumination and poor emotion regulation, than controls (Craner, Sigmon, & Martinson, 2015). Another study found that women with prospectively-confirmed MRMD showed within-person increases in self-focused attention during the symptomatic premenstrual week that partially accounted for their premenstrual mood changes (Craner, Sigmon, & Young, 2016). Conversely, Petersen et al. (2016) found that despite group differences in trait dysfunctional responses to negative emotion between women with PMDD and controls, severity of premenstrual symptoms was *not* significantly correlated with either the DERS total scores or behavioral impulsivity *within* the sample (N= 18) of women with PMDD (Petersen et al.,

2016). However, the study's use of the heterogeneous total DERS score and a heterogeneous behavioral impulsivity measure may have obscured significant effects of *specific* emotion regulation deficits (e.g., lack of emotional awareness, emotion-related impulsivity) on premenstrual symptom severity in their underpowered analyses. Therefore, more work is needed to elucidate the role of specific dysfunctional responses to emotion in MRMDs.

The Current Study

Using a larger sample of 54 women with prospectively-confirmed MRMDs, the present study examined the unique associations of the more homogeneous DERS subscales with premenstrual symptom *severity* in MRMD as reliably estimated across multiple cycles. Specifically, we examine the ability of trait dysfunctional responses to emotion to predict premenstrual symptom severity as well as the trajectory of perimenstrual (around menses) symptoms. This fine-grained information about which specific psychological factors may be most relevant to symptom *severity* in MRMDs are crucial for generating hypotheses about which cognitive behavioral interventions may be most effective for managing premenstrual symptoms in MRMDs. Of note, the present study does not include a control group and is therefore not designed to determine factors that are *unique* to MRMD; rather, the study is designed to determine which factors predict severity and trajectory of symptoms among women who have been diagnosed with this cyclical disorder.

The clinical sample in the present study was also one of the first to be prospectively diagnosed with a MRMD using the Carolina Premenstrual Assessment Scoring System (C-PASS) (Eisenlohr-Moul et al., 2017), a standardized prospective diagnostic protocol based on DSM-5 PMDD.

It was hypothesized that:

1. In women with MRMD, *trait dysfunctional responses to emotion* will predict more severe MRMD symptoms during the premenstrual week, and this association will represent a risk for greater premenstrual *increases* in symptoms relative to a woman's baseline (i.e., associations will remain significant after controlling for baseline follicular symptoms).
2. In women with MRMD, *trait dysfunctional responses to emotion* will predict *steeper increases* in symptoms across the premenstrual week as well as *slower declines* in symptoms across the follicular baseline week.

Method

Participants and Procedure

Participants were recruited in the triangle region of North Carolina via email and telephone for a study comparing two behavioral interventions for MRMDs after participating in a MRMD diagnostic feeder study. Participants were recruited for the diagnostic study through newspaper, radio, magazine, and advertisements posted throughout the community targeting women experiencing premenstrual emotional changes. Participants were screened for medical history and excluded for chronic conditions such as cardiovascular disorders, chronic or acute pain conditions, endocrine disorders (including diabetes and thyroid

disorders, unless on stable thyroid supplementation), and reproductive disorders. Women were also ineligible if they had irregular menstrual cycles (<21 or >35 days), were pregnant or nursing, or taking any psychotropic or hormonal medications. Psychiatric history was evaluated at a baseline interview using the structured clinical interview for disorders described in the fourth edition of the Diagnostic and Statistical Manual for Mental Disorders (SCID-I; First, Spitzer, Gibbon, & Williams, 2002). Participants were screened and excluded for the following current Axis I psychological disorders: schizophrenia and other psychotic disorders, bipolar and related disorders, depressive disorders with active suicide ideation or suicide attempt in the prior 5 years, neurodevelopmental disorders with existing cognitive impairments, feeding and eating disorders with amenorrhea, obsessive-compulsive and related disorders that interferes with subjects' ability to participate in group behavioral interventions, current PTSD, or substance-related and addictive disorders. Women also completed the DERS and RRS scales at this baseline laboratory session. Diagnosis of MRMD was made using daily symptom ratings across 2–4 perimenstrual phases (see description below) with the Carolina Premenstrual Assessment Scoring System (C-PASS; Eisenlohr-Moul et al., 2017). Participants were paid \$100 for their participation in the baseline portion of this study.

