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Is Pristine Inner Experience Linked To Biology? An Examination of Experience Across the Menstrual Cycle Among Women with Premenstrual Distress

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IS PRISTINE INNER EXPERIENCE LINKED TO BIOLOGY?

AN EXAMINATION OF EXPERIENCE ACROSS THE

MENSTRUAL CYCLE AMONG WOMEN

WITH PREMENSTRUAL DISTRESS

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Abstract

The link between mind and biology is intuitively known: We notice changes in our mood and behavior when hungry, in pain, or under the influence of substances. Yet, the specifics of this link—for example, how changes in biology affect directly apprehended conscious experience—are not well known. The present study was an exploratory attempt toward filling that gap by using a state-of-the-art, beeper-driven method for exploring directly apprehended conscious experience (Descriptive Experience Sampling; DES) across one of the most predictable and well-known biological cycles: menstruation. We screened approximately 300 college women to identify those who reported clinically significant symptoms of premenstrual distress but were otherwise generally healthy, and ultimately engaged five of those women in approximately 20 days each of DES sampling. Menstrual cycle status was tracked using an at-home ovulation microscope test kit, and sampling days were distributed across each participant's menstrual cycle, thereby allowing for experiential changes across cycle phases (if any) to emerge. All DES sampling and the review, captioning, and coding of samples was completed largely blind to the menstrual cycle phase associated with the samples. Then, sampling days were separated by menstrual cycle phase to explore any differences in experience across cycle phases. All five participants showed some experiential differences (some subtle, some obvious) across cycle phases. For all but one of the participants, experiences differed primarily around the time of ovulation, an important finding given that the literature on premenstrual distress assumes that the time of most experiential change is in the premenstrual phase.

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Introduction

The link between mind and biology is well-known in modern psychology and commonly championed in modern psychotherapies. For example, the mental practice of mindfulness has been found to impact the processes of inflammation and aging (Fountain-Zaragoza & Prakash, 2017; Laneri et al., 2016). The link between mind and biology is also intuitively known: We notice changes in our mood and behavior when hungry, in pain, or under the influence of substances. Yet, the specifics of this link—the directly apprehended conscious experiences corresponding to biological states and fluctuations—have arguably been explored more often in psychedelic memoirs than in systematic psychological research. This study took a step toward filling that gap in psychology's understanding. To study experience, we used a state-of-the-art method for exploring directly apprehended conscious experience—Descriptive Experience Sampling (DES). To provide access to variations in biological state, we took advantage of one of the most predictable and well-known biological cycles: the hormonal changes surrounding menstruation. Our interest was in exploring whether there were changes in experience corresponding to changes in biological (hormonal) state. That is, our interest was *not* particularly in exploring the nature of premenstrual distress. However, we focused specifically on women who reported premenstrual distress because if premenstrual distress is caused largely by menstrual cycle-related changes in biology, as is generally accepted, it seemed likely that the inner experiences of such women would be sensitive to biological fluctuations.

The idea that women can experience physical and psychological changes in accord with their menstrual cycles dates back at least to Hippocrates (460 B.C. – 370 B.C.), who observed that "the blood of females is subject to intermittent 'agitation'…" (quoted in Malik & Bhat, 2016, p. 17). We now know that as many as 80-85% (di Scalea & Pearlstein, 2017; Pearlstein &

Steiner, 2008) of women notice physical (breast tenderness, bloating, headaches, muscle, or joint pain), mood (lability, irritability, depression, and anxiety), and/or behavior changes (decreased interest in typically enjoyable activities, difficulty concentrating, low energy, changes in appetite or food cravings, and insomnia or hypersomnia) in the week or so before menses (Epperson & Hantsoo, 2014). [Hereafter, the "week or so before menses" will be referred to as the "late luteal" or "premenstrual" phase as is consistent with the literature in this area]. A subset of women notice these symptoms begin around the time of ovulation (Yonkers et al., 2008). Most women are not clinically distressed by the cycle-related changes in their mood, body, and behavior; however, 20 to 25% do experience distress, at which point the condition is known broadly as premenstrual syndrome or "PMS" (Pearlstein & Steiner, 2008). An even smaller subset, approximately 5-8% of women, experience symptoms so severe and impairing as to meet diagnostic criteria for premenstrual dysphoric disorder (PMDD; Angst et al., 2001; APA, 2013; Wittchen et al., 2002). PMDD can be considered a severe and restrictive form of PMS.

The earliest diagnostic categorization of PMDD, called then "late luteal phase dysphoric disorder," appeared in the appendix of the third edition of the Diagnostic and Statistical Manual for Mental Disorders (DSM-III; APA, 1980). The category was renamed PMDD in the fourth edition of the DSM (DSM-IV; APA, 1994) but was still relegated to the appendix pending more careful research. PMDD was officially adopted as a diagnosis within the Depressive Disorders section of the fifth (and most recent) edition of the DSM (DSM-5; APA, 2013). A diagnosis of PMDD requires that, for the majority of menstrual cycles, there be at least five of eleven total symptoms present in the final week before the onset of menses and that those symptoms start to improve within a few days after the onset of menses such that they are minimal or absent in the week post menses (APA, 2013, p. 171). At least one of the five symptoms must be one of the

four core mood symptoms of PMDD: (1) marked affective lability; (2) marked irritability or anger or increased interpersonal conflicts; (3) marked depressed mood, feelings of hopelessness, or self-deprecating thoughts; and (4) marked anxiety, tension, and/or feelings of being keyed up or on edge. Additionally, the symptoms must be associated with "clinically significant distress or interference" in one or more domains of daily functioning (e.g., work, school, social activities, or interpersonal relationships) (APA, 2013, pp. 171-2). Finally, the DSM-5 requires that a diagnosis of PMDD be confirmed by "prospective daily ratings" (i.e., filling out daily questionnaires/scales of symptoms) during at least two symptomatic cycles.

The exact etiology of PMDD is unknown; however, research has long pointed to sex hormones as a major factor. Two key hormones, estrogen and progesterone, rise and fall predictably during the menstrual cycle: Estrogen levels increase early in the cycle (between menses and ovulation), peaking at ovulation to prepare the uterus to accept a fertilized egg, and then rise and decline rapidly in the second half of the cycle if pregnancy does not occur. Progesterone levels increase only later in the cycle (following ovulation) and then decline rapidly if pregnancy does not occur (see Marshall, 2016 for an overview of the menstrual cycle).

Given that PMDD occurs only in women in their reproductive years, ovarian sex hormones have long been suspected in the etiology of PMDD (Rapkin & Mikacich, 2013). Halbreich (2003) showed that ovulation processes trigger the onset of PMS symptoms and Schmidt et al. (1998) showed that PMS symptoms recur with the reintroduction of estradiol (the predominant naturally occurring form of estrogen) and progesterone.

Direct evidence for the link between sex hormones and premenstrual symptoms has emerged in the last several years. In a landmark finding, Schmidt et al. (2017) showed that women with PMDD have an atypical reaction to changes in sex hormone levels by comparison

to women without PMDD. They found that the onset of premenstrual symptoms was due not to an excess or deficit in the *absolute* levels of sex hormones but rather to a reaction to *changes* in the levels of sex hormones.

The progesterone metabolite allopregnanolone (ALLO) has been at the center of the recent research in this area; findings suggest that women with PMDD have an abnormal response to changes in ALLO levels (Timby et al., 2016; Yonkers & Simoni, 2018) and that blocking ALLO production reduces premenstrual symptoms (Schmidt et al., 1991; Chan et al., 1994). ALLO is a neurosteroid that is synthesized from progesterone in the brain, ovary, and adrenal glands. It acts upon the $GABA_A$ receptor—the major inhibitory system of the central nervous system—which is usually associated with calming effects, but, in women with PMS/PMDD, can trigger a severe mood response when at high levels such as in the luteal phase of the menstrual cycle (Placzek, 2016).

In sum, it is well-accepted that, for women with premenstrual distress or PMDD, psychological and behavioral symptoms (e.g., affective lability, irritability, interpersonal conflicts, hopelessness) are associated with, and probably in some way caused by, cycle-related changes in biology (especially, in hormones). It would be clinically and theoretically useful to understand the details of that psychological/behavioral/hormonal association. However, the psychological/behavioral symptoms are generally cumulative aggregates rather than particular experiences, making exploration of symptom/hormone link difficult if not impossible. For example, "interpersonal conflicts" are not caused directly by hormonal shifts but by some not-well-understood combination of potentially important but diverse variables such as interpersonal history, perceptual narrowing, skin tenderness, altered focus on hopes and expectations, fatigue, and so on. Linking such an agglomeration (which importantly spans previous months and years

and future months and years) to a hormonal shift whose time scale is measured in minutes or hours presents perhaps substantial—perhaps insurmountable—challenges.

It therefore might be useful to examine psychological events that occur at precisely definable moments, that is, to investigate what Hurlburt (2011; Hurlburt & Akhter, 2006) has called "pristine inner experience." Pristine inner experience refers to directly apprehended conscious experiences—thoughts, feelings, images, sensations, and so on—as they are in their natural state, disturbed as minimally as possible by the act of introspection or experimentation. Here is an example from a previous study by Hurlburt and colleagues of what is meant by pristine inner experience:

> Ashley (not her real name) is watching a sad video. Her chest feels tight in a circular-shaped region, about palm-sized on her upper chest/sternum area. Separately but simultaneously, she feels pressure and warmth inside the bridge of her nose just between her eyes as if she is about to cry.

In the interview to discuss this sample of experience, Ashley acknowledged that this was a sad moment (spawned by the video) and, had someone interrupted her watching the video to ask, "How's your mood right now?" she likely would have answered, "sad." "How's your mood right now?" typifies the way PMDD research typically proceeds—a focus on aggregate experiences that involve not-well-understood combinations of variables. In contrast, the video-watching example above is of a particular moment of Ashley's experience. In this example, her experience was not of *feeling* sad; it was of two separate but simultaneous bodily sensations; she felt her chest tight and warm pressure between her eyes. Those bodily sensations, directly apprehended "before-the-footlights" (James, 1890) of Ashley's naturally evolving consciousness, are an example of what is meant by "pristine inner experience."

To date, most studies that have examined the phenomenology of PMS and PMDD have done so using self-report symptom rating scales. For example, the widely used Daily Record of Severity of Problems (DRSP; Endicott et al., 2006) asks respondents to rate on a scale from 1 (*Not at all*) to 6 (*Extreme*) the degree to which they "felt anxious, tense, 'keyed up,' or 'on edge,'" "felt out of control," and "had mood swings (e.g., suddenly felt sad or tearful)" throughout the day. Whereas such questions might seem on their face to inquire about pristine inner experience, they very likely do not do so (Hurlburt & Heavey, 2015). Because people generally do not know well the characteristics of their inner experience (Hurlburt et al., in press; Hurlburt 2011), they often conflate their actual experience with presuppositions (assumptions, worldviews, self-theories, self-presentations biases, and other heuristics that skew, suppress, or exaggerate observations; Hurlburt, 2011) about their experience. Therefore, Hurlburt and Heavey (2015) argued, responses on a symptom rating scale likely do not reflect one's genuine experience but rather, *presuppositions* about one's experience. Indeed, McFarland et al. (1989) found that a woman's theory of her menstrual cycle symptoms influenced her recall of symptoms, such that the more a woman believed in the phenomenon of menstrual distress, the more she reported, in recall, the negativity of symptoms during her last cycle.

Moreover, though prospective daily reports are preferred and now required for diagnosis (APA, 2013), an estimated 90% of researchers continue to use retrospective rating scales (Eisenlohr-Moul et al., 2017), which ask a woman to reflect over her last one, two, three, or more menstrual cycles. Even "prospective" daily rating scales require respondents to reflect over, potentially, 24 hours, which is a substantial and probably impossible demand. Any level of retrospection renders the results susceptible to memory errors, faulty recall, and false positives

(Craner et al., 2014), and even if minimal (i.e., daily report) retrospection were successful, averaging over 24 hours may well mask important shorter-duration psychological events.

The present study examined the inner experience of women who self-reported clinically significant PMDD symptoms across their menstrual cycles using a method, Descriptive Experience Sampling (DES; Hurlburt, 1990, 1993, 2011; Hurlburt & Heavey, 2006), that attempts to overcome these and other shortcomings of self-report rating scales. DES aims to capture and describe pristine inner experience in high fidelity. Briefly, DES participants wear a random-interval beeper while going about their everyday activities. When the beeper sounds, their sole task is to grasp whatever was ongoing in experience at the "microsecond before," or was "ongoing at" the onset of the beep or was "at the moment of the beep" (all are equivalent metaphors for the experience to be examined; Hurlburt & Heavey, 2006), and immediately to jot down notes about that experience. Then, within 24 hours, the participant meets with a team of DES investigators for an "expositional interview" during which all parties work collaboratively to arrive at a high-fidelity apprehension of each beeped experience. This sampling-interview procedure is repeated over several sampling days with the goals (a) of iteratively building the participant's skill in apprehending and describing experience and (b) of collecting and describing samples of experience. Decades of DES research has shown that, using random, natural-environment sampling, one can arrive at a high-fidelity 'sketch' of a person's characteristic inner experience. The present study attempted to capitalize on this fidelity: If experience is closely tied to some biological events (such as a change in hormone levels), then strategic DES sampling across the phases of the menstrual cycle might illuminate experiential patterns associated with those biological changes.

Participants were college-aged women from a large urban university. We screened more than 300 women to identify those who self-reported significant premenstrual symptoms and who were otherwise generally healthy. Eligible women were invited to participate in DES sampling across at least two and preferably three or more menstrual cycles. We aimed for a targeted eight sampling days per cycle, therefore, a total of 24 sampling days across three cycles. Due to the time intensive nature of the procedure (several dozen hours of wearing the beeper plus 24 hour-long, face-to-face interviews for each participant), our target sample was between six and eight women; ultimately, five women completed the study. This sample size is small but typical of other qualitative research studies, especially those with an idiographic aim (Rennie, 2012; Robinson, 2014).

To explore whether experience-level changes accompany the biological fluctuations of the menstrual cycle, we ensured that DES sampling occurred across all phases of the menstrual cycle, with care taken to sample most frequently at times of rapid biological (hormonal) change. The progesterone withdrawal and high levels of ALLO of the late luteal/premenstrual phase have historically garnered the most research attention (hence, *Premenstrual* Dysphoric Disorder); however, we were equally, if not more, interested in inner experience that might occur along with the rapid estrogen spike that accompanies ovulation (but which has garnered surprisingly little attention from PMS/PMDD researchers). Therefore, when possible, we increased the "density" of DES sampling around times where we could (cautiously) infer such biological changes were occurring. To identify menstrual cycle phases and the key moment of ovulation, we needed to monitor each participant's menstrual cycle. We did so using daily at-home saliva ovulation test kits. These test kits have been shown to detect ovulation with approximately 93.3% accuracy (95% Confidence Interval = 85.5 to 99.9; Melnick & Goudas, 2015), which is

important for the present study given that the ovulation window is short (1-2 days conservatively) and that we wanted to schedule DES sampling during each ovulatory phase to capture an adequate sample of experiences during ovulation.

Ultimately, the present study resulted in idiographic characterizations of the pristine inner experience of five women with significant premenstrual distress. As is typical of DES studies, the salient phenomena of each woman's experience were described in detail; however, for this study, we paid special attention to how those phenomena and/or other experiential characteristics might differ across menstrual cycle phases. Perhaps experience in the traditionally symptomatic (late luteal/premenstrual) phase would differ from experience in the other phases; perhaps experience when hormone levels were changing most rapidly (ovulation) would differ from experience in the other phases.

Chapter 2: Review of Literature

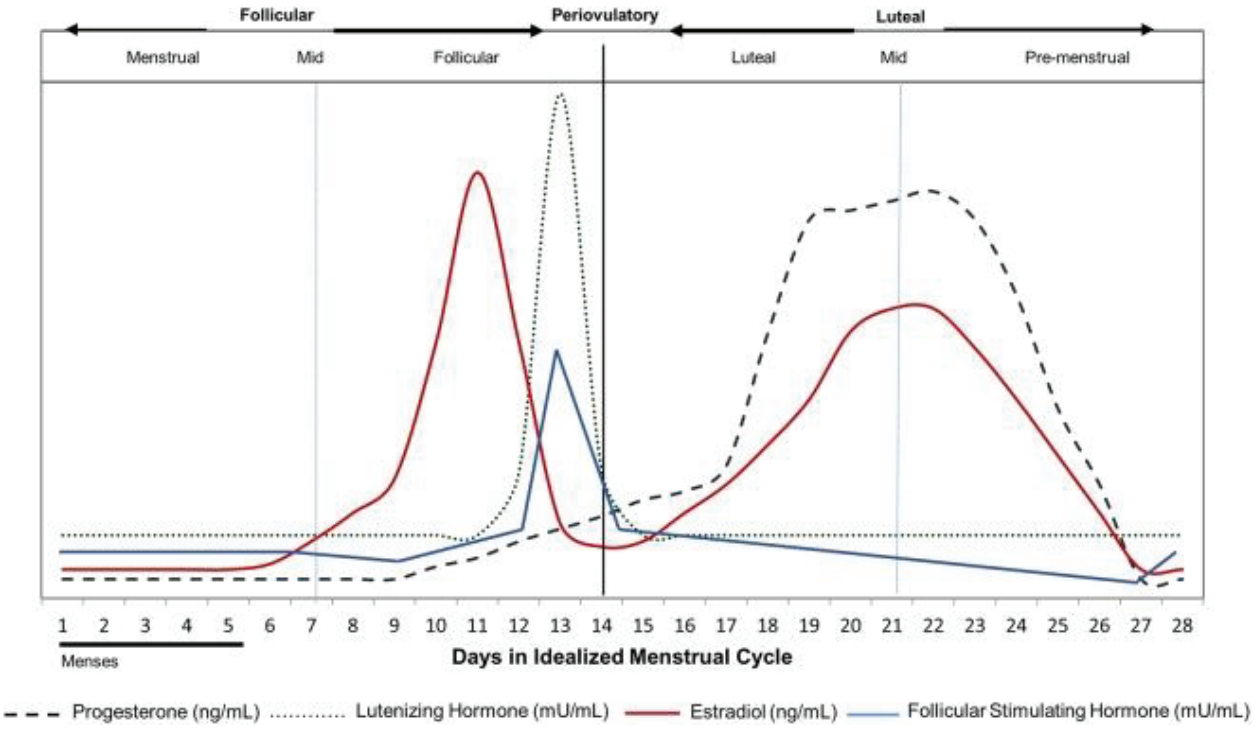
Overview of the Menstrual Cycle

The menstrual cycle refers to the female body's cyclic pattern of reproductive function. It begins at a menarche, a woman's first menses, typically around ages 12 and 13 (Campbell et al., 2013), and lasts until menopause, or the cessation of menstruation, which typically begins between ages 45 and 55 (National Institute on Aging, 2017). The absence of menstruation is known as amenorrhea, which can occur naturally, such as during pregnancy or breastfeeding, or can be a sign of another health problem, such as a genetic abnormality or dysfunction of the hypothalamus. Hypothalamic amenorrhea can be caused by excessive exercise, anorexia nervosa, extreme stress, or as a medication side effect (Hormone Health Network, 2011).

The typical female menstrual cycle lasts approximately 28 days with most cycle lengths between 25 and 30 days (Reed & Carr, 2018). A given menstrual cycle begins ("day 1") on the first day of menses, or menstrual bleeding, and ends on the first day of menses of the next cycle. The menstrual cycle is typically divided into three phases: follicular phase (approximately days 1-14), ovulation (approximately day 14), and luteal phase (approximately days 14-28). Ovulation and the luteal phase are typically relatively constant in duration; therefore, variability in cycle length is usually due to varying lengths of the follicular phase. Each phase is marked by predictable changes in pituitary hormones (FSH and LH) and ovarian hormones (progesterone and estrogen), which are depicted in Figure 1. Note especially the red line ("estradiol," the predominant variant of estrogen) and the thick black dotted line (progesterone).

Figure 1

Hormonal fluctuations across the menstrual cycle



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Follicular phase

The follicular phase begins on day 1 of the cycle and lasts until ovulation. As we have seen, day 1 of the menstrual cycle is the onset of menstruation, or the sloughing of degraded endometrial tissue (the tissue lining the uterus) in the form of menstrual fluid. Menstrual fluid flow typically lasts between four and six days but can range from as few as two to as many as eight days (Reed & Carr, 2018).

The key event of the follicular phase is the preparation of a dominant ovarian follicle that will release an ovum (egg) at ovulation. During menstruation (approximately days 1 through 4), an increase in levels of follicle-stimulating hormone (FSH) leads to recruitment of a group of ovarian follicles. Then, between days five and seven of the cycle, one follicle is selected from among that group; this follicle will release an egg (ovulate) whereas the others will degenerate. By day eight of the cycle, one follicle will be established as the dominant follicle and will promote its own growth while suppressing the growth and maturation of all other ovarian follicles (Reed & Carr, 2018).