Prospective Symptom Measurement and Diagnosis

Daily Record of Severity of Problems (DRSP) (Endicott, Nee, & Harrison, 2006)

—The DRSP is a daily symptom rating list that assesses the severity of all 11 DSM-5 PMDD symptoms, and was used in the present study to measure 6 of the most commonly-reported symptoms of MRMD using single items, including the following: depression, anxiety, mood swings, anger/irritability and interpersonal conflict, eating symptoms (increased appetite, overeating), and physical symptoms. Another single DRSP item was also used to assess the degree to which symptoms impaired relationship functioning each day. Each of these DRSP items was rated on a six-point scale ranging from 1 (not at all) to 6 (extreme). Daily ratings of each item were examined during two perimenstrual (i.e., around menses) weeks: (1) the average score during the **premenstrual week** (defined as days –7 to –1, where day –1 is the day prior to menstrual onset), which is when symptoms peak in MRMD cases, and (2) the average score during the **follicular baseline week** (defined as days 4 to 10, where day 1 is the day of menstrual onset), which is when cyclical symptoms are required to be minimal or absent. Women provided 2–4 cycles of ratings (2 cycles = 83%, 3 cycles = 10%, 4 cycles = 7%). Because summed scores on the DRSP have failed to reliably capture change over time in some PMDD samples (e.g., Eisenlohr-Moul et al., 2015), single items were used to assess specific symptoms. Nonetheless, this measure reliably captures cyclical changes in core emotional symptoms among women with MRMD (Endicott, Nee, and Harrison, 2005).

Diagnostic Process using the Carolina Premenstrual Assessment Scoring System (C-PASS) (Eisenlohr-Moul et al., 2017)

—The C-PASS is a standardized scoring system for determining whether symptoms (items) measured on the DRSP show the required MRMD pattern *in each perimenstrual frame* (i.e., days –7 to day +10 where day 1 is the onset of menses and there is no day 0). The required temporal symptom pattern as described in the DSM-5 PMDD criteria requires an elevation of symptoms in the

premenstrual week (days –7 to –1) and a remission of symptoms in the following follicular “baseline” week (days +4 to +10). The rationale for arranging cycles in such a way as to compare the premenstrual week of one menstrual cycle to the follicular baseline week of the *next* cycle is that the “switch off” of symptoms is central to the diagnosis of MRMD (Endicott et al., 2009); the cyclical symptoms must not persist into the follicular phase (in which case, they may be considered more persistent “background” symptoms rather than cyclical symptoms). The C-PASS was utilized in the present study to **establish the presence of the MRMD diagnosis** as described in Eisenlohr-Moul et al., 2017. Briefly, diagnosis with MRMD required that at least one emotional DSRP item (depression, anxiety, mood swings, anger/irritability, or interpersonal conflict) demonstrate the following: (1) sufficient relative premenstrual symptom elevation ($\geq 30\%$ difference between pre- and postmenstrual symptoms (where the numerator is the premenstrual mean minus postmenstrual mean, and the denominator is the range of scale used by the participant throughout the study), (2) sufficient absolute premenstrual severity and duration (at least two premenstrual week days with a rating ≥ 4), and (3) sufficient postmenstrual symptom clearance (maximum follicular week rating ≤ 3), and (4) that these conditions be met in at least 2 cycles (for detailed information on the C-PASS diagnostic system for MRMDs, see Eisenlohr-Moul et al., 2017).

Trait Assessment of Dysfunctional Responses to Emotion

For each of the trait measures included in this study, women were asked to complete the measure with respect to their general functioning, without reference to any specific menstrual cycle phase.

Difficulties in Emotion Regulation—The Difficulties in Emotion Regulation Scale (DERS) (Gratz & Roemer, 2004) is a 36-item questionnaire assessing six problems that individuals have in regulating negative emotion. Items are scored on six subscales, labeled lack of awareness of emotional responses (e.g., “I pay attention to how I feel”— 6 items, reverse scored), lack of emotional clarity (e.g., “I have difficulty making sense out of my feeling”— 5 items), non-acceptance of emotional responses (e.g., “When I am upset, I feel ashamed with myself for feeling this way” — 6 items), difficulties controlling impulses when experiencing negative emotions (e.g., “When I’m upset I lose control over my behaviors”— 6 items), difficulties engaging in goal-oriented behavior when experiencing negative emotions (e.g., “When I’m upset, I have difficulty getting work done”— 5 items), and limited access to effective emotion regulation skills (e.g., “When I am upset, I believe that there’s nothing I can do to make myself feel better” — 8 items). Items are rated on a 5-point scale ranging from (1) “almost never (0–10%)” to (5) “almost always (91–100%)”. Support for the reliability, stability, and validity of the DERS have been well established in previous studies (Fox, Axelrod, Paliwal, Sleeper, & Sinha, 2007; Gratz, Bornovalova, Delany-Brumsey, Nick, & Lejuez, 2007; Gratz & Roemer, 2004, 2008; Gratz, Rosenthal, Tull, Lejuez, & Gunderson, 2006). Although tendencies toward the responses described in the DERS may manifest in a state-like manner in the situational context of negative emotion, test-retest reliabilities demonstrate the stability of between-person differences in the DERS (Gratz & Roemer, 2004). In the present study, the DERS subscales demonstrated good to excellent reliability (alphas ranging from .86 to .93).

Depressive Rumination—Rumination represents another dysfunctional response to negative emotion that is not assessed by the DERS. The 10-item version of the Ruminative Responses Scale (RRS) (Nolen-Hoeksema, 1991; Treynor, Gonzalez, & Nolen-Hoeksema, 2003) was used to assess two ruminative subcomponents, *brooding* (or *depressive rumination*; e.g. “Why do I react this way?”) and *reflection* (e.g. “Go away by yourself and think about why you feel this way”). Previous work has demonstrated that, while *brooding* is associated with psychopathology, *reflection* is generally not (Treynor et al., 2003). Therefore, only brooding was used as an indicator of depressive rumination in the present study. Each item is rated on a scale ranging from 1 (almost never) to 4 (almost always). Support for the reliability, stability, and validity of the RRS have been found in previous studies (Butler & Nolen-Hoeksema, 1994; Nolen-Hoeksema & Morrow, 1991; Treynor et al., 2003). In the present study, the RRS brooding subscale demonstrated good internal consistency (.90).

Analytic Strategy

Data analysis proceeded in three steps. *First*, in order to examine the associations between trait dysfunctional responses to emotion and average severity of premenstrual symptoms, we examined zero order correlations between traits and average daily symptoms across all premenstrual weeks from cycles in which MRMD criteria were met. Zero-order spearman rank correlations were then calculated between these symptom severity estimates and trait dysfunctional responses to emotion (DERS subscales, RRS Brooding). *Second*, we used the average symptom severities from symptomatic cycles to examine partial spearman rank correlations between dysfunctional responses to emotion and *premenstrual symptom severity* controlling for follicular baseline symptoms. This analysis was completed in order to confirm that associations between dysfunctional responses to emotion and symptom severity in symptomatic premenstrual weeks were consistent with risk for *relative premenstrual elevations* in symptoms (i.e., premenstrual increases in symptoms relative to a woman’s average follicular baseline symptoms). By removing the variance in premenstrual symptom increases that is due to a woman’s general tendency toward lower or higher baseline (non-premenstrual) symptoms in a given domain, these partial correlations allow us to determine the association between dysfunctional responses to emotion and a woman’s average premenstrual *increase* in symptom severity in each domain. Post-hoc power analyses indicated that these analyses achieved 80% power to detect conventionally small-to-medium effects (critical $r = .22$).