During the follicular phase, estrogen (a female sex hormone) levels rise in parallel to the size of the maturing follicle (Reed & Carr, 2018), eventually resulting in peak levels of estrogen near the end of the follicular phase (just before ovulation). Three forms of estrogen are produced by the ovary: estradiol, estrone, and estriol. Of the three, estradiol is the most predominant and has been the subject of the most research regarding hormones and mood (Amin et al., 2005). Rising estrogen during this phase also causes a thickening of the uterine lining which creates a hospitable environment for the egg to implant (Epperson & Hantsoo, 2014).

Ovulation

At approximately day 14 of the cycle, ovulation occurs. Ovulation is triggered by rising levels of FSH and luteinizing hormone (LH). Both hormones are secreted by the pituitary gland, which cause the dominant follicle to release an egg. An "LH surge" begins approximately 34 to 36 hours prior to ovulation, and ovulation occurs approximately 10-12 hours after LH reaches its peak. The LH surge, therefore, is a relatively precise predictor of ovulation (Reed & Carr, 2018). After releasing the egg, the dominant follicle atrophies, at which point it becomes the corpus luteum.

Ovulation is the fertile phase, the most likely opportunity for fertilization if intercourse occurs. The "fertile window" has generally been considered to include the five days before ovulation and the day of ovulation itself or, more broadly, days 10 through 17 of the cycle (Beckmann et al., 1998), though Wilcox and colleagues (2000) argued that such guidelines are "outdated" given that timing of the fertile window is highly variable, even among women who report regular menstrual cycles (p. 1260). Anovulation, or the failure to ovulate, can result from normal processes, such as aging and lifestyle factors, or another medical condition, such as ovarian and gynecological conditions and endocrine disorders (Jose-Miller et al., 2007).

The ovulatory period may be a time of mood change. For example, a subset of women notices premenstrual distress symptoms begin around the time of ovulation as opposed to the more common report that symptoms begin the week or so before a menstrual period (Yonkers et al., 2008). Conversely, Rebollar and colleagues (2017) showed that, compared to women using hormonal contraceptives, naturally cycling women who were not using hormonal contraceptives reported significantly higher positive affect corresponding to the LH surge that precedes ovulation.

Given its relevance for reproduction and that it is the theoretical midpoint of the cycle, there are several methods available for determining the timing of Ovulation. These methods include: ultrasound (where an egg, if released, can be visualized), the calendar method (that determines a woman's fertile period based on the length of her past six or more menstrual cycles), urine test strips or sticks (that detect the presence of hormones indicative of impending or resolved ovulation), basal (upon waking) body temperature (where several consecutive "spikes" in basal body temperature indicate ovulation has occurred), cervical mucus (where patterns in mucus quality indicate fertility), actigraphy watches (that estimate ovulation based on

several physiological readings, including heart rate and basal body temperature), and ovulation microscopes (where a "ferning" pattern in dried saliva indicates ovulation).

Each ovulation detection method has advantages and disadvantages. For example, basal body temperature and cervical mucus methods are inexpensive (or free) but require substantial training and compliance for desired outcomes. Urine test strips and sticks have high rates of accuracy for detecting ovulation (FDA, 2018) but can be expensive (as strips/sticks can only be used once and some systems require a digital device to read the test) and require substantial compliance for desired outcomes. Early studies of actigraphy watches suggest they attain similarly high rates of accuracy for predicting ovulation (Stein et al., 2016) but are expensive and research is in its infancy. For the present study, we chose to use the KNOWHEN ® ovulation microscope which detects a fern-like crystallization pattern in dried saliva that has been shown to be indicative of ovulation. KNOWHEN ® is inexpensive, can be re-used daily for years, requires little training for participants, and affords the level of accuracy needed for this exploratory study. In brief, KNOWHEN ® users remove the lens from the microscope each morning, place a drop of saliva on the center of the lens, allow 15 minutes for the saliva to dry, and then return the lens to the microscope and peer through it to observe whether the ferning pattern is present.

Casals (1968) first described how salivary ferning crystallization patterns could be read as biological markers of impending ovulation. According to Johannes (2014, paragraph 6), "the idea behind ferning is simple. When estrogen rises in the body, so does its salt content—resulting in the fern-like pattern in saliva." Since that time, correlational studies comparing salivary ferning with ultrasound-detected ovulation (the "gold standard") have reported mixed results ranging from 36.8% (Guida et al., 1999) to 92% (Guida et al., 1993). Guida (1999) concluded that low correlations were likely due to frequently uninterpretable ferning results produced by

lower-quality device designs. More recent designs appear to have overcome this limitation; for example, Salmassi and colleagues (2013) found 78% specificity and 80% sensitivity using a microscope system to detect salivary ferning.

In an open label prospective study of the KNOWHEN system, Melnick and Goudas (2015) examined 22 women across a total of 41 menstrual cycles. The women assessed for ovulation daily using the KNOWHEN system and, at the midpoint of their cycle, underwent a transvaginal ultrasound examination to determine whether the cycle was ovulatory. Ultrasound results were then compared to results from the KNOWHEN testing. Results supported use of the KNOWHEN device, which had a positive predictive value of 93.3% (95% CI = 85.5-99.9%) and a sensitivity of 96.5% (95% CI = 90.9-99.9%) and a negative predictive value of 90.9% (95% CI = 82.1-99.7%) and specificity of 83.3% (95% CI not provided).

Luteal (premenstrual) phase

Immediately following ovulation, approximately days 14-28, is the luteal phase, which is marked by rising levels of progesterone produced by the corpus luteum. The corpus luteum is a "transient endocrine organ that predominantly secretes progesterone" (Reed & Carr, 2018, paragraph 12). Progesterone further prepares the uterine lining (endometrium) on which the potentially fertilized egg can implant. If fertilization has not occurred, the corpus luteum disintegrates, which triggers rapid decreases in progesterone and estrogen and results in the shedding of the uterine lining as the next cycle's menstruation begins (Epperson & Hantsoo, 2014; Marshall, 2016).

Premenstrual Dysphoric Disorder

Premenstrual disorders are characterized by physical, mood, and behavioral symptoms that begin the week or so before menses (late luteal/premenstrual phase), resolve during menses,

and are absent for at least one week after menses. Premenstrual disorders are generally grouped into three classes: one clinically diagnosable disorder (Premenstrual Dysphoric Disorder, or PMDD), another milder subclinical disorder (Premenstrual Syndrome, usually termed "PMS"), and "variant" disorders (O'Brien et al., 2011). The most-discussed variant disorder is known as premenstrual exacerbation (PME), or the worsening of symptoms of another psychiatric disorder, such as major depressive disorder, during the premenstrual phase. That is, women with PME do not have a distinct premenstrual disorder but rather experience an exacerbation of another underlying disorder during the premenstruum (Epperson & Hantsoo, 2014). The subclinical form of premenstrual disorders is generally known as premenstrual syndrome (PMS), which affects an estimated 20-25% of women (Pearlstein & Steiner, 2008), and is characterized by mild symptoms that, though they cause some distress, are manageable (Epperson & Hantsoo, 2014).

Premenstrual dysphoric disorder (PMDD) is the lone clinically diagnosable condition among the premenstrual disorders. PMDD, essentially a severe form of PMS, affects between 5 and 8% of women (Angst et al., 2001; APA, 2013; Wittchen et al., 2002). Women with PMDD experience premenstrual physical, mood, and behavioral symptoms that are so severe they impair one's everyday functioning. The burden of illness of PMDD is significant, with impairments noted in interpersonal and work functioning as well as effects on daily living comparable to depression, migraine headaches, and irritable bowel syndrome (Rapkin & Winer, 2009). See Table 1 for common symptoms of PMS and PMDD.

Table 1

Common Symptoms of PMS and PMDD

Domain	Symptom[a]	% of Cycles[b]
Mood	Irritability	84.6
	Anxiety	83.1
	Mood lability	76.9
	Sadness/Depression	58.5
	Feeling insecure	46.2
	Low self-esteem	46.2
	Feeling out of control	[c]
Physical	Fatigue	73.8
	Bloating	69.2
	Physical discomfort	53.8
	Breast tenderness	47.7
	Aches	[c]
	Headaches	[c]
Behavioral	Social withdrawal/isolation	55.4
	Appetite changes (i.e.., food cravings)	46.2
	Poor concentration	[c]
	Decreased interest	[c]
	Sleep disturbance	[c]

Note. PMS = Premenstrual Syndrome; PMDD = Premenstrual Dysphoric Disorder

[a] Symptoms are derived from Freeman (2003) and Bloch, Schmidt, & Rubinow (1997)

[b] Percentage of cycles in which the severity of the symptom was at least 30% greater in the premenstrual week than in the postmenstrual week based on prospective daily symptom ratings of $N = 16$ women with PMS (Bloch et al., 1997)

[c] Data not available for this symptom

Assuming they are sensitive to biological fluctuations, the present study focused on women who reported significant premenstrual distress. Among premenstrual disorders, PMDD is the most well-defined and well-researched in the literature; therefore, the review that follows will

focus primarily on PMDD. However, it should be noted that the PMDD diagnosis is sometimes viewed as unnecessarily restrictive:

> Many women with clinically significant premenstrual symptoms do not meet full diagnostic criteria; they might not have a prominent mood symptom, or the five different symptoms required as a minimum by the DSM-IV [and now the DSM-5]. (Yonkers et al., 2008, p. 2)

In a large-sample ($N = 1251$) prospective-longitudinal community survey, Wittchen and colleagues (2002) reported that whereas 5.3% of respondents met DSM-IV criteria for PMDD, another 18.6% had "near-threshold" symptoms, typically meeting requirements for the number, nature, and timing of symptoms but without the corresponding levels of impairment. To rectify this, the American College of Obstetrics and Gynecology (ACOG) uses a more inclusive definition of "moderate to severe PMS" (which includes PMDD) that requires at least one psychological or physical symptom that causes significant impairment and is confirmed by means of prospective ratings (ACOG, 2014). Additionally, the International Classification of Diseases (ICD), the other major diagnostic classification system alongside the DSM, uses a different diagnosis entirely: Premenstrual tension syndrome (WHO, 1992). Fortunately, these differences in diagnostic classification appear not to restrict the generalizability of research on PMDD. Yonkers et al. (2008) found that the descriptions of symptoms correspond well between PMS, PMDD, premenstrual tension syndrome, and the ACOG definition, and, therefore, research on PMDD is expected to be informative across the range of premenstrual disorders.

History of the Diagnosis

Hippocrates (460 – 370 B.C.), in his text, *Diseases of Women*, is typically cited as making the first known reference to premenstrual distress in his text, *Diseases of Women*: "the

blood of females is subject to intermittent agitation" and the "agitated blood makes its way from the head to the uterus from which it is expelled" (qtd in Hanson, 1975). Malik and Bhat (2016) reviewed historical references to premenstrual disorders, finding that many of the physical symptoms that define PMS today were described as early as 900 A.D., including increased body weight, food cravings, abdominal bloating, and headache. The temporal relationship between symptoms and the onset of menses appeared in academic writings as early as 1100 A.D. Descriptions of the psychological symptoms of premenstrual disorders, however, did not appear until the 17th and 18th centuries when the following were noted: mood change, irritability, insomnia, nervous attacks/nervous excitement, morbid dispositions of mind, a wayward and capricious temper, proneness to quarrel with their dearest relatives, and melancholy (Prichard, 1835). In 1902, von Krafft-Ebing provided a description of premenstrual distress that emphasized the interpersonal impairment associated with premenstrual symptoms, including difficulty getting along with other members of the household, including otherwise tenderly loved children, emotional explosions, libelous acts, and breaches of peace.

The cause of premenstrual symptoms remained largely unknown until the late 19th and early 20th centuries. Before that time, symptoms were variously attributed to hysteria, the uterus ("strangulation of the uterus"; Dubois, 1478-1555; in Stolberg, 2000), and the systemic effects of excess blood. Henry Maudsley (1873) was first to connect premenstrual symptoms to cyclical ovarian activity, which is still considered the leading explanatory cause of premenstrual disorders.

In 1931, Robert Frank created the first clinical description of premenstrual symptoms: intense personal suffering, restlessness, irritability, feeling like "jumping out of their skin," and various physical complaints seven to 10 days before the onset of menses. Frank (1931) attributed

the cause of premenstrual symptoms to an excess of circulating "female hormone." Green and Dalton (1953) built upon Frank's speculation, attributing premenstrual symptoms more specifically to dysfunctions in estrogen and progesterone. Dalton is considered a highly influential figure in the history of premenstrual disorders; among her many contributions is the coining of the term "premenstrual syndrome," which, by using the term "syndrome," helped legitimize the experience as a medical disorder.

"Late luteal phase dysphoric disorder" (LLPDD) was the first premenstrual disorder to appear in a formal diagnostic manual—Appendix A of the third edition of the DSM (DSM-III-R; APA, 1987). A diagnosis of LLPDD required a minimum of five symptoms with predictable onset in the late luteal phase and offset in the early follicular phase. In preparation for the fourth edition of the DSM (DSM-IV; APA, 1994), a work group cited the wide-ranging prevalence estimates of LLPDD (from 7-54%; Yonkers, 2012) as evidence that the disorder was not sufficiently understood to be classified as an official diagnosis. The work group recommended additional research using prospective daily rating scales to estimate the true prevalence of the disorder Though LLPDD was renamed "Premenstrual Dysphoric Disorder" (PMDD) in the DSM-IV, it was still listed only in the appendix as a provisional diagnosis pending additional research (Epperson et al., 2012). The DSM-IV PMDD diagnosis required the presence of five of 11 symptoms that occur premenstrually, involve disruption in day-to-day functioning, and abate after the menstrual period (Freeman, 2003).

In preparation for the fifth edition of the DSM (DSM-5; APA, 2013), a work group was tasked with determining whether research showed that PMDD: was a diagnosis distinct from similar diagnoses (e.g., Major Depressive Disorder); had antecedent validators, such as family history and environment risk factors; had concurrent validators, such as cognitive, biological and

temperamental correlates; and had predictive validity with respect to diagnostic stability, predictability in trajectory, and response to treatment (Epperson et al., 2012). The work group confirmed that PMDD met each of these requirements, and it was officially recognized as a diagnostic entity in the DSM-5 among the category "Depressive Disorders."

Slight changes were made to the criteria between DSM-IV and DSM-5. First, the timing criterion was altered such that symptoms need only be present in the final week before menses (as opposed to "most of the week" before menses) and symptoms need only improve (as opposed to "remit") within a few days of menses. Second, mood lability and irritability were made more prominent by moving them to first and second position in the symptom list (formerly depressed mood and marked anxiety). Third, "clinically significant distress" was included as a component of functional impairment and the "home" was now considered as a potential place of impact for that distress/impairment. Fourth, a final criterion was added to ensure that the symptoms are not due to the direct physiological effects of a substance or another medical condition.

The DSM-5 diagnostic criteria for PMDD are presented in their entirety in Table 2. Five of 11 symptoms are required, at least one of which must be a mood symptom (Table 2, Criterion B, e.g., depression, irritability, etc.) and one a cognitive/behavioral/physical symptom (Table 2, Criterion C, e.g., decreased interest in typically pleasurable activities, fatigue, etc.).

Table 2

DSM-5 Diagnostic Criteria for Premenstrual Dysphoric Disorder

Criterion	Relevance		
A	Timing	In the majority of menstrual cycles, at least five symptoms must be present in the final week before the onset of menses, start to *improve* within a few days after the onset of menses, and become *minimal* or absent in the week postmenses.	
B	Core mood symptoms	One (or more) of the following symptoms must be present:	1. Marked affective lability (e.g., mood swings; feeling suddenly sad or tearful, or increased sensitivity to rejection 2. Marked irritability or anger or increased interpersonal conflicts 3. Marked depressed mood, feelings of hopelessness, or self-deprecating thoughts 4. Marked anxiety, tension, and/or feelings of being keyed up or on edge
C	Additional symptoms	One (or more) of the following symptoms must additionally be present, to reach a total of *five* symptoms when combined with symptoms from Criterion B.	1. Decreased interest in usual activities (e.g., work, school, friends, hobbies) 2. Subjective difficulty in concentration 3. Lethargy, easy fatigability, or marked lack of energy 4. Marked change in appetite; overeating; or specific food cravings 5. Hypersomnia or insomnia 6. A sense of being overwhelmed or out of control 7. Physical symptoms such as breast tenderness or swelling, joint or muscle pain, a sensation of "bloating," or weight gain
D	Functional impairment	The symptoms are associated with clinically significant distress or interference with work, school, usual social activities, or relationships with others (e.g., avoidance of social activities; decreased	

		productivity and efficiency at work, school or home).
E	Rule out Premenstrual exacerbation (PME) or other primary diagnoses	The disturbance is not merely an exacerbation of the symptoms of another disorder, such as major depressive disorder, panic disorder, persistent depressive disorder (dysthymia), or a personality disorder (although it may co-occur with any of these disorders).
F	Required prospective assessment	Criterion A should be confirmed by prospective daily ratings during at least two symptomatic cycles (**Note:** The diagnosis may be made provisionally prior to this confirmation).
G	Rule out confounding substance or medical causes	The symptoms are not attributable to the physiological effects of a substance (e.g., a drug of abuse, a medication, other treatment) or another medical condition (e.g., hyperthyroidism)

Note. See APA (2013), pp. 171-172

Research suggests there may be clinically meaningful subtypes of PMS/PMDD characterized by different mood symptoms—specifically a subtype dominated by depressed mood and a subtype dominated by other psychiatric symptoms—however, such subtypes are not yet defined or routinely used (Landén & Eriksson, 2003).

Feminist Perspectives on PMDD

Feminist scholars have long criticized (in some cases) the PMS/PMDD diagnosis itself and (in many cases) elements and language within the diagnosis. Arguably the most salient

criticism from the feminist camp is that classifying PMDD as a disorder pathologizes female biology and underemphasizes the influence of individual, cultural, and political factors in shaping women's experiences of premenstrual symptoms (Cosgrove & Riddle, 2003; Gurevich, 1995; Ussher, 2003, 2004; King & Ussher, 2012). Gurevich (1995) argued that there are at least three faulty assumptions inherent in the biology-forward approach to PMDD. First, it is assumed that biology operates within a woman without influence from external factors. Second, it assumes that fluctuations in mood and behavior are signs of illness instead of assuming that what women naturally experience (including fluctuation) is healthy. Third, it favors positivistic methods that must reduce complex psychological and/or social phenomena into objective, presumably value-free variables (e.g., hormone levels).

A corollary of the "biologization" (Slife et al., 2010) of PMDD is that female biology is now viewed as inherently faulty, unpredictable, and inferior to the relatively more stable male biology (Gurevich, 1995), which, in turn, perpetuates the "good woman" ideal (Rodii, 1992). In feminist discourses, the "good woman" ideal explains how women tend to view themselves as "split," as being either "good" (self-sacrificing, compassionate, coping, calm) or "bad" (aggressive, impatient, anxious) (Ussher, 2004, p. 261). When interviewed about their experience of premenstrual symptoms, women allude to this split by describing their premenstrual experiences in such ways as "I'm just stressed and anxious—not a pleasant person to be around. Its [sic] like Dr. Jekyll and Mr. Hyde" (Ussher, 2004, p. 261). Notably, the hallmark symptoms of PMDD—anger, irritability, aggression, feeling out-of-control, and so on—are inconsistent with the "good woman" ideal. Some have speculated that women freely express these otherwise unacceptable emotions and behaviors during the premenstrual phase because they can do so for a medically acceptable reason (PMDD) without losing their "feminine allure" (Gottlieb, 1988, p.

13) or being labeled as neurotic (Gurevich, 1995). Ussher (2004, p. 262) theorized that the good-bad tension associated with PMDD forces women to "self-silence":

> By attributing transgressive emotions or behavior to an outside thing, 'PMS', women are able to keep a core sense of self as 'good' intact. However, in doing so, they are not addressing the needs or issues that lead to the emotions that emerge in the premenstrual phase of the cycle.

Feminist scholars have also criticized the male-dominated early history of PMDD, especially given that it is a uniquely female disorder. Gurevich (1995), for example, argued that Robert Frank's motivation in defining "premenstrual tension" (Frank, 1931) was to identify a deficit in women that would make them appear less desirable to employers. Chrisler and Caplan (2002) saw Frank's definition as adding a "modern veneer to the cult of invalidism and Victorian era concerns" about the potential effects of women exerting themselves in intellectual and workforce activities (p. 283). At the time, women were entering the workforce in greater numbers to account for male employees serving overseas in World War I, and Martin (1987) viewed this as a trend in PMDD's history: "When women's participation in the labor force [is viewed] as a threat, menstruation [becomes] a liability" (p. 121). These ideas may persist into the modern day where many women with PMS symptoms are advised to treat their symptoms by resting and slowing the pace of their lives (including, especially, work demands), which may, in turn, threaten their potential for successful careers (Chrisler, 2001). Like Chrisler and Caplan, Gurevich noted the similarities between PMDD and the Victorian era concept of "hysteria": both were overwhelmingly applied to women; both were blamed on female physiology (the uterus); and, ultimately, both dictated:

> that a woman's most natural functions lie in the realm of childbearing and caretaking. Therefore, when women transgress by stepping out of or, worse yet, by completely abandoning their 'natural' sphere of domesticity, they are inevitably subject to psychological disturbances, such as PMS. (1995, p. 76)

Overall, feminist scholarship hopes to affect the future of PMDD by calling for an understanding of premenstrual symptoms that: is in women's own words; values but does not overemphasize biology; integrates constructivist views, including the influence of social and political factors; and considers the possibility that premenstrual fluctuations are normal and healthy (and that some women actually experience positive changes in the premenstruum; King & Ussher, 2012).