Finally, we examined whether the effects of trait dysfunctional responses to emotion (DERS subscales and RRS Brooding) impacted the *trajectories of symptom change* in either the premenstrual or follicular baseline weeks. To accomplish this, we used multilevel models (with daily symptom ratings nested within phases nested within women, specifying random effects of phase and day) in SAS PROC MIXED. For these analyses, data were taken from all available cycles. We specified an autoregressive structure (day-1) for within-person error. Models predicted each of the 7 outcomes (depression, anxiety, mood swings, anger/irritability and conflict, eating symptoms, physical symptoms, and relationship impairment) on a given day from the following predictors, examining each trait moderator separately: (1) phase (where 0 = follicular baseline week and 1 = premenstrual week), (2) day of the week

(ranging from 1 to 7 in each phase), (3) the trait dysfunctional responses to emotion in question, (4) the interaction between phase and day, (5) the interaction between trait and phase, (6) the interaction between trait and day, and (7) the interaction between trait, phase, and day. The final term is key for testing our trajectory hypotheses, as it examines the impact of trait dysfunctional responses to emotion on the slope of symptoms over time during each phase. After correcting our sample size based on the intraclass correlations of our key outcomes (see Snijders & Bosker, 1999), post-hoc power analyses indicated that our multilevel analyses achieved 80% power to detect conventionally small interactive effects of trait, phase, and cycle day on daily symptoms.

Results

Data Screening and Preliminary Descriptive Analyses

Data were first screened for normality. Because daily DRSP outcomes were right-skewed, multilevel models described below utilized a log transformation of the dependent variable. In addition, because average premenstrual and postmenstrual scores were also skewed, spearman rank correlations were used for zero-order and partial correlations involving these variables. Descriptive information for the sample can be found in Table 1. Two hundred women met all other eligibility criteria as described above, and therefore underwent prospective screening for MRMDs using the C-PASS to diagnose daily ratings. Each of these women provided 2–4 menstrual cycles of daily ratings. If a woman met C-PASS criteria after 2 cycles, they were enrolled and no further daily ratings were collected. However, they could complete up to 4 cycles of daily ratings in order to meet criteria on two cycles. Eighty-four (42%) of the women in this larger sample met prospective C-PASS diagnostic criteria for an MRMD (as reported in Eisenlohr-Moul et al., 2017). Of those 84 women, 54 women met all inclusion criteria and agreed to participate in an intervention study comparing two behavioral interventions for MRMDs; these 54 women comprise the sample used in the present paper. Each woman provided approximately 13.25 (out of 14 possible) daily ratings per cycle, with an average of 2.56 months. Intraclass correlations of daily symptom variables at the person level were relatively low across all seven domains, with approximately 9–18% of the variance in symptoms attributable to person-level variance; this is consistent with the cyclical, non-trait-like nature of symptoms in MRMDs. Intraclass correlations of symptoms at the phase level were much higher, with approximately 53–67% of the variance in symptoms attributable to phase-level variance (i.e., presumably the influence of the menstrual cycle).

Zero-order Pearson correlations between subscales of the DERS and RRS Brooding were calculated to verify that these constructs are related in our sample. Results are presented in Table 2. Consistent with the notion that *RRS Brooding* (depressive rumination) and the DERS subscales are both representative of difficulties responding adaptively to emotion, brooding was positively associated with most of the DERS subscales. Consistent with previous work, the DERS subscales were positively interrelated, with a few exceptions: neither DERS *Lack of Emotional Clarity* nor DERS *Nonacceptance of Emotional Responding* showed the expected positive correlations with subscales of the DERS that

capture behavioral dysregulation in response to negative emotion (i.e., Difficulties with Goal Pursuit and Emotion-Related Impulsivity).

Spearman rank correlation coefficients also revealed that a woman's average follicular baseline and average premenstrual DRSP scores were modestly positively correlated for depression, anxiety, mood swings, and eating symptoms, but were not significantly associated for anger and interpersonal conflict or for physical symptoms. Higher baseline follicular symptoms predicting higher premenstrual symptoms for depression (Spearman's $\rho = .19, p = .004$), anxiety (Spearman's $\rho = .16, p = .004$), mood swings (Spearman's $\rho = .17, p = .004$), and eating symptoms (Spearman's $\rho = .19, p = .004$). Follicular baseline symptoms were not associated with premenstrual levels of anger/interpersonal conflict (Spearman's $\rho = .074, p = .86$) or physical symptoms (Spearman's $\rho = .16, p = .19$). *Therefore, a given woman's "background" symptoms of mood, anxiety, and eating dysregulation were predictive of similar premenstrual symptoms to a greater degree than "background" symptoms of anger/interpersonal conflict or physical discomfort.*

Trait Dysfunctional Responses to Emotion and Premenstrual Symptom Severity

We hypothesized that trait dysfunctional responses to emotion would predict greater severity of premenstrual symptoms across domains. The first set of analyses examined zero-order spearman rank correlations of trait dysfunctional responses to emotion (subscales of the DERS and RRS Brooding) with a woman's average premenstrual symptom severity in MRMD cycles; the purpose of these analyses were to test the hypothesis that greater trait dysfunctional responses to emotion would predict greater severity of premenstrual symptoms in women with MRMDs. Zero-order spearman rank correlations between traits and premenstrual symptoms are presented in Table 2. Dysfunctional responses to emotion related to internal processing of emotion, such as Brooding, and Emotional Awareness, Emotional Clarity, and Emotional Nonacceptance, were generally not significantly correlated with a woman's average severity of premenstrual symptoms. However, dysfunctional responses to emotion related to failures of behavioral regulation in the face of intense emotion, especially Difficulties Pursuing Goals and Emotion-Related Impulsivity, were positively related to the severity of premenstrual behavioral symptoms, such as anger and interpersonal conflict, relationship interference, and eating symptoms. Additionally, Difficulties Pursuing Goals was also linked to more severe premenstrual physical symptoms, and Limited Access to Emotion Regulation Strategies was also associated with greater anger and interpersonal conflict.

A second set of analyses were completed to examine whether these associations truly represented associations of DERS subscales with relative premenstrual *increases* in symptoms rather than merely elevated mean levels across the cycle (which could be driven by "background" psychopathology unrelated to cyclical change). These analyses examined partial spearman rank correlations (controlling for a woman's average follicular baseline week symptoms in the same domain) of each of the trait RRS/DERS variables with each woman's average *premenstrual symptom* in each domain. Partial spearman rank correlations and rho-squared values for significant correlations can be found in Table 3. Significant partial correlations indicated that DERS *Difficulties Engaging with Goal-Directed Behavior*

remained significantly associated with premenstrual severity of eating and physical symptoms, accounting for roughly 6% and 11% of the variance in these outcomes, respectively; however, it was no longer associated with premenstrual changes in anger and interpersonal conflict or relationship interference after controlling for baseline follicular symptoms. DERS *Emotion-Related Impulsivity* remained associated with more severe premenstrual eating symptoms (accounting for 10% of the variance in premenstrual changes), anger/interpersonal conflict (accounting for 25% of the variance in premenstrual changes) and relationship interference (accounting for 12% of the variance in premenstrual changes). Nonacceptance of Emotion was no longer significantly related to severity of premenstrual mood lability after controlling for baseline follicular symptoms severity, and Limited Access to Strategies was no longer significantly related to premenstrual anger/interpersonal conflict after controlling for baseline follicular symptoms. In summary, after controlling for ‘background’ follicular phase symptom severity, *Difficulties Engaging with Goal-Directed Behavior* and *Emotion-Related Impulsivity* remained robust predictors of premenstrual symptom increases.

Trait Dysfunctional Responses to Emotion and Cyclical Symptom Trajectories

Finally, the third set of analyses utilized multilevel models to test the hypothesis that trait *dysfunctional responses to emotion* would predict *steeper increases* in symptoms across the premenstrual week as well as *slower declines* in symptoms across the follicular baseline week. In most cases, the multilevel models testing trajectory hypotheses revealed that the three-way interactions between trait, phase, and day were nonsignificant ($ps > .10$); indicating that dysfunctional responses to emotion did not generally impact the trajectory of symptom change across the premenstrual week or the postmenstrual (follicular baseline) week in women with MRMDs. However, RRS Brooding (depressive rumination) demonstrated three-way interactions with phase and time for two outcomes; specifically, Brooding influenced the trajectories of both *depression* ($\gamma_{\text{TRAIT} \times \text{PHASE} \times \text{DAY}} = .035$, $SE = .013$, $t(1155) = 2.70$, $p < .01$) and *eating symptoms* ($\gamma_{\text{TRAIT} \times \text{PHASE} \times \text{DAY}} = .057$, $SE = .013$, $t(1157) = 4.39$, $p < .0001$). Probing this pattern of results indicated that Brooding was associated with both significantly steeper premenstrual increases in depression and eating symptoms during the premenstrual phase and significantly slower recovery from these premenstrual symptoms in the follicular baseline phase (see Figure 1).