Epidemiology

Most reproductive-age women—an estimated 80-85%—experience mild, non-clinical premenstrual characteristics (di Scalea & Pearlstein, 2017; Pearlstein & Steiner, 2008). Twenty to 25% experience mild to moderate distress consistent with descriptions of PMS premenstrual syndrome or PMS (Freeman, 2003; Pearlstein & Steiner, 2008). Approximately 5-8% of women experience symptoms severe and disabling enough to meet diagnostic criteria for premenstrual dysphoric disorder (PMDD) (Angst et al., 2001; APA, 2013; Wittchen et al., 2002). Estimates of PMDD have hovered consistently around 5% since the time of the DSM-III-R when it was termed "late luteal phase dysphoric disorder" (Rivera-Tovar & Frank, 1990; Soares et al., 2001). Alevizou and colleagues (2018) noted that women who display four severe PMDD symptoms are double or even triple the number of those who report five severe symptoms as required for a DSM-5 diagnosis of PMDD. For this reason, PMDD has been criticized for being too stringent and failing to capture a substantial number of women who also experience distressing symptoms (Yonkers et al., 2008).

PMDD is present across disparate cultures, as confirmed by epidemiological studies in the United States, Canada, Europe, India, and Japan (Epperson et al., 2012). Di Scalea and Pearlstein (2017) concluded that the rates and symptoms of PMDD are consistent across several continents. However, one study of tribal cultures (Paige & Paige, 1981) found that 0% of individuals reported premenstrual problems, and others (Gurevich, 1995) have argued that only the physical symptoms of PMDD are consistent cross-culturally whereas the mood symptoms of PMDD are specific to the United States and other westernized cultures. A cross-sectional analysis of community-based studies from 14 different countries (N = 7,226 women) found that, across all countries, physical symptoms were the most prevalent and that irritability was the most common among the four mood complaints (Dennerstein et al., 2011).

Rates of PMDD are comparable among White and African American women in the United States (Epperson et al., 2012). However, Pilver and colleagues (2011) found that rates of PMDD among ethnic minority women may be influenced by exposure to American culture. In their study of nearly 4,000 English-speaking Asian, Latina, and Black women, they found that nativity status, duration of residence, and age at immigration were significantly associated with PMDD. U.S.-born women and women who immigrated to the U.S. before age six were more likely to have PMDD than those who arrived after age six. Additionally, the likelihood of PMDD increased with one's duration of residence in the U.S.

Relation to other Disorders

The exact taxonomy and nomenclature of PMDD remains hotly debated (Alevizou et al., 2018), and there has been question as to whether PMDD should be considered a variant of depression, a variant of anxiety, or a disorder (gynecological or psychological) of its own. At present, there appears to be consensus that PMDD should be considered distinct from depression

and anxiety, as reflected in the inclusion of PMDD as its own disorder in DSM-5 (Epperson et al., 2012; Landén & Eriksson, 2003).

Depression. PMDD has historically been criticized for its similarity to major depressive disorder (MDD), which, especially in preparation for the DSM-5, led to increased research into the distinctions between the two disorders, five of which will be considered here. First, the timing of symptoms in proximity to menstruation is unique to PMDD. MDD symptoms must occur consistently for at least two weeks but need not have any temporal relationship to the menstrual cycle. Second, though PMDD and MDD share symptoms, they are emphasized differently. Specifically, irritability and mood lability are key components of PMDD, whereas they are less common in individuals with MDD (Yonkers et al., 2008). Third, there are several physical symptoms (e.g., bloating, breast tenderness) that are unique to PMDD. Fourth, PMS does not share substantial genetic variance with MDD or with broadband personality traits like neuroticisms (Kendler et al., 1998; Epperson et al., 2012). Fifth, selective serotonin reuptake inhibitors (SSRIs), a form of antidepressant, act differently upon PMDD. Whereas patients with MDD may wait weeks to experience symptom improvement from an SSRI, patients with PMDD can begin taking SSRIs in the luteal phase and experience nearly immediate alleviation in symptoms, suggesting a different mechanism of action (Dimmock et al., 2000; Epperson et al., 2012).

Premenstrual disorders do frequently co-occur with depressive disorders both over the lifetime and concurrently. Other depressive disorders occur concurrently in approximately 12-25% of PMS/PMDD patients, though this is perhaps an underestimate due to the symptom overlap mentioned above (Kim et al., 2004; Yonkers & McCunn, 2007). Lifetime co-occurrence rates are much higher: Women with PMDD are more likely to have major depressive disorder

and/or postpartum depression in the future (Bloch et al., 2000; Hartlage et al, 2001). At least 30% of women with PMS will have a minor or major depressive episode at some point in their lives (Yonkers et al., 2008) and between 30 and 70% of women with PMDD have had an episode of major depression in the past (Yonkers & McCullen, 2007).

Anxiety. Women with PMDD frequently report premenstrual anxiety symptoms, including nervousness (27.1% prevalence), anxiety (4.9% prevalence), and tension (27.1% prevalence) (Landén & Eriksson, 2003). Women with severe premenstrual complaints are believed to be at greater risk for anxiety disorders including panic disorder and generalized anxiety disorder (Angst et al., 2001). However, as with depression, these figures may be inflated by the fact that individuals who retrospectively report premenstrual anxiety symptoms are actually experiencing premenstrual exacerbation of a chronic anxiety disorder and would not meet diagnostic criteria for PMDD using prospective daily ratings. Unfortunately, rates of premenstrual exacerbation of anxiety are unknown (Kim & Freeman, 2010).

Between four and 38% of women with PMS/PMDD (as confirmed by prospective report) were found to have comorbid generalized anxiety disorder (Kim et al., 2004). Estimates of concurrent PMS/PMDD and panic attacks/panic disorder are generally higher and much more consistent than of concurrent PMS/PMDD and generalized anxiety disorder, at about 25% when using prospective reports (Kim et al., 2004). Estimates of concurrent PMS/PMDD and phobic disorders are also fairly consistent, ranging from 16-30% for simple phobia and 19-23% for social phobia (Kim et al., 2004). Estimates of concurrent PMS/PMDD and obsessive-compulsive disorder are lowest among anxiety disorders, ranging from 1-2.26% (Kim et al., 2004).

Bipolar disorder. Data on the comorbidity of PMDD and bipolar disorder is sparse (Kim et al., 2004) and may overestimate the true prevalence if retrospective or other flawed methods

of diagnosis are used (Kim et al., 2011). An early study of women with late luteal phase dysphoric disorder (confirmed by prospective reports), found no relationship (0%) with bipolar disorder (Fava et al., 1992). More recent estimates of concurrent PMS/PMDD and bipolar disorder (inclusive of both bipolar I and bipolar II disorder) based on retrospective reporting range from 11-20% (Kim et al., 2004). Wittchen et al. (2002) distinguished between bipolar I and bipolar II disorder, finding similar rates of comorbidity for each with PMS/PMDD—5.7% and 4.9%, respectively. Payne et al. (2007) also distinguished between bipolar I and bipolar II disorder but examined premenstrual symptoms broadly (as opposed to official diagnoses), finding high rates among both groups—65.1% and 70.5%, respectively. Premenstrual exacerbation of underlying bipolar disorder symptoms is common, reported by 60-70% of women (Kim et al., 2011).

Seasonal affective disorder. Estimates of concurrent PMS/PMDD and seasonal affective disorder range from 38-46% when using prospective reports (Kim et al., 2004). The two disorders share unique features—namely, cyclicity and a combination of somatic and psychiatric symptoms—suggesting similar biological mechanisms or vulnerabilities; however, additional research is needed.

Etiology

Raffi and Freeman (2017) produced an etiological model that they call "the 5 interwoven pieces of the PMDD puzzle." The model is shown in Figure 2 and is a useful summary of the most recent and robust research in this area. Each of the five factors (among others) will be elaborated in this section. See also Table 3 below for an overview of etiological findings.

Figure 2

The five interwoven pieces of the PMDD puzzle (Raffi & Freeman, 2017, p. 24)

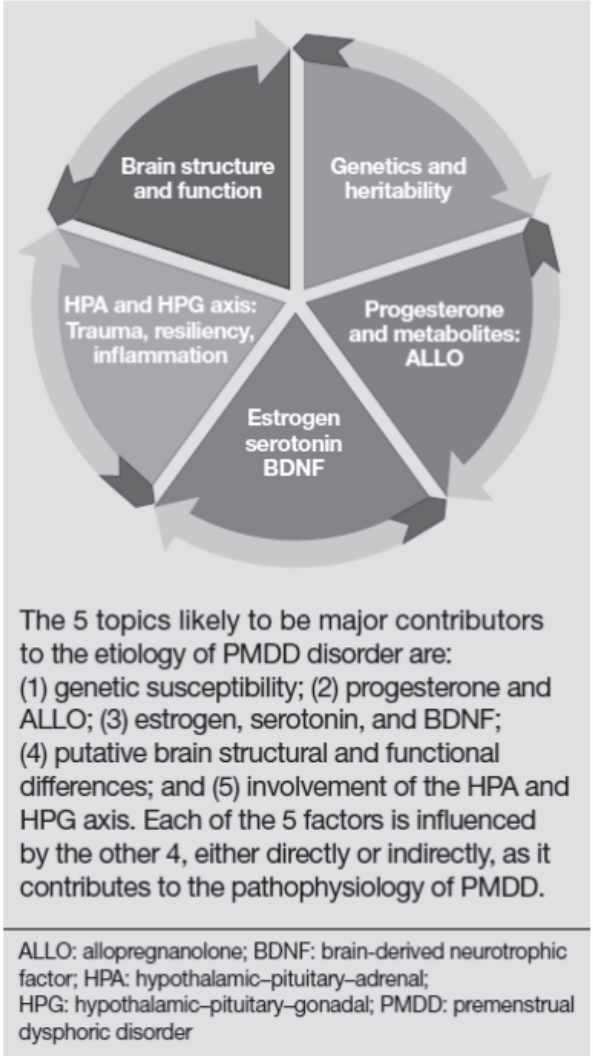

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Table 3

Summary of Studies of PMS and PMDD Etiological Factors

Source	Finding	Cycle days affected
In General		
Backström et al. (2014)	PMDD is associated with increased negative mood (depression, irritability) during the luteal phase reaching a maximum during the last days of the menstrual cycle or first days of menstrual bleeding	21-28
Hormones		
Backström et al. (2011)	In animal models, premenstrual anxiety and depression during progesterone withdrawal can be mitigated by preventing the conversion of progesterone into ALLO	Not specified; can infer approximately days 21-28
Epperson et al. (2002)	Cortical GABA levels increased across menstrual cycle for women with PMDD (opposite pattern of "healthy" controls), suggesting a luteal-phase specific decrease in cortical inhibition	Late luteal phase (1-5 days before menses)
Girdler et al. (2001)	Women with PMDD with greater levels of premenstrual anxiety and irritability had significantly reduced ALLO levels in the luteal phase as compared to less symptomatic PMDD women	Luteal phase (days not specified); can infer approximately days 15-28
Lovick (2013)	Rapid withdrawal from ALLO when progesterone drops in the late luteal phase precipitates premenstrual symptoms	Late luteal phase (days not specified); can infer approximately days 21-28
Martinez et al. (2015)	Blocking conversion of progesterone to ALLO led to a reduction in PMDD symptoms	Week 4 of menstrual cycle; can infer days 21-28
Schmidt et al. (2017)	PMDD is associated with changes from low to high levels of estradiol/progesterone	Luteal phase (days not specified); can infer approximately days 20-25
Timby et al. (2016)	PMDD is associated with heightened sensitivity to ALLO	17-28

	at $GABA_A$ receptors in luteal phase	
Yen et al. (2018)	Women with PMDD who had lower levels of estrogen had high anxiety and perceived stress in the premenstrual phase	7 days before menstruation (predicted based on the last menstruation cycle)
Neurotransmitters		
Inoue et al. (2007)	Compared to "healthy" controls and women with PMS, those with PMDD had highest serotonergic function during follicular phase and lowest during luteal phase (which has been associated with cognitive-affective PMDD symptoms)	Late luteal phase (days not specified); can infer approximately days 21-28
Oral et al. (2015)	PMDD is associated with higher luteal serum BDNF levels and serum BDNF levels were significantly higher in the luteal phase than in the follicular phase for women with PMDD	21-25
Sue et al. (1997)[a]; Steinberg et al. (2012)[b]	Fluoxetine, an SSRI, administered continuously[a] or only during luteal phase[b] improved self-reported emotional and physical PMDD symptoms in luteal phase	7 days before menses[a]/Luteal phase (days not specified)[b]
Brain function		
Gingnell et al. (2013)	PMDD is associated with an exaggerated response in prefrontal cortex when anticipating negative stimuli in late luteal phase	8-13 days after ovulation
Protopopescu et al. (2008)	PMDD is associated with an increased emotional response to negative stimuli in the premenstrual phase	1-5 days before menses
Other		
Bannbers et al. (2011)	Compared to "healthy" controls, women with PMDD display a heightened startle response to both positive and negative stimuli in the luteal phase	1-7 days before menses
Bertone- Johnson et al. (2014)	Premenstrual symptoms were associated with inflammatory markers in blood during mid-luteal phase	Mid-luteal phase (days not specified)

Neuroendocrine explanations. Given that PMDD occurs only in women in their reproductive years, ovarian sex hormones have long been suspected in the etiology of PMDD. As Timby et al. (2016) wrote, "The pathophysiology of PMDD is not yet fully understood, but the temporal association with circulating ovarian steroids, in particular progesterone, produced by the corpus luteum after ovulation, is obvious" (p. 2019). Estrogen and progesterone are key ovarian sex hormones, both of which can directly or indirectly affect central nervous system functioning including mood (Reid & Soares, 2018; for a review, see Table 1 in Soares & Zitek, 2008).

Recall from Figure 1 that progesterone levels are low during menses and the follicular phase, increase in the luteal phase, and then decrease rapidly before the next menses. This pattern of chronic exposure followed by rapid withdrawal of progesterone is associated with anxiety and alterations to one of the central nervous system's major inhibitory systems, the gamma-aminobutyric acid (GABA) system (Hantsoo & Epperson, 2015). Recall also from Figure 1 that estrogen levels are low during menses and rise gradually during the follicular phase, peaking just before ovulation. Estrogen levels then decrease rapidly after ovulation, rise gradually in the luteal phase, and then decrease rapidly again around the next menses. Estrogen—mostly through an interaction with the serotonergic system—has been shown to have broadly beneficial effects on mood, cognition, appetite, sleep, and behavior (Hantsoo & Epperson, 2015). Low levels of estrogen in the luteal phase are associated with serotonin abnormalities, which can result in the PMDD symptoms of low mood, craving of specific foods, and impaired cognitive performance (Hantsoo & Epperson, 2015).

Emphasizing these patterns in estrogen and progesterone, Rafi and Freeman (2017) suggested that PMDD may be best conceptualized as a disorder of withdrawal caused by mechanisms similar to those demonstrated in substance use withdrawal. They theorized that the intersecting withdrawal from serotonin (caused by an interaction with estrogen) and GABAergic activity (caused by the decline in progesterone) may explain PMDD.

Abnormal response to normal fluctuations of ovarian sex hormones. Research indicates that PMDD is not caused by an excess or deficit in sex hormones (Yonkers & Simoni, 2018); instead, research shows that women with PMDD are more vulnerable than others to *changes* in hormone levels (Schmidt et al., 2017). Schmidt and colleagues examined 22 women prospectively diagnosed with PMDD who were given a gonadotropin-releasing hormone (GnRH) agonist to suppress ovarian activity (including hormone production). After 2-3 months of the GnRH alone, the women whose self-reported PMDD symptoms were in remission ("responders") were selected to continue in the study. Responders continued to receive monthly GnRH for another four months followed by one month of single-blind (participant only) placebo (a patch which they believed to be a hormone patch) and finally, three months of hormone (combined estradiol and progesterone) replacement. Results showed that self- and observer ratings of PMDD symptoms increased significantly during the first month of hormone replacement as compared to the last month of GnRH, the placebo month, and the second and third months of estradiol/progesterone. This suggested that the onset of PMDD is associated with changes from low to high levels of estradiol/progesterone as opposed to any differences in steady-state levels.

Newhouse and Albert (2015) speculated that decreased estradiol may attenuate emotion regulation such that, when levels of estradiol drop, women experience altered reactivity to

negative emotional information which may explain the mood disturbance observed in PMDD. Yen et al. (2018) tested this hypothesis in a sample of 240 university students, 137 of whom met diagnostic criteria for PMDD. For three menstrual cycles, participants were assessed one week before menstruation and then again during the pre-ovulatory follicular phase. The assessments included blood samples (to measure estrogen levels) and questionnaires measuring PMDD symptoms, affective style, depression, anxiety, and perceived stress. Results showed that women with PMDD who had lower levels of estrogen had high anxiety and perceived stress in the premenstrual phase, suggesting that estrogen plays a role in the stress response for women with PMDD but not for those without. Additionally, women with PMDD had more unhealthy emotion regulation qualities in the premenstrual phase than in the follicular phase, though there was no association with estrogen levels. Therefore, in line with Schmidt et al. (2017), the authors concluded that emotion regulation is affected by a decline in estrogen levels but not by differences in steady-state estrogen levels.

Decreased sensitivity of the $GABA_A$ receptor to allopregnanolone (ALLO). Recent research has narrowed in on ALLO and its effect on GABA receptors. ALLO is a neurosteroid metabolized by progesterone and produced by the corpus luteum; circulating levels of ALLO are found in the brain (Raffi & Freeman, 2017). ALLO is also a strong positive modulator of $GABA_A$ receptor with calming and sedative effects similar to those of benzodiazepines and alcohol. ALLO is known to provide relief in times of acute distress (Raffi & Freeman, 2017) and has been implicated in the pathophysiology of mood disorders (Schule et al., 2014). Animal models show that the effects of premenstrual progesterone withdrawal (e.g., anxiety and depression) can be mitigated by preventing the conversion of progesterone into ALLO (Backström et al., 2011). Similarly, in an important randomized controlled trial, Martinez et al.

(2015) showed that blocking the conversion of progesterone to ALLO led to a reduction in several symptoms (irritability, sadness, anxiety, food cravings, and bloating) for women with PMDD. There was no such effect on symptoms for women without PMDD or for women with PMDD who were given a low dose of the ALLO-blocker.

Monteleone et al. (2000) examined basal levels of ALLO and progesterone in the follicular and luteal phases over three months in patients with prospectively diagnosed PMS and a non-PMS control group. They also performed a GnRH challenge test during the luteal phase of the third month to identify any difference in ALLO response. Results showed that, compared to women without PMS, women with PMS had lower basal levels of ALLO and exhibited a lesser ALLO response to GnRH ovarian suppression. Similarly, Timby et al. (2016) demonstrated that women with PMDD had a decreased response to ALLO in the follicular phase as compared to the luteal phase (i.e., women with PMDD exhibited lower levels of ALLO in the luteal phase), whereas the opposite pattern was observed in a control group of women without PMDD. Severity of symptoms, especially anxiety and irritability, may be negatively associated with ALLO levels, such that women with the most severe symptoms have the lowest ALLO levels (Girdler et al., 2001). Research also suggests that a small subset of women react to increases in ALLO (e.g., in the midluteal phase) paradoxically: Instead of experiencing calm and a return to homeostasis, they experience more or worsened mood and anxiety symptoms (Bäckstrom et al., 2014).

It is thus believed that women with PMDD have an altered sensitivity at the ALLO site of the $GABA_A$ receptor and do not experience the expected calming and inhibitory effects in response to stress in the luteal phase (diScalea & Pearlstein, 2017). Indeed, Girdler et al. (2001) showed that, whereas 83% of women without PMDD showed a stress-induced increase in

ALLO, only 42% of women with PMDD showed the same response. It is possible that part of the reason selective serotonin reuptake inhibitors (SSRIs) are effective in treating PMDD is that SSRIs enhance the sensitivity of $GABA_A$ receptors, thus increasing the ALLO response (Raffi & Freeman, 2017).

Neurochemical explanations. Neurotransmitters, or chemical messengers in the brain, have been implicated in the etiology of PMDD, usually in complex connections with other systems and chemicals such as hormones.