Discussion

Overview of Findings

The present study examined how trait dysfunctional responses to emotion predict the severity and trajectory of premenstrual symptoms in a sample of women with a prospectively-diagnosed MRMD. Since negative emotions peak in MRMDs during the premenstrual week, we hypothesized that individual differences in dysfunctional *responses to such negative emotions* would predict the severity of premenstrual distress and impairment. Results indicated that premenstrual symptom severity and degree of premenstrual symptom increase (over follicular baseline) were especially amplified by behavioral aspects of emotion dysregulation, such as emotion-related impulsivity and difficulty pursuing goals when upset. These effects were present only for interpersonal (e.g.,

anger), behavioral (e.g., eating), and physical symptoms. In addition, depressive rumination (RRS Brooding) uniquely affected the perimenstrual trajectory of symptoms, steepening the premenstrual increase in symptoms and slowing the postmenstrual recovery in both depressive and eating symptoms. This study is one of the first to examine the role of multifaceted trait dysfunctional responses to emotion in MRMDs, and suggests a need for further work on the manner in which known psychological risk factors for affective disorders are differentially associated with premenstrual symptom severity among women with an MRMD.

Implications for the Psychopathology of MRMDs

These findings suggest that vulnerability to emotion-related behavioral dysregulation plays a role in the severity of the cardinal premenstrual behavioral symptoms among women with MRMDs. These findings are especially important given previous work demonstrating that increased anger and conflict during the premenstrual phase are the most consistent and prominent symptoms of MRMDs (Freeman et al., 2011). Therefore, these results suggest that the impact of abnormal negative emotional reactions to ovarian steroid changes in MRMDs (Schmidt et al., 1998) may be intensified by individual differences in the presence of problematic behavioral urges to aggress or overeat in response to negative affect, or by individual differences in the ability to regulate such urges. Here, we replicate the findings of Petersen et al., (2016), who reported that women with PMDD report higher behavioral impulsivity and global difficulties in emotion regulation (as measured with the DERS total scores). However, our finding that only *some* of the DERS subscales are correlated with premenstrual symptom severity may help to explain their failure to find significant correlations of premenstrual symptom severity with either behavioral impulsivity or the DERS total score, since it appears that only a few subscales of the DERS, and emotion-related impulsivity in particular, that predict symptom severity.

In addition, depressive rumination (Brooding on the RRS) was associated with steeper increases in premenstrual depressive and eating symptoms and slower return to baseline functioning in these areas. These results may suggest that women with an MRMD who endorse depressive rumination in response to negative emotions may have more difficulty regulating premenstrual increases in negative affect and more difficulty returning to baseline following menses. Notably, this finding is in line with some previous work demonstrating that a history of major depressive disorder (which is strongly associated with trait depressive rumination) is associated with a slower return to baseline among women with an MRMD (Warner, Bancroft, Dixon, & Hampson, 1991). In addition, the link between trait depressive rumination and a slower return to baseline functioning suggests that women with an MRMD who ruminate in response to negative affect are at higher risk of experiencing more severe distress *throughout* the cycle.

Clinical Implications

The present findings add to a small body of literature suggesting a role for dysfunctional responses to negative emotion in the cognitive and behavioral mechanisms of distress and impairment in women with an MRMD. This suggests the potential utility of emotion regulation skills training, such as in Dialectical Behavioral Therapy (DBT) (Linehan, 2015),

as well as other behavioral interventions that target a variety of dysfunctional responses to emotion, such as mindfulness skills training (Bluth, Gaylord, Nguyen, Bunevicius, & Girdler, 2015; Campbell, Labelle, Bacon, Faris, & Carlson, 2012; Shapiro, Oman, Thoresen, Plante, & Flinders, 2008), in the treatment of MRMDs. As is true for other disorders characterized by emotional lability (e.g., borderline personality disorder, bipolar disorder), treatment with DBT may be especially useful in MRMDs due to its ability to cultivate the flexible use of either acceptance-based or change-based behavioral skills, especially in the context of rapid premenstrual alterations in emotional intensity or cognitive capacity. Tracking emotion and responses to emotion daily, such as is common practice in DBT, may also be a useful tool for psychotherapists seeking to encourage the cultivation of behavioral skills in the face of changing affect and resources across the cycle.

Strengths and Limitations

The present study had several notable strengths. First, this study utilized a standardized, reliable protocol (the C-PASS; Eisenlohr-Moul et al., 2017) to prospectively diagnose MRMDs on the basis of daily symptom ratings across several months. Second, the use of multilevel models and prospective symptom data lead to a high-resolution understanding of the impact of certain traits on trajectories of symptoms in women with an MRMD. Finally, this is the first study to examine a broad array of dysfunctional responses to emotion in MRMDs.

The study also had several notable limitations. First, the present study was designed to examine the associations of individual differences in dysfunctional responses to emotion with average premenstrual symptom severity in MRMDs. Although we feel this is an important empirical question, one should be cautious not to interpret the present findings to support the notion that trait dysfunctional responses to emotion exert an impact on premenstrual symptoms that is *unique* to women with MRMDs. Given the well-established role of dysfunctional responses to emotion (including rumination and impulsivity) in various types of psychopathology, we would not necessarily predict that trait dysfunctional responses to emotion exert different effects in women with a MRMD than in women without a MRMD. Rather, we simply expect that dysfunctional responses to emotion, especially rumination and impulsivity, are relevant psychological factors to be addressed in MRMDs. Second, since there were many exclusionary criteria for the present study (e.g., chronic medical conditions, suicidality, oral contraceptive use, manic symptoms), results may not be generalizable to all women with MRMD. Finally, although dysfunctional responses to emotion demonstrate strong stability in many samples, future work should prospectively evaluate daily dysfunctional responses to emotion as measured using the DERS and other inventories. Such prospective assessment would allow for clearer delineation of how stable between-person variance and fluctuating within-person variance in dysfunctional responses to emotion translate into the severity of MRMD symptoms. It would also allow for more granular tests of existing emotion regulation theories of psychopathology in MRMD.

Conclusions

Only a handful of studies have examined psychological factors that mediate or maintain symptoms in women with prospectively-confirmed MRMDs. The present study sought to

examine the associations of several trait dysfunctional responses to emotion with daily affective, behavioral, and physical symptoms of MRMD within a group of women with a prospectively-confirmed MRMD. The current study findings suggest that future studies should focus on interventions and treatments for women with menstrually related mood disorders that focus on skills to strengthen behavioral regulation in the face of strong negative emotions, such as Dialectical Behavioral Therapy (DBT), and interventions that target rumination and emotion regulation, such as Mindfulness Based Stress Reduction.

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Figure 1.
Depiction of the Interactions Between Trait Brooding, Menstrual Cycle Phase, and Day Predicting Daily DRSP Depression and Eating Symptoms

Table 1

Sample Descriptive Information (N = 54)

Variable	Mean (SD) n (%)	
Age	38.11 (6.75)	
<i>Race</i>		
White	35 (65%)	
Black	16 (30%)	
Latina	2 (4%)	
Mixed or Other	1 (1%)	
<i>Education Level</i>		
High School	2 (4%)	
Trade School	3 (6%)	
Some College	13 (24%)	
College Grad	15 (28%)	
Graduate/Professional	21 (38%)	
Average Cycle Length in Days	29.42 (4.39)	
DERS Nonacceptance of Emotional Responses	2.15 (.90)	
DERS Lack of Emotional Awareness	2.32 (.85)	
DERS Lack of Emotional Clarity	1.97 (.65)	
DERS Limited Access to Emotion Regulation Strategies	1.88 (.62)	
DERS Difficulties Pursuing Goals	2.80 (1.02)	
DERS Emotion-Related Impulsivity	2.05 (.72)	
RRS Brooding	2.22 (.65)	
<i>Average Phase-Level Symptom Means Across Cycles</i>	<i>Follicular Baseline</i>	<i>Premenstrual</i>
Depression	1.55 (.60)	2.73 (.99)
Anxiety	1.59 (.58)	3.11 (1.15)
Mood Swings	1.56 (.56)	3.12 (1.05)
Anger and Interpersonal Conflict	1.52 (.48)	3.25 (1.09)
Physical Symptoms	1.20 (.46)	2.87 (1.45)
Relationship Interference	1.29 (.42)	2.56 (1.05)

Note. Standard Deviations and Within-group Percentages in Parentheses.