Alterations in the serotonergic system. The etiological impact of serotonin on PMDD has been demonstrated by many studies using primarily indirect measures of central serotonin levels and serotonin transmission (diScalea & Pearlstein, 2017). Rapkin et al. (1987) were the first to report whole-blood serotonin abnormalities in women with PMS. Brain imaging studies have since shown associations between PMS symptoms and serotonergic transmission (Eriksson et al., 2006; Jovanovic et al., 2006). Inoue et al. (2007) reported that women with PMDD had the highest levels of serotonergic functioning during the follicular phase and the lowest levels during the luteal phase compared to women with PMS and asymptomatic controls. Low serotonergic function is associated with many of the cognitive-affective symptoms seen in PMDD, such as low mood, food cravings, and decreased cognitive performance (Hantsoo & Epperson, 2015).

Estrogen appears to interact with serotonin to produce the mood symptoms observed in PMDD. Brain imaging studies have found increased serotonin binding with the addition of estrogen and even higher potential for binding with the addition of combined estrogen and progesterone (Amin et al., 2005; Moses-Kolko et al., 2003). As Hantsoo and Epperson (2015, p. 87) summarized: “It is possible that women with PMDD are more sensitive to these effects of estrogens on serotonergic function. Women with PMDD or PMS exhibit specific serotonin (5-

HT) abnormalities that are particularly apparent in the late luteal phase when estrogen levels have declined."

The influence of brain-derived neurotrophic factor (BDNF). BDNF is a Neurotransmitter found throughout the brain; it promotes neuronal growth and survival and is critical for learning and memory (Bathina & Das, 2015). Though research in this area is just beginning, preliminary results suggest that BDNF may play a role in the etiology of PMDD through its link to estrogen (BDNF levels are influenced by estradiol and have been shown to cycle predictably with the menstrual cycle; Carbone & Handa, 2013) and specific gene polymorphisms (Hantsoo & Epperson, 2015). Oral and colleagues (2015) showed that women with PMDD had significantly higher luteal serum BDNF levels than women without PMDD and that BDNF levels were significantly higher in the luteal phase than in the follicular phase among women with PMDD. The authors speculated that higher levels of BDNF in the luteal phase may reflect the brain's attempt to respond to distress and prevent neuronal damage from the depressive and other mood symptoms associated with PMDD.

Genetics. Twin studies find the heritability of PMDD to range from 30-80%, suggesting a genetic component to the disorder (Condon, 1993; Kendler et al., 1992; Kendler et al., 1998; Treloar et al., 2002). Polymorphisms in the human estrogen receptor 1 (ESR-1), also known as human estrogen receptor alpha (ESRα), gene has been implicated in the heritability of PMS/PMDD (Huo et al., 2007). Yen et al. (2018) found negative associations between stress, depression, and estrogen level for those with the G genotype of ESRα, but not for those with the AA genotype, suggesting a potential stratifying effect of ESRα. The human serotonin gene and serotonin transporter genotype have also been considered in the heritability of PMDD, though results are mixed (Raffi & Freeman, 2017).

Neuroanatomical explanations. Neuroimaging studies have shed light on differences in brain structure and function between women with PMDD and women without.

Differences in brain structure. Women with PMDD have evidenced atypical brain structure in brain regions associated with emotional processing. Jeong and colleagues (2012) were the first to employ structural magnetic resonance imaging (MRI) in the study of PMDD; structural MRI allows for comparison of between-group differences in gray matter volume. Gray matter refers to the tissue (composed of neuronal cell bodies, glial cells, synapses, capillaries, and more) found in various brain regions that is said to be involved in information processing; higher gray matter volume (if in the 'right' regions) is generally positive, indicative of higher performance or intellect. Jeong et al. (2012) scanned 15 women with PMDD and 15 women without during the luteal phases of their menstrual cycles, finding that women with PMDD showed lesser gray matter density in the left parahippocampal gyrus and greater gray matter density in the right parahippocampal gyrus. As the parahippocampal gyrus is involved in the formation of emotional memories and detection of emotional stimuli, the authors speculated that the atypical structure in these areas may lead to increased sensitivity to negative emotional stimuli and an exaggerated emotional response in the luteal phase of the menstrual cycle.

Conversely, Berman and colleagues (2013) observed the MRI scans of 12 women with PMDD compared to 13 women without, finding that women with PMDD had greater gray matter volume in the posterior cerebellum, another region involved in emotional processing, as compared to women without. These results suggested that PMDD may be associated with a protection against age-related grey matter loss in this region, and the authors speculated that the apparent protection may result from "effortful mental exercises" that afflicted women must employ to compensate for and emotionally cope with their PMDD symptoms each month (p.

270). Overall, PMDD appears to be associated with atypical volume of gray matter of brain regions known to be involved with emotions.

Differences in brain function. Studies using functional magnetic resonance imaging (fMRI) have found that women with PMDD exhibit an increased emotional response to negative stimuli and a diminished emotional response to positive stimuli during the late luteal (symptomatic) phase of their menstrual cycles (Protopopescu et al., 2008). Gingnell and colleagues (2012) found no difference in luteal phase emotional response between women with and without PMDD, but they did find that trait-level anxiety and progesterone levels seemed to modulate menstrual cycle related reactivity in the amygdala, a key emotion processing center in the brain.

While those studies focused on the amygdala, others have focused on the prefrontal cortex, the uniquely human brain region that is involved in planning, decision-making, inhibition, and other complex cognitive tasks. Atypical functioning of the prefrontal cortex is believed to be a risk factor for PMDD (Hantsoo & Epperson, 2015). Gingnell et al. (2013) showed that, during the luteal phase, women with PMDD exhibited an exaggerated prefrontal cortex reaction when anticipating (but not when exposed to) negative stimuli, which was positively correlated with progesterone level. The authors speculated that this increased reactivity may help explain why women with PMDD frequently report feeling like they lack emotional control. Using two forms of brain imaging technology, fMRI and positron emission tomography (PET), Baller et al. (2013) found that women with PMDD displayed atypical activation in the prefrontal cortex during a working memory task and that levels of activation were positively associated with symptom severity and impairment. Overall, PMDD appears to be associated with abnormalities in brain response, especially to negative emotional stimuli.

Stress. The brain's stress response systems are known as the hypothalamic-pituitary-adrenal (HPA) axis and the hypothalamic-pituitary-gonadal (HPG) axis and these two axes interact with respect to hormones (Mastorakaos et al., 2006). For example, reproductive (HPG axis) hormones, such as testosterone (male) and estrogen (female), modulate the HPA axis response; Estrogen appears to increase serotonin receptor function at presynaptic sites whereas it decreases serotonin receptor expression at postsynaptic sites, which may explain why women display a heightened HPA axis response to stress compared to males. In the reciprocal direction, activation of the stress axes, especially if repeated or chronic, inhibits production of estrogen and testosterone (Mastorakaos et al., 2006). Dysregulation of the HPA and HPG axes is suspected to contribute to PMDD. For example, HPG axis dysregulation is associated with sleep disruption and mood symptoms during menopause, both of which are also common symptoms of PMDD. In addition, one study found that women with PMDD who had high levels of ALLO (HPG-related) had low, or blunted, levels of cortisol (HPA-related) as compared to women without PMDD who had high levels of ALLO (Segebladh et al., 2013).

Indeed, women with PMDD are shown to experience high levels of stress and trauma. Two studies of approximately 3,000 participants each found associations between trauma/abuse and PMS/PMDD (Bertone-Johnson et al., 2014a; Pilver et al., 2011). There are several working explanations for the relationship between PMDD and stress/trauma, both of which refer to ALLO. Recall that, in healthy individuals, ALLO increases in response to stress, triggering calming, sedative effects. However, women with PMDD do not have the same response to ALLO and therefore, do not experience its sedative effects (Hantsoo & Epperson, 2012), which renders them less efficient at responding to and re-stabilizing in times of stress.

Inflammation. A relatively newer area of investigation has considered the role of immune activation and inflammation in PMDD, thus far focusing mostly on menstrual changes in inflammatory markers (e.g., specific proteins and genes that signal inflammation) among women with and without premenstrual disorders (Hantsoo & Epperson, 2015). Given that inflammatory markers are already associated with depressive symptom severity, Bertone-Johnson and colleagues (2014b) examined whether inflammatory markers are also associated with menstrual symptom severity and PMS. A total of 277 reproductive-age women self-reported on menstrual symptoms, lifestyle, diet, and other factors and also provided mid-luteal phase blood samples which were examined for markers of chronic inflammation. Results showed that participants' total menstrual symptom score was positively associated with inflammatory markers and that, women who met criteria for PMS had increased proinflammatory markers as compared to women without PMS.

Psychological correlates

Premenstrual disorders are characterized by cycle-dependent changes in one's psychology—particularly with respect to mood and behaviors. Refer to Table 1 for a summary of the common symptoms observed in PMS and PMDD. Refer also to Table 2 for the DSM-5 diagnostic criteria for PMDD, which require the presence of at least one core mood symptom (of four possible forms) and at least one additional physical or behavioral symptom (of seven possible forms). In addition to the well-defined mood and behavioral symptoms, research has focused on personality and neurocognitive correlates of PMDD.

Personality. Studies of the personality correlates of premenstrual disorders are limited in several ways: (1) They tend to use different measures of personality traits or disorders, making comparison difficult; (2) They are overwhelmingly correlational, rendering causal arguments

moot; and (3) They are predominantly of women with ill-defined variations of "PMS" as opposed to the clinical definition of PMDD, meaning conclusions may not generalize to the PMDD population.

Freeman and colleagues (1995) administered the Tridimensional Personality Questionnaire (TPQ; Cloninger et al., 1991), a now well-validated measure of personality dimensions, to $N = 157$ women who met "clearly defined criteria" for PMS, $N = 20$ age-matched women with major depression and $N = 24$ age-matched women with premenstrual exacerbation of major depression. The three dimensions of the TPQ are harm avoidance (tendency to be cautious, tense, and apprehensive in new situations), novelty-seeking (tendency to be excitable, exploratory, enthusiastic, and impulsive), and reward dependence (tendency to be sensitive and dependent). Women with PMS earned higher TPQ scores on all three dimensions as compared to normative samples and their harm avoidance and novelty seeking scores were modestly correlated with daily premenstrual symptom scores ($r = .19$ for both). However, women with PMS actually scored significantly lower on harm avoidance than did women in either of the two depression groups. The authors concluded that there is little support for the idea that personality pathology is a central underlying feature of premenstrual disorder that distinguishes it from other depressive disorders. Eissa (2010) replicated Freeman et al.'s (1995) finding that women with PMS earned higher scores on the TPQ harm avoidance scale compared to those without PMS, albeit in a much smaller sample ($N = 22$ women with "severe PMS" and $N = 20$ "healthy" controls).

Eissa's (2010) study also found that women with PMS earned higher scores on a scale measuring perfectionism and that this was particularly true for women reporting the highest severity of PMS symptoms:

> High symptom women showed patterns of perfectionism, an emphasis on self-sacrifice and unfavorable comparison of self with others. They reported feeling alone, overwhelmed by unresolved tensions…A major issue for high symptom women was that they struggled to tolerate imperfections, both in their own performance or in their relationships with others. (p. 59)

Berlin and colleagues (2001) used the Personality Diagnostic Questionnaire-Revised (PDQ-R; Johnson & Bornstein, 1991), a broadband measure of personality disorder symptomatology, with $N = 40$ women with PMS and $N = 20$ women with non-menstrual-cycle-related depression. All participants completed the PDQ-R in both the follicular and luteal phases of their menstrual cycles. Results showed a cycle phase effect such that only women with PMS evidenced a significant increase in total score (reflecting overall personality pathology) from the follicular phase to the luteal phase, which the authors interpreted to mean that, for women with PMS, personality dysfunction may occur at both the state and trait levels.

Sassoon and colleagues (2011) used the Structured Interview for DSM-IV Personality Disorders (SID-P; Pfohl et al., 1995) to determine categorical diagnoses of personality disorders in $N = 33$ women with severe PMS and $N = 26$ matched "healthy" controls. Results showed that, in general, women with PMS were more likely to be diagnosed with a personality disorder (27%) than were their healthy peers (0%). Additionally, a sizeable portion of women with PMS (18%) had obsessive-compulsive personality disorder, a finding consistent with earlier studies showing a relationship between obsessive personality traits and PMS symptoms (Critchlow et al., 2001; Eissa, 2010) but inconsistent with rates of comorbidity between the two disorders (which are low, between one and 3 percent). Unlike Berlin et al. (2001), Sassoon and colleagues (2011) did

not find a cycle phase effect; however, participants completed the SCID-IV-PD in *either* the follicular *or* the luteal phase, not in both as Berlin et al. (2001) had done.

Gingnell et al. (2010), in contrast, involved participants with valid DSM-IV diagnoses of PMDD as confirmed by prospective daily ratings for two menstrual cycles. They administered the Swedish universities Scales of Personality (SSP; Schalling et al.,1987) to $N = 30$ women with PMDD and $N = 55$ "healthy" controls, finding that women with PMDD scored significantly higher on neuroticism-related traits, including somatic trait anxiety, psychic trait anxiety, embitterment, trait irritability, mistrust, and detachment compared to the "healthy" controls. These differences were disproportionately accounted for by those with the most severe symptoms (the "high-severity PMDD patients").

More recent research has focused on potential interactions between genetics and personality. For example, a link between the estrogen receptor 1 gene (ESR-1) and the traits neuroticism, emotional stability, abstractedness, impression management, and harm avoidance has also been shown to distinguished patients with PMDD from those without (Miller et al., 2010). Gingnell et al. (2010) compared the genotypes of 27 women with PMDD and 18 "healthy" controls, finding that individuals with PMDD who carried the short allele for 5-HTTLPR (a serotonin transporter gene) earned higher scores on psychic trait anxiety and lack of assertiveness compared to "healthy" controls, suggesting that "genetic vulnerability factors and associated personality traits may, in concert or separately, influence symptom severity in PMDD patients" (p. 422).

Neurocognitive. Women with premenstrual disorders subjectively report problems with cognition during the symptomatic phase of their menstrual cycle (Diener et al., 1992). Indeed, "subjective difficulty in concentration" is listed as one potential symptom in the DSM-5 criteria

for PMDD (APA, 2013). However, studies examining performance on cognitive tasks in women with PMDD have produced conflicting results, finding either no (Morgan & Rapkin, 2002; Rapkin et al., 1989) or only mild impairment (Diener, et al., 1992; Evans et al., 1998; Man et al., 1999; Posthuma et al., 1987; Resnick et al., 1998). Souza and colleagues (2012) reviewed 27 studies that compared neuropsychological performance across the menstrual cycle. They concluded that all women (i.e., with and without premenstrual symptoms) evidence mild impairments in cognitive performance during the luteal phase for visuospatial and motor skills, attention and concentration, verbal memory, visual memory, working memory, and reaction time. However, these changes are more pronounced for women with PMS or PMDD, specifically, on tasks of visuospatial and motor skills, attention and concentration, verbal memory, working memory, reaction time and impulsivity. For a review of neuropsychological impairment in PMDD, see Wiklund (2017).

Working memory. Earlier studies had found that working memory was impaired during the luteal phase for both women with PMDD and "healthy" controls (Man et al., 1999). More recently, Yen et al. (2012) studied a relatively large sample of women with (N = 64) and without (N = 62) PMDD, finding that, on a working memory task, women with PMDD showed a decrease in performance during the luteal phase whereas women without PMDD did not show this decrease. Similarly, Reed and colleagues (2008) engaged women with (N = 14) and without (N = 15) PMDD in cognitive tasks (while also measuring hormone levels and obtaining subjective ratings of mood) and found that women with PMDD performed worse than did women without PMDD on two working memory tasks—digit recognition after a brief delay and word recall after a four-hour delay—during the luteal phase.

Executive functioning. Executive functions, broadly, refer to higher-level mental activities, such as prioritizing, planning, multitasking, switching attention, and inhibiting competing stimuli. Executive functioning is generally measured using neuropsychological tests. Yen et al. (2014) engaged 59 women with PMDD and 74 "healthy" controls in a "Go/NoGo task" intended to measure cognitive control, or the ability to select and prioritize behavior in response to a stimulus while inhibiting competing stimuli, finding that women with PMDD showed decreased cognitive control during the late luteal phase. However, this decrease was only observed in women with a specific genotype (G/G) on the HTP1A gene which is thought to be involved in the inhibition of serotonin neurotransmitter. Bannbers et al. (2012) also engaged women with (N = 13) and without (N = 14) PMDD in a Go/NoGo task during the follicular and luteal phases of their cycle, but they also measured brain activation during the task using fMRI scanning. Results showed no difference in performance on the task, and, therefore, no difference in cognitive control between the two groups, though there was a significant difference in brain activation. Women with PMDD showed a decrease in activation throughout the menstrual cycle (not limited to specific phases) in several brain areas, especially areas within the parietal lobe.

Diagnosis

Diagnostic screening tools. Diagnostic screening tools for PMDD are typically grouped into one of two camps: retrospective or prospective. Research has shown that retrospective PMDD symptom reports can be easily biased by one's beliefs about premenstrual symptoms (Marván & Cortés-Iniestra, 2001; McFarland et al., 1989) and by memory distortions, including, for example, the impact of the context in which the memory is retrieved (Bosman et al., 2016). Moreover, retrospective reports are discrepant from prospective reports: Retrospective reports tend to overestimate symptoms (Haywood et al., 2002) and cases initially diagnosed by

retrospective report are only confirmed by follow-up prospective reports only about one-third of the time (Endicott & Halbreich, 1982; Rubinow et al., 1984). To rectify this issue, a valid diagnosis of PMDD now requires an evaluation of prospective daily symptom ratings for at least two, and preferably more, menstrual cycles (APA, 2013; Eisenlohr-Moul et al., 2017).

Prospective daily rating scales typically require respondents to indicate the presence and/or severity of a myriad of physical and psychological symptoms. In practice, diagnosis is typically made by visual inspection of the rating charts, though due to the complexity of the information and potential for diagnostician error, computerized models have recently been developed (Eisenlohr-Moul et al., 2017). In the research literature, a 30% increase in the severity of the symptom from the follicular phase to the luteal phase is typically required to consider a diagnostic criterion met (e.g., Yen et al., 2018), though others have required changes as high as 50% or 75% (Freeman et al., 2000; Yonkers et al., 1997).

For a recent review of available diagnostic screening tools, including prospective daily rating scales, see Hall and Steiner (2015). For the present purposes, consider, as an example, the Daily Record of Severity of Problems (DRSP; Endicott et al., 2006), the most commonly used prospective measure of premenstrual symptoms (Bosman et al., 2016). The DRSP is a self-report measure that consists of 21 items inquiring about physical and psychological symptoms and three items inquiring about impairment caused by those symptoms. The DRSP items adhere to the DSM-IV definition of PMDD and, to my knowledge, have not been updated to reflect the DSM-5. Respondents indicate “the degree to which you experienced each of the problems” on a six-point severity scale ranging from 1 (*Not at all*) to 6 (*Extreme*). See Figure 3 for an example of one item from the DRSP.

Figure 3

Example item from the Daily Record of Severity of Problems (© 1997, Jean Endicott, Ph.D. and Wilma Harrison, M.D)

DAILY RECORD OF SEVERITY OF PROBLEMS

Please print and use as many sheets as you need for at least two FULL months of ratings.

Name or Initials _____

Month/Year _____

Each evening note the degree to which you experienced each of the problems listed below. Put an "x" in the box which corresponds to the severity: 1 - not at all, 2 - minimal, 3 - mild, 4 - moderate, 5 - severe, 6 - extreme.

Enter day (Monday="M", Thursday="R", etc) >																														
Note spotting by entering "S" >																														
Note menses by entering "M" >																														
Begin rating on correct calendar day >	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1 Felt depressed, sad, "down,", or "blue" or felt hopeless; or felt worthless or guilty	6																													
	5																													
	4																													
	3																													
	2																													
	1																													

Note. This image is reprinted without permission from the freely available DSRP at https://iapmd.org/provider-resources.

In a large sample ($N = 243$) of women who met criteria for PMDD, Endicott et al. (2006) demonstrated high internal consistency for DRSP total and summary (depressive symptoms, physical symptoms, and anger/irritability) scores (Cronbach's alphas ranging from .76 to .95) as well as high test-retest reliability for total score (intraclass correlation coefficients ranging from .73 to .83). The authors found moderate correlations between DRSP total and summary scores and other measures of depressive symptoms (*r*s ranging from .36 to .39), problems of social adjustment (*r*s ranging from .37 to .45), and quality of life (*r*s ranging from -.36 to -.44). With respect to validity, Endicott et al. (2006) found that the individual items and summary scores were sensitive to change with treatment and capable of detecting the differential effects of two treatment modalities. Borenstein et al. (2007) examined whether the DRSP, which is typically

analyzed after one month of ratings, could be made more efficient. They administered the DRSP to $N = 697$ women, more than half of whom continued to complete the record for two full cycles, and then compared DRSP first day (i.e., first day of menses) scores to prospectively confirmed PMS diagnoses. First-day scores were calculated using the sum of all 21 items (standard) or the sum of the highest rated items within each of the 11 scale domains (alternative), finding positive and negative predictive values of 53.8% and 83.4% respectively (standard) and 52.7% and 84.0% respectively (alternative). The authors thus concluded that administering the DRSP on the first day of menses is an acceptable and potentially much more efficient screening method to identify women with PMS or PMDD.

Bosman and colleagues (2016) reviewed 75 studies to assess how prospective symptom rating scales have been used in research on PMDD. They identified several methodological problems inherent in research studies that have used such measures. First, there is little overlap in the choice of measure, which limits the ability to compare results across studies. Second, few studies specified the time of day that reports should be completed, which is problematic given that prior research suggests PMDD symptom severity may vary within a day. Third, most studies looked only at reports during the premenstrual phase, thus eliminating any opportunity to observe within-person processes or other phasic changes. Fourth, there does not appear to be agreement as to which days constitute the premenstrual phase; some authors used the seven days before menses, others the ten days before menses, and still others, the five worst days out of the seven before menses. Bosman et al. (2016) noted that mean symptom severity will be artificially lowered if the chosen period includes days without symptoms. Fifth, most studies have examined between-group differences (i.e., women with PMDD compared to women without PMDD) which

is problematic because group-level differences are difficult to generalize at the individual level (Molenaar, 2004). Truly idiographic approaches are needed.

Even though prospective rating tools are preferred, and several psychometrically valid versions are now available, Eisenlohr-Moul et al. (2017) estimated that approximately 90% of practicing clinicians continue to use retrospective measures. This is not, however, entirely the result of ignorance or sloth: The International Society for Premenstrual Disorders encourages use of retrospective measures to avoid delaying treatment (Hall & Steiner, 2015). Again, consider one example, in this case the most widely used retrospective measure, known as the Premenstrual Symptoms Screening Tool (PSST; Steiner et al., 2003). The PSST is a self-report measure that consists of 19 items inquiring about physical and psychological symptoms and another five items inquiring about functional impairment. Respondents answer, "Do you experience some or any of the following premenstrual symptoms which *start before* your period and *stop* within a few days of bleeding" on a four-point severity scale ranging from *not at all* to *severe*. Like the DRSP, the PSST is based on DSM-IV criteria for PMDD and, to my knowledge, has not been updated to reflect the DSM-5. The psychometric properties of the PSST have been validated (Hall & Steiner, 2015). Ozdel (2014) reported high item internal consistency (Cronbach's alpha = .93), adequate concurrent validity with another measure of psychiatric problems, and the ability to discriminate between groups (PMS versus sub-threshold PMDD versus PMDD).

Differential diagnosis. Perhaps the most common difficulty in distinguishing PMDD from related disorders is the necessity of ruling out premenstrual exacerbation (PME). Many women who have an underlying chronic mood or anxiety disorder experience worsening symptoms during the late luteal phase, which is characteristic of PME but can be easily

misdiagnosed as PMDD (Raffi & Freeman, 2017). Indeed, women themselves often misattribute worsened symptoms as menstrual cycle-related: Research suggests that women who retrospectively report PMS or PMDD symptoms but for whom those symptoms are not confirmed by prospective daily report are likely to suffer from a chronic underlying depressive disorder, such as MDD, which they misperceive as related to their menstrual cycle (Yonkers & McCunn, 2007). Gynecological and other medical conditions must also be ruled out in the differential diagnosis of PMDD, including dysmenorrhea, menopausal transition, endocrinological diseases (e.g., hypo- or hyperthyroidism), and hormonal treatments (e.g., use of some hormonal contraceptives) (Sánchez Blanco et al., 2017).

Treatment

Pharmacological.

Antidepressants. According to the American College of Obstetrics and Gynecology (ACOG; 2001), pharmacological treatments are considered first line for PMDD, with selective serotonin reuptake inhibitors, or SSRIs, considered the "gold-standard" (Hantsoo & Epperson, 2015). A 2013 systematic review of 31 randomized controlled trials comparing SSRIs to placebo for a total of $N = 4372$ women diagnosed with "clinical PMS" concluded that SSRIs are effective for reducing symptoms of PMS overall (Marjoribanks et al., 2013). However, effect sizes have generally been small to moderate (Cohen's *d*s ranging from .29 to .58; Kleinstäuber et al., 2012) with response rates ranging from 12 to 50% after accounting for placebo effects (Halbreich, 2008). Halbreich (2008) thus concluded that "it should be acknowledged that, even though SSRIs are efficacious as treatment in many women with PMDD, this is still not sufficient" (p. 572).

Results are mixed as to whether continuous (medication administered across the entire cycle) or intermittent (medication administered in only the luteal phase) dosing is more effective (di Scalea & Pearlstein, 2017). Typically, when SSRIs are prescribed to treat mood-related conditions, intermittent dosing is not possible because the therapeutic effects of the medication take weeks to appear. In PMDD, SSRIs have been shown to have a much faster therapeutic effect on the order of days or even hours (Landén & Thase, 2006; Steinberg et al., 2012). This difference is apparently due to SSRIs ability to increase metabolization of progesterone into ALLO (Hantsoo & Epperson, 2015). Landén and colleagues (2007) showed that intermittent dosing may be particularly helpful for treating irritability and mood lability, though longer-term treatment appears to be required to treat depression and physical symptoms.

Oral contraceptives. Given the relationship between PMDD symptoms and ovulatory processes, clinicians have long prescribed oral contraceptives as treatment for PMDD albeit with little research support to substantiate that choice (di Scalea & Pearlstein, 2017). To date, there is scant research support for the use of oral contraceptives in treating PMDD (Cunningham, Yonkers et al., 2009). A systematic review concluded that treating PMDD with single hormones (e.g., progesterone or estrogen) is not effective (Ford et al., 2012), though the oral contraceptive Yasmin ("Yas" or "Yaz") has shown promising results and was approved by the FDA as a treatment for PMDD in 2006 (di Scalea & Pearlstein, 2017). Yaz contains drospinerone, a synthetic form of progesterone, and estradiol, and was shown to perform better than placebo in reducing PMDD symptoms and improving quality of life (di Scalea & Pearlstein, 2017; Pearlstein et al., 2005; Yonkers et al., 2005).

Ovulation-suppressants. The administration of gonadotropin releasing hormone (GnRH) agonists suppresses ovulation and, with it, the secretion of ovulatory hormones, thus inducing

postmenopausal levels of estradiol, progesterone, and ALLO (di Scalea & Pearlstein, 2017; Hantsoo & Epperson, 2015). There is some research support for the use of GnRH agonists as compared to placebo (Wyatt et al., 2004) and this method is often recommended after women have not experienced relief following a trial of SSRI treatment (Hantsoo & Epperson, 2015). However, ovarian suppression also leads to the sudden onset of menopausal symptoms and, therefore, hormone replacement, or "add-back," therapy is often needed (Reid & Soares, 2018).Ovulation can also be suppressed through administration of estrogen (in gel, patch, or implant form), which is more common in Europe, or, as a last-resort, by oophorectomy (surgical removal of the ovaries) or hysterectomy (surgical removal of the uterus) (di Scalea & Pearlstein, 2017; Reid & Soares, 2018). Reid and Soares (2018) noted that surgical treatment is usually preferred by women who have attempted other forms of treatment without avail, who are burdened by the cost of continued medical procedures, and who have other gynecological concerns for which surgery may be beneficial.

Psychotherapeutic.

Cognitive behavioral therapy (CBT). CBT is the most studied psychotherapeutic intervention for PMDD, though findings are of mostly small effects (di Scalea & Pearlstein, 2017; Hantsoo & Epperson, 2015). Lustyk and colleagues (2009) reviewed seven trials of CBT, including five randomized controlled trials, and concluded that "it is clear that the cognitively focused therapies do not outperform pharmacotherapy, and, in some instances, they do not outperform forms of basic behavioral intervention alone (e.g., relaxation)" (pp. 94-95). However, compared to pharmacotherapy, CBT has been found to be uniquely helpful in altering negative thoughts and increasing one's ability to cope with the distress associated with PMDD (Reid & Soares, 2018). For instance, a 2012 systematic review concluded that CBT was not more

effective than SSRIs in treating anxiety symptoms but was associated with better use of coping skills and a shift in understanding of symptoms (Kleinstäuber et al., 2012).

Lifestyle modification. According to ACOG (2001), lifestyle modification may be appropriate for those with mild PMS but is not recommended as the primary treatment for individuals with PMDD. Exercise may help alleviate premenstrual symptoms, though studies are rare and have yet to evaluate efficacy in women with prospectively diagnosed PMS or PMDD (Daley, 2009). Dietary changes may also be beneficial, and common recommendations include decreased caffeine, frequent snacks or meals, reduction of sugar intake, and an increase in complex carbohydrate consumption (di Scalea & Pearlstein, 2017). Freeman, Stout, Endicott, and Spiers (2002) showed that consumption of a carbohydrate-rich beverage led to a reduction in symptoms for approximately 30% of women (compared to 5% of women consuming a placebo beverage) likely by increasing the availability of tryptophan which increases serotonin production and, in so doing, improves mood. Calcium supplementation has demonstrated small benefits, not superior to SSRIs but better than placebo (Yonkers et al., 2013).

Prognosis

Symptoms of PMDD can begin any time after menarche and occur only during her reproductive years, thus ceasing after menopause. Symptoms tend to be chronic and stable across cycles; that is, women with PMDD typically experience the same, severe symptoms with each menstrual cycle, and this stability appears to be especially true for mood symptoms (Bloch et al., 1997; Wittchen et al., 2002). According to Landén and Eriksson (2003), clinicians commonly believe that symptoms worsen with age until menopause; however, Ramcharan and colleagues (1991) reported that, in a large ($N = 6232$) population-based sample, PMS symptoms appeared to

be the most severe among women in their twenties to mid-thirties and actually tended to improve as women approached menopause.

Exactly what percentage of women with PMDD receive treatment is not known, but Freeman (2003) reported that, on average, women notice symptoms for approximately 10 years before seeking treatment. Pearlstein et al. (2000) and Yonkers et al. (1996) found that women who seek treatment for PMDD tend to be those who experience impairments in functioning and social adjustment. Robinson and Swindle (2004) extended that finding in a large ($N = 1022$) nationally representative sample of reproductive-age women, showing that treatment-seeking for PMS was associated with symptom severity, symptom chronicity, older age, greater overall use of healthcare services, and less negative attitudes towards PMS.

Impact

In an important 2009 paper, Rapkin and Winer reported on PMDD's burden of illness and impact on quality of life. They assessed burden of illness in the standard way by examining direct medical costs, occupational productivity, and quality of life. Summarizing across several studies, the authors reported that women with PMDD experience adverse effects on their schoolwork, emotional well-being, social life, and work activity. They cited a large ($N = 1045$ general population women) cross-sectional study that found the greatest premenstrual-related impairment was experienced in the home followed by social situations, school and the workplace (Hylan et al., 1999). In addition, Rapkin and Winer (2009) found that a diagnosis of PMS or PMDD was associated with greater utilization of healthcare services, a relationship that strengthened as symptom severity increased.

Quantitative data on work-related impairments due to PMDD are mixed; some studies report significant rates of work absenteeism whereas others do not. More consistently, PMDD

symptomatic phases are related to lower quality and efficiency of work. Qualitative interview studies of PMS and PMDD have helped clarify the impact of the disorder on a woman's work life. Jurvanen's (2017) thesis is a classic example: 11 women with PMDD were interviewed according to a "phenomenological approach," which the author described as an attempt "to overlook her [the researcher's] preunderstanding (assumptions) and instead try to see the world through the participant [sic] perspective" (p. 14). The author interviewed each woman independently following an "interview guide" that was provided to the participants during the interview and was arranged into four topic areas with potential subtopics and questions. For example, topic area two was titled "Work related – subjective experiences about PMDD in relation to working," which included the bulleted section "Demands (psychological experience)" and the potential questions "What is expected of you?" and "How do you cope?" (p. 51). The interviews were transcribed verbatim, read several times, summarized, and then analyzed for patterns, or "themes," according to Braun and Clarke's (2006) guidelines for thematic analysis.

The final product, according to Jurvanen, was a "map of themes that accurately correlated with the full data, meaning that the essence of participant's experiences were [sic] represented and the plan gave a good summarizing overview" (p. 19). Interviewees reported that their work quality is lower and that they socially isolate or otherwise struggle in work relationships when they are symptomatic; the vast majority indicated that they can continue to work despite these difficulties, but perhaps at some psychological cost; many reported that they have required sick leave or changes in their schedule to accommodate symptoms. Also using a semi-structured interview approach, Hardy and Hardie (2017) arrived at similar conclusions. In their sample of 15 women with PMDD, respondents indicated that symptoms interfered with their work (specifically, difficulty concentrating, self-doubt, paranoia, fatigue, tearfulness, a heightened

sensitivity to the environment and people, outbursts, and finding social interaction difficult), and that those symptoms led to greater absences and lesser quality of work. Notably, Hardy and Hardie (2017) also found that, after symptoms improved, many women felt significant guilt for the premenstrual changes in their work behavior and would subsequently attempt to overcompensate by working longer hours, taking work home, or doing extra work, all of which contributed to negative long-term outcomes including leaving their jobs.

The social impact of PMDD is also well-documented by qualitative interview studies (Jurvanen, 2017; Siahbazi et al., 2018). Women report increased relationship conflict, difficulty managing social interaction, increased social isolation, and lack of emotional experience, all of which have a negative impact on their significant relationships. Women with romantic partners expressed distress about decreased sexual desire and reduced sexual pleasure; parents reported feeling inadequate in their roles, for example stating things like "Even in the morning, it's hard for me to wake up and handle family members. I hardly prepare my child to go to school" (Siahbazi et al., 2018, p. 289). Yet, women also frequently endorse the need for social support and connection during symptomatic phases (Jurvanen, 2017).

Critique of Methods for Exploring Premenstrual-related Inner Experience

Premenstrual symptoms are understood to be inner experiences—private to the external observer but directly appended by the woman herself. For example, whereas the external observer may notice a sullen look or slow speech (both potential signs of depression), only the woman herself *experiences* "depressed mood." At present, what we know about the inner experiential world of PMDD comes mostly from questionnaires, diary-type studies—the repeated, daily administration of questionnaires or symptom rating scales—and, to a lesser extent, from single-occasion semi-structured interviews guided by broad interests and questions.

Such methods have important limitations, some of which were mentioned before, and which will be elaborated in this section.

First, questionnaires typically require substantial retrospection. For example, the cycle version of the Moos Menstrual Distress Questionnaire (MDQ; Moos, 1968) and the Premenstrual Assessment Form (PAF: Allen et al., 1991) ask respondents to rate the presence of symptoms "during your last cycle" (therefore, requiring them to retrospect over approximately an entire month). The Premenstrual Symptoms Screening Tool (PSST: Steiner et al., 2003) does not specify a time frame or specific menstrual cycle, but rather implies that respondents are to report on their menstrual cycles in general (therefore, requiring them to retrospect and summarize over, potentially, several months or years).

The diary-type administration of questionnaires or symptom rating scales (for example, the DRSP; Endicott et al., 2006) limit the amount of retrospection required. For example, the DRSP asks respondents "each evening" to rate the severity of a list of possible symptoms (recall Figure 3), therefore requiring them to retrospect over, potentially, an entire day. The memory errors (Tourangeau, 2000) and biases (Tversky & Khaneman, 1974) associated with retrospection are well-known, including, specific to the PMS/PMDD population, a tendency for over-reporting (Endicott & Halbreich, 1982).

Second, prior research has shown that, on questionnaires and rating scales, women tend to misattribute symptoms to their menstrual cycle based on self-theories of menstruation. In an important early study in this area, Ruble (1977) deceptively informed $N = 44$ college-aged women that the researchers could predict whether they were in the premenstrual phase of their cycle using electroencephalography (EEG). Each participant underwent an EEG simulation, after which she was told that she was either "premenstrual" (expected to begin her period within 1 or

2 days) or "intermenstrual" (not expected to begin her period for at least one week to 10 days). Fifteen women were also assigned to a control group and were not given any information about their menstrual cycles. Immediately after learning this information, all participants completed the MDQ (Moos, 1968) which asked them to rate the severity of 48 symptoms they may have experienced over the last two days. Results showed that women who were led to believe they were in the premenstrual phase earned significantly higher symptom scores than did women in the "intermenstrual" or control groups, suggesting that symptom reporting is influenced by the cycle phase a woman perceives herself to be in, regardless of the actual phase of her cycle (Veeninga & Kraaimaat, 1995).

McFarland et al. (1989) showed that the more a woman believed in the phenomenon of menstrual distress, the more she reported, in recall, the negativity of symptoms during her last cycle. Similarly, Marván and Cortes-Iniestra (2001) showed that the more prevalent a woman believed premenstrual syndrome to be, the more premenstrual changes she recalled in her own cycles. Veeninga and Kraaimaat (1995) examined the ways women with and without premenstrual symptom histories explained their physical and psychological complaints across two (cycles) months. They found that women with a history of PMS reported significantly more physical and psychological symptoms than did those without PMS, both during the premenstrual phase and during the intermenstrual (traditionally non-symptomatic) phase. And while women with PMS were, indeed, more likely to attribute their complaints to the menstrual cycle, they also more commonly used non-medical explanations, such as psychological distress, physical exertion, and even the weather.

Third, both questionnaires/rating scales and qualitative interviews rely on pre-determined questions and prompts that bias the responses in favor of existing cultural and scientific theories

and unnecessarily constrain the phenomena that can be explored. Rating scales are typically aligned with diagnostic criteria, which makes them useful for establishing diagnosis, but may also lead respondents to overreport symptoms they do not truly experience (but that are listed on the form) and entirely neglect other symptoms they do truly experience (but that are not listed on the form). Attempting to overcome the confinement of questionnaires/rating scales and to consider the experience of PMS/PMDD in terms beyond merely symptomatology, some have turned to qualitative interview approaches. For example, Siahbazi and colleagues (2018) conducted semi-structured interviews with 21 high school and college-aged Iranian women. Their goal was to assess the effects of PMS on women's quality of life and, to that end, each interview began with the question, "What has been premenstrual syndrome's effect on your quality of life?" This question appears to be open-ended, though closer examination shows that both the beginning and end of the question are specified: The beginning specifies that the interviewer presumes a connection between premenstrual syndrome and quality of life. Questions that are both open-ended and open-beginninged are needed. An open-*ended* prompt (such as those used in qualitative interviews) is of the form: "I am interested in X; tell me about how *X* is included in your experience." An open-*beginninged* prompt is of the form: "I am interested in your experience, whatever that experience might be (including nothing); tell me about your experience in as complete details as possible" (Hurlburt & Heavey, 2006a).

Fourth, most questionnaire and interview prompts (including "premenstrual syndrome" and "quality of life" in the example before; Sizbazhi et al., 2018) are ambiguous, referring to constructs that are typically not adequately defined for participants and therefore, are likely interpreted in disparate ways. The failure to clarify prompt language implies that constructs such as "quality of life" are believed to be easily identifiable and universally understood experiential

phenomena. However, there is no reason to believe that people could reliably say, *Aha, yes, now I am experiencing "quality of life = 7."* One cannot directly apprehend one's own "quality of life"; instead, an impression of quality of life is undoubtedly derived from some combination of directly apprehended experiences, heuristics, self-presentation and other biases, self-theories, cultural and scientific theories, and so on. On questionnaires and rating scales, not only is the content of a question ambiguous, but the response options are also often ambiguous, typically asking participants to rate potential symptoms on a range of severity. For example, the PSST (Steiner et al., 2003) asks respondents to rate the severity of symptoms during the premenstrual phase as either *not at all*, *mild*, *moderate*, or *severe*. The authors do not define any of these response options; thus, respondents are left to make their own judgments of what qualifies as, for example, *mild*, or how much more distress must be present for a symptom to be rated as *severe* as opposed to *moderate*.

Despite their limitations, it is from these commonly used methods that science has derived its understanding of the everyday lived inner experience of women with PMDD. Hurlburt (2011; Hurlburt & Akhter, 2006) has called everyday lived inner experience "pristine inner experience"—the thoughts, feelings, images, sensations, and so on that are directly apprehended ("before the footlights of consciousness"), undisturbed by experimentation, manipulation, or reflection. Commonly used methods seem on their face to inquire about pristine inner experience. For example, if women with PMDD report frequent and severe irritability on symptom rating scales, we assume they must *feel* highly irritable in their direct inner experience much of the time. However, as we have seen, such methods are inadequate for exploring pristine inner experience because they invite the influence of presuppositions (assumptions, worldviews, self-theories, self-presentations biases, and other heuristics that skew, suppress, or exaggerate

observations; Hurlburt, 2011) about inner experience. Hurlburt and Heavey (2015) argued that, unless methods make systematic efforts to "bracket" (limit the influence of) presuppositions, results will reflect some "ill-defined mixture of presuppositions, judgments about experience, and pristine experience itself" (p. 148). Descriptive Experience Sampling is one result of the sincere effort to bracket the influence of presuppositions.