Table 2

Zero-Order Spearman Rank Correlations Between Dysfunctional Responses to Emotion and Premenstrual Symptom Severity Among Women with Prospectively-Confirmed MRMD (N = 54)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Age															
2. Avg DSM-5 Sx Per Cycle	-.04														
3. Avg PM Depression	-.21	.53***													
4. Avg PM Anxiety	-.16	.56***	.73***												
5. Avg PM Mood Lability	-.17	.60***	.82***	.72***											
6. Avg PM Anger/Conflict	-.03	.59***	.62***	.74***	.77***										
7. Avg PM Eating Sx	-.02	.69***	.53***	.78***	.62***	.74***									
8. Avg PM Physical Sx	-.08	.61***	.45***	.65***	.57***	.64***	.78***								
9. Avg PM Relationship Int	-.12	.75***	.63***	.67***	.68***	.92***	.71***	.64***							
10. RRS Brooding	-.03	-.15	-.09	-.03	.01	-.03	.10	.13	.05						
11. DERS Nonacceptance of Emotion	-.15	-.03	.13	-.08	.15**	.02	-.07	.11	.11	.39***					
12. DERS Difficulties Pursuing Goals	-.17	-.02	.10	.22	.14	.17**	.33***	.35***	.19**	.22***	.22				
13. DERS Emotion-Related Impulsivity	-.20	-.08	-.01	.21	.19	.57***	.35***	.14	.35***	.19	.12	.59***			
14. DERS Lack Emotional Awareness	.02	-.09	-.15	-.13	-.10	-.03	-.07	-.09	-.06	.27***	.60***	.21***	.32***		
15. DERS Limited Strategies	-.21	-.15	.11	.04	.07	.18**	.11	.06	.10	.26***	.54***	.63***	.60***	.49***	
16. DERS Lack Emotional Clarity	-.08	-.20	-.15	-.06	-.02	-.08	-.04	-.08	-.005	.27***	.52***	.16	.10	.66***	.41***

Note:

p < .001.

PM = Premenstrual. Premenstrual is defined as days -7 to -1 where -1 is the day before menstrual onset.

Partial Spearman Rank Correlations (Controlling for Follicular Baseline Symptoms) Between Dysfunctional Responses to Emotion and Premenstrual Symptoms Among Women with Prospectively-Confirmed MRMD (N = 54)

Average Premenstrual Symptoms (Controlling for Follicular Baseline)	Trait Dysfunctional Responses to Emotion											
	Brooding		Non-Acceptance of Emotion		Difficulties Pursuing Goals		Emotion-Related Impulsivity		Lack of Emotional Awareness		Lack of Strategies	
	ρ	ρ^2	ρ	ρ^2	ρ	ρ^2	ρ	ρ^2	ρ	ρ^2	ρ	ρ^2
Avg PM Depression	-.06	-	.12	-	.05	-	.07	-	-.11	-	.01	-
Avg PM Anxiety	-.09	-	.13	-	.04	-	.06	-	-.13	-	-.04	-
Avg PM Mood Lability	.01	-	.16	-	.05	-	.01	-	-.14	-	.01	-
Avg PM Anger/Conflict	-.11	-	.07	-	.14	-	.52***	25%	-.02	-	.15	-
Avg PM Eating Sx	-.03	-	-.03	-	.34***	11%	.32**	10%	-.07	-	.06	-
Avg PM Physical Sx	.02	-	.01	-	.28***	6%	.07	-	-.23	-	.02	-
Avg PM Relationship Int	.02	-	.17	-	.18	-	.35***	12%	.01	-	.18	-

Note:

 $p < .001$.

PM = Premenstrual. Premenstrual is defined as days -7 to -1 where -1 is the day before menstrual onset.

ρ^2 refers to the proportion of variance (expressed as a percentage) in premenstrual symptoms that is accounted for by the trait variable after controlling for the woman's average follicular phase levels of the same symptom.