Descriptive Experience Sampling

Descriptive experience sampling (DES; Hurlburt, 1990, 1993, 2011; & Heavey, 2006a) is a method that aims at exploring pristine inner experience with fidelity. DES was originated by Hurlburt in the 1970s after he created the beeper that made what is today known as "experience sampling" (then, "thought sampling," or "random sampling of cognitions," Hurlburt, 1979) possible. In DES, participants are given a random-interval beeper (shown in Figure 4) and asked to wear the beeper for approximately three hours while going about their everyday activities. The beeper emits a 700 Hz tone at random intervals (average = 30 minutes, minimum = a few seconds, maximum = one hour). Therefore, three or four hours is typically long enough to collect approximately half-a-dozen "beeped" experience samples. When the beeper sounds, participants' sole task is to attend to whatever was ongoing in their inner experience at the "microsecond just before your awareness was disturbed by the beep" (Hurlburt & Heavey, 2006a, p. 84), that is, to apprehend that which was "caught in flight" by the beep (Hurlburt & Heavey, 2006a, p. 15). They are instructed to immediately jot down notes about the experience in a small notebook provided to them; these notes will serve as memory aids in later interviews.

Figure 4

The standard DES beeper ("v.3.x Random Interval Generator")

Note. Re-printed with permission from hurlburt.faculty.unlv.edu/beeper.html.

Within 24 hours of collecting a half-dozen or so sampled experiences, participants meet with a team of DES investigators (at least 2, usually more) for an in-person "expositional interview," during which all parties work together to understand and describe each beeped experience. The interview is always guided by some form of the question, "What, if anything, was ongoing in your experience at the moment the beep interrupted you?" (Hurlburt & Heavey, 2006, p. viii) with disambiguating follow-up questions. Expositional interviews are videotaped for investigator training and/or to review and discuss differences in understanding. Within 24 hours of each expositional interview, the investigators collaboratively complete written descriptions of each beeped experience. Consensus is not the object; all descriptions are circulated among investigators for tracked-changes editing and commentary and are left "messy" with disagreements/differences in understandings explicitly noted (Hurlburt, 2017).

Participants repeat this natural-environment-sampling-followed-by-expositional-interview process several times (usually at least four, sometimes dozens), each time iteratively building skill through "on-the-job" training (Hurlburt, 2017). DES finds that iteration is absolutely essential, allowing for participant and investigators to confront their potentially disparate understandings of what is meant by pristine inner experience and the specificity of "the moment of the beep" as well as clarifying language for describing inner experiences, for which, by their private nature, there is no common language (Heavey et al., 2010). Iterative interviews also allow for opportunities to identify and practice bracketing presuppositions for both participant and investigator.

Ultimately, the DES procedure results in a collection of randomly sampled moments of one's naturally occurring inner experience and from this, a "sketch" of characteristics of his or her inner experience can be created. Some DES studies engage several individuals who belong to some group (e.g., individuals with the same psychiatric diagnosis) and, after following the typical DES procedure for each participant, compare those several or many characterizations to identify experiential characteristics that emerge as highly salient for the group as a whole or for some subset of individuals. When it seems virtuous, DES beeps can be coded for the presence of experiential phenomena and those codings can be used to derive estimates of frequency in the standard way (total number of samples containing the phenomena ÷ total number of samples) within individuals or across a group of individuals.

Throughout the characterization process, DES investigators remind each other that the experiences themselves are the meaningful data—not the interviews, the written descriptions, the coding of the descriptions, or anything else—and that the goal of any characterization is to bring to life these individual experiences in all their rich detail (or lack thereof), and, often, messiness.

Thus, wherever the characterization process involves some reduction (e.g., coding), investigators explicitly resist the temptation to ascribe more meaning to those reduced categories than is given to the individual experiences themselves.

Distinguishing Features

DES is distinguished from questionnaire and interview-based methods in that it maximizes ecological validity (by sampling experience in one's natural environment) and minimizes retrospection (by asking participants to describe, only, the experience ongoing at the last undisturbed moment before the beep). Other experience sampling methods, such as ecological momentary assessment (EMA; Stone & Shiffman, 1994) and the experience sampling method (ESM; Csikszentmihalyi & Larson, 1987), also seek to maximize ecological validity and minimize retrospection by randomly or quasi-randomly cuing participants to respond to questionnaire-like items multiple times throughout a day. These can be called "questionnaire-based experience sampling methods" (Hurlburt et al., in press).

However, whereas questionnaire-based experience sampling methods typically provide one-shot instructions and training specific to compliance (i.e., monitoring and providing feedback on whether participants complete the prompts when they are cued to do so), DES provides repeated training (through expositional interviews) that is iterative, in-person, and confrontational (in the front-to-front etymological essence, not negative but actually supportive; Hurlburt, 2011). Additionally, whereas interviews and questionnaire-based studies rely on pre-determined prompts (and, usually, hypotheses), DES has no pre-determined interest beyond experience itself and therefore asks the "open-beginninged" question, "What, if anything, was ongoing in your experience at the moment the beep interrupted you?" (Hurlburt & Heavey, 2006a, p. viii). Additionally, whereas the questionnaires used in questionnaire-based (including

experience sampling) studies are developed and validated for groups of people, DES is truly idiographic in that its fundamental purpose is to describe one person's experience one randomly selected moment at a time. This is especially salient to the present study given feminist critiques of the PMDD literature; a truly idiographic approach like DES aims at one woman's experience, as she experienced it, in her own words, with explicit efforts to set aside biological, psychological, and sociocultural ideas or theories that may influence her experience or descriptions of experience. Though the present study's participants will know they are taking part in a study of women with premenstrual symptoms, DES investigators will emphasize repeatedly that the interest is in their experience one randomly selected microsecond at a time—regardless of whether that experience has any connection to the menstrual cycle.

Perhaps most importantly, DES makes substantial principled efforts to bracket presuppositions. Recall that presuppositions are assumptions, worldviews, self-theories, self-presentations biases, and other heuristics that skew, suppress, or exaggerate apprehensions of experience (Hurlburt, 2011). A presupposition is, therefore, a blind spot—a taken-for granted "notion about the world that is so fundamental that it exists prior to critical examination" (Hurlburt & Heavey, 2006a, p. 151). A presupposition is more than just a mistaken preconception; it's a mistaken presupposition bolstered by unquestioned and powerful assumptions (Hurlburt & Schwitzgebel, 2011a), and is therefore difficult to escape from and highly likely to influence what one reports. Presuppositions about experience are rampant within individuals (e.g., "I'm a verbal person who mostly thinks in words") and within psychology (e.g., "Human beings talk to themselves every moment of the waking day"; Baars, 2003, p. 106).

Hurlburt (2011; Hurlburt & Schwitzgebel, 2007, 2011a, p. 225) has argued that presuppositions must be actively battled, that it is possible for "the bracketing skill" to

overpower the "presupposition skill" within an individual at least so that experience can be described with some fidelity in its pristine state. There is no single act or procedure that could be called "bracketing presuppositions"; rather, it is a spirit that infuses the entire DES process, from the instructions to the participant to the random sampling to the open-beginning prompts to the final pen stroke characterizing the experience. Hurlburt (2011) discusses a hundred "constraints" inherent in the exploration of inner experience, most if not all of which can be thought of as aiming at bracketing presuppositions.

Consider the self-characterization presupposition mentioned before: "I'm a verbal person." DES attempts to bracket such presuppositions, sometimes explicitly: for example, when a participant says in an expositional interview something like, "I was saying to myself, 'Don't go there.' That's how I pretty much always think—I talk to myself a lot," DES investigators will respond with something like, "We accept that you may talk to yourself a lot. But we don't know that yet, so let's set that self-theory aside for now and focus on *this* experience, regardless of how you usually are. If you do, in fact, talk to yourself frequently, then we will find many examples of self-talk over several days of sampling. But sometimes people are surprised to find that their experience is quite different from how they thought prior to DES sampling, and we want to be open to that possibility, too." In other ways, the bracketing of participant's presuppositions is more implicit: For example, randomly selecting moments of experience prevents participant's from wittingly or unwittingly choosing moments that they think would be the most interesting or avoiding moments that they think would be difficult or boring (both forms of self-presentation bias).

DES investigators, too, have presuppositions. Sometimes those are addressed explicitly, such as through discussing the value of presuppositions (so that that valuing is kept front and

center) and encouraging disagreement among investigators (so that presuppositions can be questioned and exposed). Sometimes they are addressed more implicitly, such as through including multiple investigators (so that one investigator's individual presuppositions might be balanced by another investigator's).

Decades of DES research have concluded that people are often mistaken (sometimes dramatically so) about the characteristics of their inner experience and are often surprised to find that their experience as captured by DES is barely (or not at all) reflective of their pre-sampling presuppositional views of their experience (Hurlburt, 2011; Hurlburt et al., in press). Hurlburt and Heavey (2015) argued that what people report on questionnaires and in questionnaire-based experience sampling is likely littered with, if not totally composed of, one's presuppositions. If that is true, it may explain the huge discrepancies between what DES and other methods find about inner experience: For example, Hurlburt et al. (in press) showed that questionnaire-based methods produced dramatically higher (from two to four times as high) frequencies of experiential phenomena than were discovered by DES with correlations between questionnaire reports and sampling frequencies were near zero. Those discrepancies raise several questions which future research should address. Whose estimates are accurate: DES or questionnaire-based methods? If DES estimates are accurate, is it, as DES proponents have argued, the result of the bracketing of presuppositions? And is the tremendous time and skill required to bracket presuppositions worth it for psychological science?

Phenomena

By comparison to retrospective questionnaires (which are typically interested in impressions of psychological constructs), DES is fundamentally interested in directly apprehendable phenomena of inner experience. To that end, investigators have described in

detail phenomena that commonly emerge across DES studies. For example, Hurlburt et al. (2013) described inner speaking (a.k.a. inner speech); Heavey et al. (2017) described feelings (the experience of emotion); Hurlburt et al. (2009) described sensory awareness (attending to a particular sensory aspect of the internal or external environment without particular regard for instrumentality); and Hurlburt and Akhter (2008) described unsymbolized thinking (the direct experience of thinking without words, images, or other symbols). Together with inner seeing (a.k.a. visual/mental imagery), these phenomena have been dubbed the "five frequent phenomena" of inner experience, or the "5FP" (Kühn et al., 2014). McKelvie (2019) observed that what DES calls sensory awareness, feeling, inner seeing, and unsymbolized thinking seem to respectively resemble theoretical elements identified by the classical introspectionists: sensations, feelings, images, and imageless thought.

To examine if and how frequent the 5FP "truly" are, Heavey and Hurlburt (2008) engaged $N = 30$ college students (stratified by self-reported level of psychological distress) in three days each of DES sampling according to the typical procedure. This resulted in a total of 295 experience samples (approximately 10 samples per participant after discarding the first day samples as is typical), which were then coded for the presence of the 5FP. Results showed that each of the 5FP occurred in approximately one-quarter of experience samples in this stratified college student sample. To establish concurrent validity of the 5FP, Kühn et al. (2014) presented the case study of one woman trained in DES and then scanned by functional magnetic resonance imaging (fMRI) while intentionally or naturally innerly speaking. Results showed that the participant's inner speaking (intentional or natural) was reliably associated with activation in brain areas known to be involved in speech processing.

It can be useful to code experience samples for the presence of certain phenomena, usually including, because they are so frequent, the 5FP. Codings for the 5FP have been shown to be reliable: When two independent raters each coded 60 samples (6 each from $N = 10$ participants), Hurlburt and Heavey (2002) reported a median Spearman-Brown estimate of interrater reliability as 0.98; Across three studies, when five raters each coded a subset of $N =$ 997 total samples, Hurlburt et al. (in press) reported an average Spearman-brown split-half reliability of .95. Hurlburt et al. (in press) thus concluded, "whatever DES measures, it does so reliably" (p. 38).

Adequacy

The adequacy of DES has been discussed at length, including in a special issue of the *Journal of Consciousness Studies* (Weisberg, 2011) and through back-and-forth dialogue with a "skeptic" of first-person methods (Hurlburt & Schwitzgebel, 2007) and a literary scholar (Caracciolo & Hurlburt, 2016). Mostly, DES, which is considered a form of introspection ("looking into our own minds and reporting what we there discover"; Boring, 1953, p. 170), has been pitted against other introspective methods. In Hurlburt and Schwitzgebel (2011b), Hurlburt responded to a series of criticisms of the DES method and argued that DES need not be considered the epistemic tribunal against which other methods should be judged, but that DES takes seriously constraints inherent in introspection that consciousness science has largely ignored. For example, most introspective methods ask participants to simulate a specific experience (e.g., "Form a visual image of some familiar object, such as the front of your house"; Schwitzgebel, 2002, p. 38); Hurlburt argued that such simulated phenomena (in this case, inner seeing, or imagery) may be importantly different from the same phenomena as they occur pristinely (due, for example, to the social pressures of the investigator's asking) and that an

open-beginninged approach (such as DES) is therefore better-able to capture pristine inner experience (Kühn et al., 2014). More recently, McKelvie (2019) favorably compared DES to "classical introspection" (training participants to report the contents of their ongoing awareness; p. 1) based on six criteria: function, training, terminology, reliability, validity, and disputes.

Prior studies

DES has been undertaken with clinical populations, including individuals with depression, anxiety, posttraumatic stress disorder (PTSD), obsessive-compulsive disorder (OCD), schizophrenia, borderline personality disorder, bulimia nervosa, and more. Some of these studies have uncovered phenomena that—despite being highly salient across participants—are completely unknown or poorly described in the clinical literature. For instance, across several studies (N = 24 total) of women with bulimia, Hurlburt and colleagues (Jones-Forrester & Hurlburt, 2011; Doucette & Hurlburt, 1993a,b) reported that the inner experience of bulimia is overwhelmingly (60% of the time on average, ranging from one-third of the time to nearly all the time; Krumm, Jones-Forrester, & Hurlburt, 2019) characterized by fragmented multiplicity—the experience of several or many (10 or more) separate, disjointed phenomena occurring simultaneously. Fragmented multiplicity is rare among non-clinical participants (Heavey & Hurlburt, 2008) and therefore appears to be a hallmark experiential characteristic of bulimia.

No DES study has systematically examined individuals across a biological process, but prior studies have included individuals with cyclical disorders. For example, Hurlburt (1993) presented four case studies of individuals who experienced distinct mood periods such as normalcy punctuated by periods of depression or a cycling between high-energy euphoria and fatigue. Hurlburt (1993) made five observations which, though speculative due to the small sample size, could be generalized to all four participants. First, symbolization of experience (i.e.,

the presence of words and images) decreased as depression increased. Second, inner perceptual clarity (e.g., the color and detail of imagery) decreased as depression increased. Third, depressed participants had difficulty discriminating an actual perceptual experience (e.g., innerly seeing something) from metaphors or conceptual descriptions (e.g., that use visual language but do not refer to an actual inner seeing). Fourth, some depressed participants seemed to have distinctly different mental states associated with different kinds of thoughts; that is, the experiential *process* (not only the experience) was not constant. Fifth, as participants became more depressed, they reported more frequent feelings (emotions present in awareness) and fewer emotional processes ongoing outside of awareness (which were common during non-depressed periods).

A review of "John," one of Hurlburt's (1993) case study participants, will help illustrate the first two observations. John was a 27-year-old university student at the time of his DES sampling. John's baseline, typical functioning was labeled "slightly hypomanic," where "hypomanic" reflects the clinical definition: a distinct and continuous period of elevated mood and increased energy lasting less than one week (APA, 2013). According to John, he generally had a great deal of energy, needed little sleep (between three and five hours each night), and was highly goal-oriented, jumping from one activity to the next. John's high energy was obvious to the DES investigators as well. According to John, this slightly hypomanic state was persistent but punctuated by occasional, brief (a day or so) periods of "fatigue." John wore the DES beeper for four days during his typical, slightly hypomanic, functioning, and collected a total of 42 experience samples.

John's experience during the slightly hypomanic period was marked by near constant (95% of those samples) inner seeings that were clear, vivid, colored, richly detailed, and usually

in motion. For example, at beep 16 (square brackets separate context and background information from direct experience):

> [John was remembering a pigeon he had watched die earlier that day. John had picked up the bird to soothe it and, noticing that it did not respond, put the bird on the floor of his car to take to a zoological park. On the way to the park, the bird flapped its wings vigorously, its eyes became beet red, and it then fell over backwards, dead.] Now, at the moment of beep 16, John was innerly seeing the dying bird flapping its wings, exactly as he had seen it earlier, viewed from the above left, that is, from the same perspective he had seen it in the original incident while driving with the bird on the passenger-side floor. Simultaneously, he was feeling a little sad, a bodily feeling that centered around his chest area. (Hurlburt, 1993, p. 31)

Of the four case study participants, John was the most euphoric/least depressed and his experience was also the clearest and most symbolized, which suggested that perhaps symbolization of experience is inversely related to depression. To examine this possibility within John, he was asked to wear the beeper again when he noticed he was feeling fatigued. He did so on one occasion and collected a total of 10 experience samples. John's experience during the fatigue period was also frequently of inner seeings (90% of those samples). However, the fatigue-period inner seeings were, indeed, less symbolized; they were less clear, less detailed, lacked motion, and had atypical features, including abrupt edges and unusual and impossible perspectives. For example, at beep 48:

> [John was imagining himself and the two DES investigators in the office where their sampling interviews took place.] At the moment of the beep, he was innerly seeing the three sitting engaged in conversation. John himself was in the center, holding his

> sampling notebook, and gesturing with both hands slightly outstretched as if to emphasize a point. The inner seeing was frozen; for example, his hands were not moving. Moreover, the visual details were somewhat indeterminate; for example, he could not say whether he held the notebook at the bottom or top; he could "see" that one of the investigators was wearing a dress but could not define its color or style; he could not see any of their faces, despite apparently seeing their hands. [John described the inner seeing as "blurred" or "fuzzy," but was not confident about that either.] (Hurlburt, 1993, p. 39)

Thus, beep 48 during the fatigue period was importantly different from beep 16 during the slightly hypomanic period: It was less clear, less detailed, and lacked motion. Overall, it was noticeably less symbolized than John's inner seeings during his typical, slightly hypomanic, functioning, further supporting the notion that symbolization of experience may be inversely related to depression.

There were limitations to Hurlburt's (1993) approach, including the small sample size and the fact that participants' self-reported cyclicity was not confirmed in any bona fide diagnostic way (though there were signs visible to the investigators that corroborated participants' self-reports). Despite these limitations, the results suggest that inner and external experience may covary. The present study will build on that early finding by examining experience across a truly cyclic and biologically well-defined process—the menstrual cycle.

The Present Study

Overall, a sizeable portion of women report psychological and behavioral symptoms (e.g., mood lability, irritability, interpersonal conflicts, depression) that are associated with, and probably in some way caused by, cycle-related changes in biology and, especially, in hormones. We were therefore interested in exploring whether there are also changes in one's directly

apprehended pristine inner experience during times of cycle-related biological change. To do so, we identified women who (by self-report questionnaire) experienced significant premenstrual distress and engaged them in multiple (between 16 and 22) days of Descriptive Experience Sampling (DES). DES is a beeper-driven method designed to capture pristine inner experience in as high fidelity as the current state of the art allows. We dispersed DES sampling days throughout the several phases of each participant's menstrual cycle, thereby allowing for experiential differences (if any) to emerge across cycle phases. We suspected that experiences would differ around times of rapid biological change, such as during the popularly studied progesterone withdrawal of the Late Luteal/Premenstrual but also during the lesser-studied estrogen spike of around Ovulation, and so targeted these phases for additional sampling days.

Chapter 3: Method

The Present Study proceeded in two steps: (1) Screening and (2) Descriptive Experience Sampling. (It might be seen as customary to refer to these as "phases" rather than "steps," but using "phase" to refer to investigation step introduces a substantial conflict with the use of "phase" to refer to the segment of the menstrual cycle.)

Step 1: Screening

The purpose of Step 1 was to identify women who self-reported clinical or near-clinical premenstrual symptoms and to advance approximately six of those women to the second and main phase of the study. All study procedures were approved by the University of Nevada, Las Vegas (UNLV) institutional review board.

Participants

Participants were recruited from the UNLV psychology subject pool online study database. The study was advertised as appropriate for women who have noticed premenstrual symptoms. In total, 339 women (M_{age} = 20.20 years, SD_{age} = 3.72) completed the screening step. 31.9% identified as White or Caucasian, 30.1% as Hispanic or Latinx, 23.3% as Asian and/or Pacific Islander, 8.0% as Black or African American, and 5.9% as Other.

Measures

Health & Eligibility Questionnaire. The Health & Eligibility Questionnaire was developed for the present study. It included questions about the participant's typical menstrual cycles, use of hormonal contraceptives, and health conditions/behaviors that may have affected hormone activity. It also included questions about basic demographic and contact information. Participants could refuse to answer any question except those related to contact information. The entire questionnaire is shown in Appendix A.

DSM-5 PMDD Visual Analogue Scales. These visual analogue scales (VAS) were adapted from Steiner et al. (2005) to reflect the updated DSM-5 criteria for PMDD. A single-item VAS was used to assess each of the 11 diagnostic criteria, each consisting of a horizontal line ranging from 0 = *not at all* ("the way you normally feel when you don't have premenstrual symptoms") to 100 = *extreme symptoms* ("the way you feel when your premenstrual symptoms are their worst"). Respondents drug a bar along the line to select their response, which was displayed numerically in a box above the bar and changes in real-time as they did so. Steiner et al. (2005) administered the VAS to participants on multiple occasions during different phases of their menstrual cycles; however, for the present study, participants completed the VAS only once and were thus asked to reflect over "the majority of your menstrual cycles." In the prompt, the premenstrual phase was defined as starting "before your period" and ending "within a few days of bleeding." In keeping with Steiner et al. (2005), VAS scores for the four core symptoms were averaged to create a mean "mood symptoms" score and all 11 VAS scores were averaged to create a mean "total VAS" score.

Steiner et al. (2005) showed that VAS mean mood symptoms and total scores correlated moderately with observer ratings of PMS symptoms on the Premenstrual Tension Syndrome – Observer form (PMTS-O; Steiner et al., 1980) with *r*s ranging from .41 to .63. Internal consistency was high for VAS mood symptoms scores during both the luteal and follicular phases (Cronbach's alpha ranging from .88-.96). The mean VAS mood symptoms score was 41 (95% CI = 38-44) for participants with mild symptoms, 54 (95% CI = 52-55) for participants with moderate symptoms, and 70 (95% CI = 66-73) for participants with severe symptoms.

The 10-item Premenstrual Assessment Form (PAF; Allen et al., 1991). The 10-item PAF is based on the 10 most endorsed items on the original PAF (Halbreich et al., 1982).

Respondents rate the intensity of each of 10 premenstrual symptoms during their last cycle from 1 (*not present or no change from usual*) to 6 (*extreme change, perhaps noticeable even to casual acquaintances*). The premenstrual phase is defined as beginning "about seven days prior to menstrual bleeding (or seven days before your period)" and ending "about the time bleeding starts." Scores on the 10-item PAF range from 10 to 60, and in the normative sample were normally distributed with a mean of approximately 30 (M = 27.4, SD = 10.9). The PAF was normed on a non-PMS-related sample of N = 417 Caucasian women between the ages of 22 and 65 who reported regular menstrual cycles and were taking part in a smoking cessation treatment trial. The 10-item PAF demonstrated high internal consistency (Cronbach's alpha = .95 at baseline) and moderate to high test-retest reliability (rs ranging from .6 to .7).

DSM-5 PMDD Checklist of Symptoms. This Checklist of Symptoms was developed for the present study and directly mirrors the DSM-5 criteria for PMDD. Participants rated the presence (*yes/no*) of the 11 diagnostic criteria and then rated the extent to which those symptoms interfere with their functioning in five life domains (from *not at all* to *severely* with the possibility of selecting *not applicable*). The entire questionnaire is shown in Appendix B.

Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). The HADS is a popular and brief tool used primarily in general medical settings to screen for anxiety and depression. It is composed of 14 questions, seven pertaining to anxiety and seven to depression, and takes approximately two to five minutes to complete. Respondents are asked to choose the response that indicates how they have been feeling over the past week. Each item is scored from 0 to 3 with higher scores reflecting greater symptomatology. Total anxiety (HADS-A) and depression (HADS-D) scores are computed separately and range from 0 to 21 where: 0-7 = Normal, 8-10 = Borderline, and 11-21 = Abnormal.

The HADS has been studied extensively. Bjelland and colleagues (2002) reviewed *N* = 71 studies that have used the HADS finding support for the two-factor structure of the HADS and effective cut scores (average sensitivity and specificity of approximately 0.80). They also reported that the HADS has demonstrated moderate to high concurrent validity (e.g., HADS-D correlations with the Beck Depression Inventory range from .62 to .73; HADS-A correlations with the State Trait Anxiety Inventory range from .52 to .81) and adequate internal consistency (Cronbach's alphas .60 or greater across all studies).

Nevada Inner Experience Questionnaire (NIEQ; Heavey et al., 2019). The NIEQ presents 10 visual analogue scales, two (a *Frequently* item and a *Generally* item) for each of the "five frequent phenomena" of inner experience ("5FP"; Kühn et al., 2014): inner speaking, inner seeing, unsymbolized thinking, feelings, and sensory awareness. The original NIEQ was administered with paper and pencil; the present study used a computer presentation where (as with the DSM-5 PMDD VAS) respondents drug a bar along a horizontal line ranging from 0 = *none of the time* to 100 = *all of the time* to select their response, which was displayed numerically in a box above the bar, changing in real-time as they did so. In keeping with Heavey et al.'s (2019) method, markings for each pair were averaged to produce subscale scores for the frequencies of each of the 5FP. The five-factor structure of the NIEQ was confirmed, and the complete NIEQ is shown in Heavey et al. (2019).

Procedure

Participants followed a link to a Qualtrics survey to complete all measures. The entire survey took approximately 30 minutes and had to be completed in a single sitting. Participants earned subject-pool research credits for their participation. Responses were reviewed in order of appearance and evaluated based on the below inclusionary/exclusionary criteria.

Inclusion/Exclusion criteria. Any woman who self-reported clinical or near-clinical premenstrual symptoms and who was otherwise healthy was eligible to advance to Step 2, the main part of the study.

Because the DSM criteria are arguably the most well-established by both research and consensus, the presence and severity of premenstrual symptoms were determined using the DSM-5 PMDD Checklist of Symptoms, where "clinical" = 5 or more symptoms endorsed (at least one of which had to be a mood symptom) with functional impairment rated as moderate or worse in at least one domain (all of which is consistent with a DSM-5 diagnosis of PMDD; APA, 2013). "Near-clinical" = 4 symptoms endorsed with at least moderate impairment in at least one functional domain. Scores on the DSM-5 PMDD VAS and 10-item PAF were also considered. However, as we have seen, retrospective reports are problematic, and were therefore interpreted gently. A participant who endorsed all 11 DSM-5 criteria for PMDD, for example, was not assumed to experience PMDD symptoms at literally twice the level of severity compared to another participant who endorsed only 5 of the 11 DSM-5 criteria for PMDD. Both results indicated only that distress was present and that the participants were appropriate for the present study.

To ensure that our participants were generally healthy with (as best we could deduce) typical hormonal fluctuations, we examined responses on the Health & Eligible questionnaire and considered excluding participants if there was substantial evidence to suggest that their biological fluctuations were atypical and/or that their symptoms were caused primarily by something other than menstrual-cycle-related fluctuations. Thus, we excluded anyone who currently used hormonal contraceptives or "birth control"; anyone who had been pregnant or breastfeeding within the last year; anyone who met criteria for substance dependence; anyone

who used substances known to impact systemic hormones; or anyone with comorbid severe depression or anxiety.

There were no outright reasons for a participant to be excluded unless she did not report premenstrual distress. Knowing her biological characteristics allowed us to maintain an "eyes-wide-open" approach to understanding participants' experience that honored the many potential causes of fluctuation and allowed for the potential discovery of novel patterns in women who, for the factors mentioned above, would typically be excluded from studies of PMS/PMDD. Additionally, premenstrual symptoms are thought to be caused by the biological changes (especially hormones) of a typical menstrual cycle and, if we found evidence of cycle-related changes in experiences for a participant whose cycle/biology was atypical (e.g., someone with a shift-work schedule), that could be of great interest to science.

Screening Step Results

Select findings from the screening step are reported here and questionnaire results are shown also in Table 4. On the Health & Eligibility questionnaire, 72.6% of all screening participants reported having a regular menstrual period, and 39.2% of participants reported they currently take a hormonal birth control medication. On the Premenstrual Assessment Form, the mean score was in the Average range at 34.21 (*SD* = 11.07). On the DSM-5 PMDD Visual Analogue Scales, the mean score for mood symptoms was in the mild to moderate range for both mood (*M* = 49.86, *SD* = 25.18) and total symptoms (*M* = 50.07, *SD* = 20.94). On the DSM-5 PMDD Checklist of Symptoms, participants endorsed, on average 2.56 mood symptoms (*SD* = 1.35) and 6.91 total symptoms (*SD* = 2.88), indicating that, on average, participants (by self-report alone) endorsed clinically significant symptoms of PMDD. Finally, participants endorsed,

on average, slightly abnormal levels of anxiety (M = 13.70, SD = 10.56) and normal levels of depression (M = 8.74, SD = 9.97).

Step 2: Descriptive Experience Sampling & Cycle Tracking

The purpose of Step 2 was to use descriptive experience sampling (DES) to explore the naturally occurring pristine inner experience of women who self-reported significant premenstrual symptoms and, eventually, to determine whether pristine inner experience differed across the menstrual cycle.

Participants

All women deemed eligible in the Screening step were invited by phone or email to participate in the Step 2. Of the 339 total screening participants, 232 were evaluated for eligibility (the remaining 107 were never considered due to time constraints). Of the 232 participants evaluated for eligibility, 82 were deemed eligible and invited to participate in Step 2; 10 agreed to participate and attended, at least, the Consent and Instruction Meeting. One participant dropped out after the Consent meeting citing scheduling difficulties. The remaining 9 participants each completed at least one day of DES sampling.

Five women ultimately completed the entire study (M_{age} = 21.2, SD = 5.54, range = 18-31) and will hereafter to be referred to as the "DES Participants." Of those five, 2 identified as Hispanic or Latinx, 1 as White or Caucasian, 1 as Asian and/or Pacific Islander, and 1 as "Other." All were currently enrolled in college courses; one also worked full-time, two worked part-time, and two were unemployed outside of their schooling.

See Table 4 for a summary of Screening results for all screening participants and the 5 DES participants. A review of Table 4 shows that the Screening step was apparently effective:

The DES participants reported higher numbers and severity of premenstrual symptoms across all premenstrual assessments and lower rates of comorbid depression and anxiety.

Table 4

Screening Questionnaire Mean (SD) Results by Participant Group

	Screening Participants	DES Participants
N	339	5
Visual Analogue Scales – Mood Symptoms[b]	49.86 (25.18)	70.05 (20.20)
Visual Analogue Scales – Total Symptoms[b]	50.07 (20.94)	66.13 (18.74)
Premenstrual Assessment Form[a]	34.21 (11.08)	40.0 (11.22)
DSM-5 PMDD Mood Symptoms[c]	2.55 (1.35)	3.0 (1.0)
DSM-5 PMDD Total Symptoms[d]	6.91 (2.88)	8.4 (2.51)
Hospital Anxiety and Depression Scale – Anxiety[e]	13.70 (10.56)	8.8 (6.98)
Hospital Anxiety and Depression Scale – Depression[e]	8.74 (9.97)	4.8 (6.38)
Nevada Inner Experience Questionnaire[f] – Inner Speaking	59.75 (26.73)	62.5 (22.93)
Nevada Inner Experience Questionnaire[f] – Inner Seeing	51.95 (26.44)	57.5 (16.92)
Nevada Inner Experience Questionnaire[f] – Feelings	68.30 (22.25)	75.9 (13.81)
Nevada Inner Experience Questionnaire[f] – Sensory Awareness	50.64 (23.38)	66.6 (13.50)
Nevada Inner Experience Questionnaire[f] – Unsymbolized Thinking	38.20 (26.10)	37.0 (31.72)

[a] In a non-clinical sample of women, the average score was 30 with a standard deviation of 10.

[b] Scores range from 0 to 100 where 38-44 = "Mild," 52-55 = "Moderate," and 66-73 = "Severe" (Steiner et al., 2005)

[c] Recall that the DSM-5 diagnosis of PMDD requires at least 1 of the 4 possible mood symptoms be present.

[d] Recall that the DSM-5 diagnosis of PMDD requires at least 5 of the 11 possible symptoms be present.

[e] Scores range from 0 to 21 where 0-7 = "Normal," 8-10 = "Borderline," and 11-21 = "Abnormal" (Zigmond & Snaith, 1983)

[f] Recall that responses on the Nevada Inner Experience Questionnaire refer to how much of the time a participant believes he or she experiences each of the five frequent phenomena of inner experience.

Materials

DES Sampling.

Beeper. Participants were issued the standard 4.15” x .85” x 2.40” beeper and single earphone used in DES studies (Hurlburt & Heavey, 2006a; see also Figure 4). The beeper delivers a 700 Hz tone (beep) at uniformly distributed random intervals (mean = 30 minutes) through an earphone. The beep cues participants to attend to their current ongoing experience.

Notebook. Participants will be issued a 3” x 5” spiral-bound notebook in which to jot down notes regarding each experience.

Cycle Tracking.

KNOWHEN Saliva Ovulation Test Kit. Participants were each issued a commercially available, FDA-approved KNOWHEN ® Advanced Ovulation microscope test kit. Each kit contained a lipstick-shaped, hand-held mini microscope shown below in Figure 5. The kit could be reused daily.

Figure 5

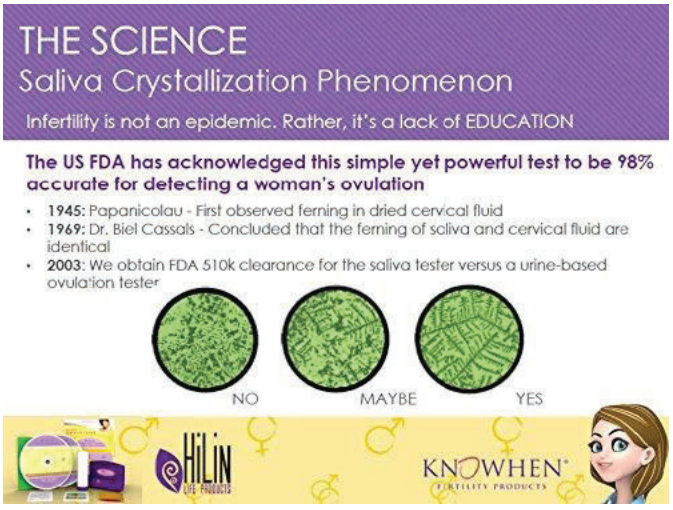
The KNOWHEN Advanced Ovulation Test by Hilin Life Products, Inc.

Note. Re-printed and retrieved from https://www.knowhen.com/en/ovulation-test/knowhen-ovulation-test.

As previously mentioned, KNOWHEN ® is designed to detect the five most fertile days of a woman's cycle (i.e., ovulation and surrounding days) based on a salivary ferning pattern. Users examine and compare the crystallization pattern on the microscope to determine the likelihood of ovulation based on example patterns provided in the test kit (See Figure 6 below). The KNOWHEN system is marketed as fast ("results in minutes"), easier to use than "messy urine strips," and affordable (as it can be reused daily for years and requires no refills or supplemental purchases; https://www.KNOWHEN.com/en/).

Figure 6

Instructions for interpreting KNOWHEN saliva crystallization pattern results by Hilin Life Products, Inc.



Note. Re-printed and retrieved from amazon.com/KNOWHEN-Saliva-Ovulation-Fertility-Monitor.

Procedure

Consent and Instruction Meeting. Those who agreed to participate in Step 2 of the study met with this author at the Inner Experience Sampling Lab located on UNLV's campus for a consent and instruction meeting. During this meeting, participants were informed of the purpose of the study, the risks and benefits of participation, and the limits of confidentiality. They were informed that DES is a fundamentally collaborative procedure in which they, as the participant, would be considered a "co-investigator" (Hurlburt & Heavey, 2006a) who would always hold "51% of the vote" and be free to suggest modifications or to discontinue the procedure at any time. Scheduling sampling interviews and sharing cycle tracking data required participants to maintain daily contact with this author and therefore, to ensure confidentiality, participants also selected at this meeting a pseudonym to be attached to their study data (e.g., cell phone numbers, sampling descriptions, KNOWHEN results, etc.).

After obtaining informed consent, this author explained the DES sampling and cycle tracking procedures. With respect to cycle tracking, each participant was provided with her own KNOWHEN ®ovulation test kit and an instructional handout for how to use the device and communicate results with the present author. With respect to DES, this meeting included reiterating the purpose of DES, clarifying what is meant by DES terms such as "inner experience" and "the moment of the beep," and demonstrating how to operate the beeper. In DES, consent is treated as a living, breathing process and, therefore, was reiterated anew at each interaction.

Finally, the first DES expositional interview was scheduled according to all parties' availability. Participants were instructed to wear the beeper within 24 hours of the expositional interview for approximately three hours (or long enough to collect six beeps) during a time of

their choosing. Participants were asked to provide consent for expositional interviews to be videotaped, and all did so without reservation.

Cycle Tracking. Recall that, if ovulation (the key event of the menstrual cycle) can be detected with some degree of confidence, then the surrounding cycle phases can be relatively easily deduced. Recall also that we chose to use an ovulation microscope as the means to detect ovulation. Participants were instructed to use their KNOWHEN ® ovulation microscope test kit daily until the cessation of their DES sampling. However, when participants struggled to establish this daily habit (as was the case with Allison, for example), they were strongly encouraged to aim for using the KNOWHEN ® kit *at least* on the days surrounding DES sampling days (i.e., the day before sampling, the day of sampling, and the day after sampling). That improvised method, though it produced a less complete sense of the overall pattern of a participant's results, still allowed for determinations to made as to whether ovulation was present around the time of sampling. This author explained the procedure recommended by the makers of KNOWHEN ®: Participants were asked to apply a thick drop of saliva to the glass surface of the microscope each morning before eating drinking, smoking, or brushing their teeth. When the saliva had dried completely (approximately 5-15 minutes), they were instructed to take a photo of the resulting salivary pattern and to text that photo to this author who would 'read' the result for the presence of the ovulation fern ing pattern and securely store a note of the result. After sending the photo, participants were to wipe the glass surface of the microscope, return it to the holding tube, and repeat the same procedure the next morning.

Participants were asked to send me ovulation-test photos daily. I typically accumulated those photos in batches of 10 or more days before I interpreted the photos, thus keeping me largely blind to the participant's current cycle phase. I was typically only aware of a participant's

cycle phase at the end of her participation if we determined it was necessary to strategically schedule in phases for which we desired more data. Russell Hurlburt (RTH), however, was always blind to ovulation test results and participant's cycle phase.

DES Sampling. Sampling followed the typical DES procedure described before and in Hurlburt (2011; Hurlburt & Heavey, 2006). In brief, participants wore a random-interval beeper for approximately three to four hours while going about everyday activities. When the beeper sounded, they were instructed to attend to and immediately jot down notes about whatever experience was ongoing at the last undisturbed moment before the beep. Then, within 24 hours, they met with a team of DES investigators for an "expositional interview" intended to describe with fidelity their experience at each beeped moment. Most participants completed all interviews in-person though, due to limitations related to the coronavirus pandemic, two participants completed at least some of their interviews by videoconference.

The goal was for this natural-environment-sampling-followed-by-expositional-interview procedure to be repeated approximately 20 times (roughly eight times per menstrual cycle for two to three menstrual cycles). However, a participant was considered to have successfully completed the study if she obtained samples on at least 6 days for at least 2 menstrual cycles (i.e., at least 12 sampling days total). As is typical of DES, participants were asked to collect approximately six experience samples on each sampling day, therefore resulting in approximately 19 days (excluding day 1 samples as training, as is DES custom) × 6 samples per day = 114 total samples per participant, or 5 participants × 114 samples per participant = 570 total samples across all participants.

Because the number of sampling days varied for participants (M = 19.6, SD = 2.3, range = 16-22) and because participants sometimes only collected five samples on a given sampling

day or an interview only had time to discuss five samples, we actually obtained an average of 107.8 samples per participant for the five participants resulting in a grand total of 539 samples across all participants.

DES Analysis and Characterization. The analysis of each participant's sampling data occurred in two parts. Part One was typical of DES: We reviewed and characterized all samples blind to the associated menstrual cycle phase, the object being to create an idiographic characterization of the individual participant. Part Two was specific to the present study and involved separating sampling days by menstrual cycle phase and comparing experiential characteristics and frequencies across phases.

Part One: The individual (blind to menstrual cycle phase). Recall that the first part of the analysis was typical of DES studies in that the goal was to review and characterize all samples together blind to and regardless of associated menstrual cycle phase. Upon completion of a participant's sampling, the present author and RTH met to review each sample of her experience. The purpose of this meeting was to re-encounter each sampled experience for five overlapping reasons: (a) the important characteristics of any particular sampled experience might not be evident when that experience is initially encountered—thematic characteristics might emerge from later samples that must then be reapplied back to the earlier samples. That is, what might have seemed to be an insignificant detail at first encounter might become a salient aspect when viewed from the perspective of subsequent samples; (b) it serves to reawaken recollections of earlier samples. Our study sampled women across three or more months, and we needed some mechanism to overcome any recency effect; (c) we need a means of keeping the sampled experiences easily available. Our study accumulated approximately 100 experience samples for each participant, which we needed to keep "fresh in mind"; (d) we needed a convenient, flexible

ways to be able to access each sample from whatever variety of perspectives that might occur; and (e) we wanted our final idiographic characterization of a participant to be shaped by all of her experiences. To serve all those goals, during this sample-review meeting we collaboratively wrote a brief "caption" for each sampled experience. These captions summarize in a few words the phenomena and other characteristics that we understood to have been present at the moment of the beep or that we wondered about (and therefore intended to keep alive as we encountered and re-encountered each sample. For example, a sample caption may be as simple as "IS" (short for "inner speaking") or may require more detail, such as this caption of Lane's: "IS, SA (short for sensory awareness) sound, separate apprehension short of cognitive but more specific than just hearing, multiple." These captions serve as signposts that point back to and help re-awaken in us the experiences themselves. When needed for clarification or to resolve disagreements in understanding, investigators returned to the original videotape of the interview. When disagreements persisted, they were reflected in the final characterization. This meeting very often awakened investigators to features of a participant's inner experience that had not been clear or apparent when encountered at each sample. Sometimes, when taken together and considered side-by-side with other similar or dissimilar experiences, nuances and "edges" of experiential characteristics emerged or were clarified.

As soon as possible after (usually within 24 hours of) the review of all samples, RTH and I independently wrote a brief characterization of the participant's inner experience and circulated those characterizations to each other to identify any major discrepancies. The goal was to ensure that each of our general impressions were commensurate, and that no phenomenon would be overlooked or mischaracterized.

Guided by those brief characterizations, I created an Excel file containing, as columns, all relevant idiographic phenomena or other characteristics that were identified in the sample review and, as rows, each sampled experience. RTH and I then independently coded each experience sample for the occurrence of each of the idiographic phenomena/characteristics. We used the typical DES coding scheme where "1" = *confidently present*, "0.5" = *possibly but not confidently present*, and "0" = *not at all present*. The coding process was ever evolving; if it became clear that a certain category could not meaningfully capture the experiential phenomena, that category could be reconceptualized or discarded; conversely, if another, previously overlooked category presented itself as being useful, it could be added.

After we had independently coded each sampled experience for a given participant, we considered any disagreements between coders, a process DES calls "rectification." Rectification is designed to correct coding mistakes, if any, but as each coder defended the thinking that led to a coding, the particular phenomenon might be clarified, adjusted, and/or solidified to (as best we could jointly determine) reflect the participant's experience. Consensus was not necessarily valued; lingering disagreements were noted and reflected in the final characterization in so far as they helped describe the phenomena.

Part Two: Comparing experience across menstrual cycle phases. After all samples were reviewed and characterized blind to cycle phase, we turned our attention to cycle-phase-related differences.

Recall that, throughout a participant's sampling, RTH was fully blind to that the participant's cycle-phase information. I was usually fully (sometimes only partially) blind to the cycle phase associated with each of her sampling days; recall that I typically accumulated daily ovulation-test results in batches of 10 or so days before I interpreted them. Therefore, in general,

sampling days were selected primarily based on scheduling convenience alone, not by handpicking certain cycle phases (as we had originally proposed). Because most participants elected to sample weekly until they completed the study, and because cycle phases (except for ovulation) last approximately one or two weeks each, this scheduling strategy typically effectively captured samples from within each cycle phase. On one or two occasions, a "positive" ovulation test prompted a participant to suggest an immediate DES sampling (so as to capture the ovulation window which lasts only 1-2 days) and, on those occasions, I was not blind to cycle phase, though RTH still was.

Near the end of a participant's sampling participation (e.g., on the 17th or 18th day of sampling), I reviewed the cycle phases in which we had actually sampled with that participant to determine whether additional sampling days were needed in any particular phase or phases. I made these cycle phase determinations based on the best available evidence, using the ovulation ferning results (to mark the time of ovulation), the cycle day, and the cycle length. Sampling days were classified into one of the following three phases: ovulation; late luteal/premenstrual; or what we called the "traditionally non-symptomatic" phase. We were primarily interested in ovulation and the late luteal/premenstrual phase as they are associated with dramatic changes in hormone levels, whereas the periods included in the traditionally non-symptomatic phase are typically more biologically stable. See Table 5 for an explanation of each of the classifications.

Table 5

Menstrual Cycle Phase Classifications

Phase Classification	Part(s) of Typical Menstrual Cycle	Biological (Hormonal) Associations
"Traditionally Non-Symptomatic"	Follicular (beginning of cycle to ovulation) and Early Luteal (immediately post-ovulation to late luteal) phases; theoretically days 1-13 or 14; and 15 or 16-21	Estrogen and progesterone remain relatively stable; fluctuations, if any, are minor and gradual
"Ovulation"	Theoretical midpoint of cycle; theoretically 1-2 days surrounding day 14	Rapid spike in estrogen
"Late Luteal/Premenstrual"	Final 7-10 days of cycle, generally considered days 21+	Withdrawal of progesterone

For two participants (Candy and Cat), that procedure caused us to request the participant to monitor her ferning and schedule sampling within particular phases that needed additional sampling. In those cases, I was not blind to cycle phase, though RTH still was. However, for two of the other participants (Allison and Lee), we had obtained an adequate number of experiences within each cycle phase scheduling by convenience alone and therefore need no additional strategic sampling. For Lane, we would have liked to continue sampling—especially around ovulation—but were unable to do so because she requested to terminate her participation due to, she said, scheduling difficulties (she was working full-time and going to school). Thus, across all participants, I was blind to the participant's cycle phase (as a rough estimate) 90% or so of the time.

After sampling days were classified within one of the three cycle phases, we explored menstrual-cycle-related differences in inner experience. This was intended to be a consideration of phenomenological characteristics, but one quantitative analysis presented itself, unplanned, in the course of our consideration of the phenomena of our first participant, Candy, across cycle

phases. As a way of keeping track of potential differences in experience across phases, and because she had collected more than 100 experience samples, we arranged the sample captions in a table that "binned" all sample captions by cycle phase. As mentioned before, the sample captions attempt to summarize in as few words as possible the salient phenomena and any other relevant characteristic present in the experience. Recall also that captions are signposts pointing back to the experiences themselves and thus, the table displaying these captions binned by cycle phase was a feasible way for us to recollect and consider all experiences and the ways they potentially differed in different phases.

When we observed Candy's table of sample captions "binned" by cycle phase, we noticed that the captions from the ovulation phase appeared to be much longer than the captions in the other cycle phases. To test that observation, we conducted an exploratory single-factor ANOVA comparing sample caption lengths across cycle phases. This post hoc procedure violates the ANOVA assumptions, which we justified by using it in an exploratory way. Therefore, when we say that Candy's result was "significant," we mean that had we not violated the assumptions, the resulting ANOVA test statistic could be said to be larger than would be expected by chance. We discovered that Candy's caption lengths were indeed significantly different across phases by this definition. There was apparently *something* that varied across menstrual phases that was captured by the differences in caption length. As a second step for Candy, we asked her to participate in two more days of DES sampling—one during ovulation (where caption lengths had been long) and the other in the late luteal/premenstrual phase (where caption lengths had been short). We then could conduct a *t* test comparing caption lengths in those two days. That *t* test was significant (this time without the post-hoc violations of the ANOVA assumptions). This suggested that the ANOVA of sample captions might be a helpful

tool, so we determined to use this quantitative method as a standard analysis for all later participants (therefore violating fewer assumptions for the subsequent participants).

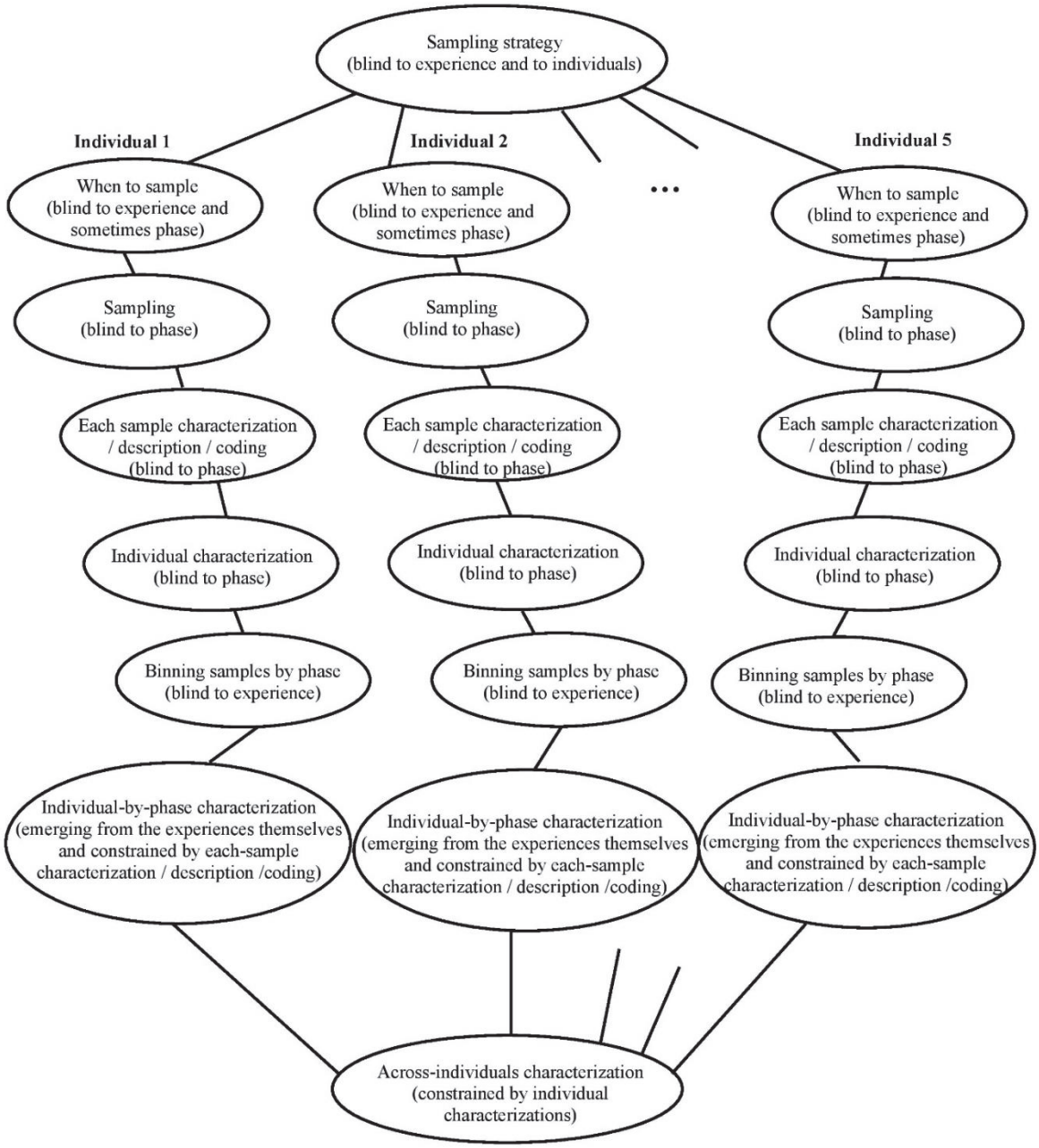
Finally, to assess for potential differences in the frequencies of experiential phenomena across cycle phases, we conducted exploratory chi-squared analyses to test whether a phenomenon's frequency differed across cycle phases. Given that these analyses were exploratory, we did not adjust for multiple tests; we use the term "significant" to imply only that the differences were relatively large.

Figure 7 schematizes the overall Step 2 procedure. Notice that, though it was not feasible to remain fully blind to cycle phase and/or experience at all times, principled efforts were made to be blind (to the extent possible) to biasing factors throughout. There, the top ellipse illustrates that we created a sampling strategy that emphasized the desirability of particularly frequent sampling during the ovulation and the late luteal phases. This strategy was created before any sampling had begun and was therefore blind to any particular participant's characteristics. Then, for each of our five individual participants, we decided which days to sample based on considerations blind to the participant's own experiential characteristics—the days themselves occurring mostly weekly. Then, within each sampling day, the time of each sample was selected randomly (and therefore blind to participant characteristics). Then, at the end of a participant's participation, our sample review (and caption creation) was conducted blind to cycle phase, as was the preparation of the idiographic characterization of that participant. Then we binned samples by phase, which took into consideration the ovulation-test and day within cycle but was kept blind to the experiences themselves. Then we considered differences across phases, a procedure that unblinded the experiences themselves and the phase binning, both of which were constrained by the previous steps. Then, finally, we considered similarities or differences across

participants, constrained by all the previous results. Those kinds of efforts are designed to bracket presuppositions as much as possible at every step of the procedure.

Figure 7

Step 2 (DES Sampling & Characterization) Procedure



Chapter 4: Results by Participant: Overview and Summary

The next five chapters will be devoted to characterizing each of the five DES participants. While the overall aim and general analyses were the same, there are important differences between participants' chapters. This is in keeping with the truly idiographic nature of DES: Approaches and analyses were regularly adapted when those adaptations seemed better-able to capture an individual's experience. Thus, to prepare the reader, what follows is a preview of the chapters to come. Efforts have been taken to ensure a participant's anonymity; all names are pseudonyms.

Chapter 5 presents Candy, a Hispanic woman who was between the ages of 18 and 25 at the time of her participation (we specify only an age range to protect her anonymity). Candy ultimately completed 19 days of DES sampling, collecting a total of 112 beeped experiences. Across the more than 120 days of her involvement, the ferning test detected ovulation on only one occasion, which may have been an artifact of the test (i.e., frequent "false negatives") or an indication that Candy was not regularly ovulating. Regardless, we were able to make a fairly confident determination (including the positive ferning test result) that she was ovulating on two of her sampling days. In general, Candy's experience was fairly straightforward with typical (by DES standards) phenomena—most often inner speech and sensory awareness. With respect to menstrual cycle phase, Candy's experiences differed appreciably: especially by comparison to the late luteal/premenstrual phase, candy's experiences during ovulation were more frequently unclear and complex with inchoate, not-fully-figural phenomenon.

Chapter 6 presents Lane, a Caucasian woman between the ages of 25 and 35 at the time of her participation. Lane completed 16 days of DES sampling, collecting a total of 88 beeped experiences. Lane's participation was unusual in that after 12 days (66 sampled experiences) of

sampling, she requested a pause in sampling. During that pause, Lane was diagnosed with ADHD and Bipolar Disorder and started psychotropic medications. Those medications (she and we suspected) caused her to stop having menstrual periods. Even though that would make our usual determination of cycle phase impossible, we continued sampling with her for four more sampling days (22 experience samples). As a result, we divided our analysis of Lane into two parts. The first part is our usual analysis—the characterization of her 66 non-medication experiences in general and then with respect to cycle-phase-related differences. We found that her experiences were notably clearer and simpler around the time of ovulation (an observation that was supported by the ANOVA of caption lengths) as compared to non-ovulation phases. The second part of Lane's characterization focuses on the potential impact of medication on inner experience: We explored whether the 22 with-medication samples differ from her 66 without-medication experiences. We found that Lane's experiences with-medication were even messier than her non-ovulation-phase experiences had been in the first analysis; her with-medication samples were often busy, unclear, and with unusually (by DES standards) specific phenomena.

Chapter 7 presents Allison, a Hispanic woman who was between the ages of 18 and 25 at the time of her participation. Allison completed 19 days of DES sampling, collecting a total of 96 beeped experiences. Allison's sampling days were difficult to classify within cycle phases as it seemed the ovulation (ferning) test was ineffective for her, frequently producing positive results that were either "false positives" or indicative of atypical hormone activity. As a result, some of the determinations of cycle phase for particular sampling days were made crudely (e.g., based only on the day within the cycle) and were at higher risk of inaccuracy. Even with those crude determinations, we found subtle differences in Allison's experience across cycle phases. Specifically, Allison's sensory awarenesses seemed different during ovulation as compared to

the late luteal/premenstrual phase; her ovulation sensory experiences more often involved her face and seemed to "grab" and "move" her in ways they did not during other cycle phases.

Chapter 8 presents Lee, a multi-ethnic woman who was between the ages of 18 and 25 at the time of her participation. Lee completed 21 days of DES sampling, collecting a total of 111 beeped experiences. In general, Lee's experience was rich, detailed, and sometimes creative. She experienced each of the five frequent phenomena (5FP; Kühn et al., 2014; inner speaking, inner seeing, feelings, sensory awareness, and unsymbolized thinking) in approximately 20-25% of her samples. Because Lee was inconsistent in providing ovulation test (ferning) results, we sometimes had to crudely determine which cycle phase a sampling day belonged in based only on the cycle day. Like Allison, this increased the possibility of inaccuracy. However (also like Allison), even with those sometimes-crude classifications, we found differences in experience across cycle phases. Specifically, Lee more frequently had experiences that were unusual by DES standards (e.g., experiencing emotional feelings in color or innerly seeing words) during the late luteal/premenstrual phase, whereas such unusual experiences never occurred during ovulation.

Finally, Chapter 9 presents Cat, an Asian woman who was between the ages of 18 and 25 at the time of her participation. Cat completed 21 days of DES sampling, collecting a total of 126 beeped experiences. Cat provided consistent ovulation test results and the test appeared to be highly effective for her, thus allowing for more confident classifications of her cycle phases. In general, Cat's experience was dominated by sensory awareness (occurring in more than half of all samples) and inner speech (occurring in roughly one-third of all samples). With respect to menstrual cycle phases, we observed that Cat's inner experience was somewhat more complex around ovulation. Whereas her experience was usually straightforward with one or maybe two

focused and clear phenomena, her ovulation-phase experiences were more often “busy” and contained multiple not-as-well-articulated phenomena.

Chapter 5: Candy

Candy is a Hispanic female. At the time of sampling, she was between the ages of 18 and 25 years old (for anonymity, we provide only an age range). She was a full-time undergraduate university student and also worked part-time.

Step 1: Screening

Candy reported she had regular menstrual periods. She denied any medical conditions, behaviors (e.g., shift work), or medications (including birth control) that would alter her hormone function. Her screening results indicated slightly atypical levels of anxiety, but she denied any current or previous diagnosis of an anxiety disorder.

Candy's responses indicated she experienced clinically significant symptoms of Premenstrual Dysphoric Disorder (PMDD). She endorsed all 11 DSM-5 symptoms of PMDD and noted that those symptoms profoundly impacted her schooling, social activities, relationships, and activities of daily living. On the Premenstrual Assessment Form (PAF), Candy earned a score of 53, which placed her score higher than 98% of those in the normative, non-clinical sample. On the Visual Analogue Scales of PMDD symptoms, she reported that her mood symptoms were, on average, 90% worse during the premenstrual phase as opposed to the rest of her cycle. She reported all PMDD symptoms (mood *and* behavioral) were, on average, 73% worse during the premenstrual phase as opposed to the rest of her cycle.

Step 2: DES Sampling & Cycle Tracking

Candy completed 19 days of natural-environment Descriptive Experience Sampling (DES), amassing 112 total beeped experiences (this count excludes day 1 which was discarded as training, as is typical of DES). She followed the typical DES sampling-interview procedure that is described fully in Chapter 3 (Method), Step 2.

Candy participated in the study across a total of four menstrual cycles. With few exceptions (approximately 16 days missed over the course of more than 120 days of active sampling), Candy shared daily pictures of her ovulation test kit results. However, for Candy, the test successfully detected ovulation (ferning) on only one occasion. We cannot say whether this was related to the test itself (e.g., the test failed to detect ovulation when it was, in fact, present; a "false negative") or to Candy's hormone activity (e.g., perhaps she was not regularly ovulating). Therefore, to determine which sampling days occurred during ovulation, we first considered the midpoint of her cycles. Over the time she participated, her average cycle length was 29 days, therefore estimating ovulation as occurring approximately between cycle days 13 and 17. Consistent with that range, the lone occasion on which her test indicated ovulation was cycle day 17. Table 6 displays in the top panel the breakdown of Candy's sampling days by cycle phase. The bottom panel displays the frequencies of her salient experiential phenomena within each cycle phase and overall.

Table 6

Characteristics of Candy's inner experience overall and by cycle phase

Menstrual Cycle Phase	Traditionally Non-Symptomatic	Ovulation	Late Luteal/ Premenstrual	Total	$X^2(2)$
Days of Menstrual Cycle	1-12 and 18-20	13-17	21+		
Number of Sampling Days	6	6	7	19	
Number of Samples	36	36	40	112	
	Frequencies (%)[a] of Experiential Phenomena				
Inner speaking (IS)	29.2	19.4	32.5	27.2	1.73
Inner seeing	2.8	8.3	12.5	8.0	2.43
Unsymbolized thinking	0.0	1.4	2.5	1.3	0.90
Feeling	6.9	12.5	10.0	9.8	0.63
Sensory awareness (SA)	13.9	23.6	20.0	19.2	1.12
IS while reading	9.7	11.1	0.0	6.7	4.52
IS while texting/typing	2.8	8.3	2.5	4.5	1.87
Word-by-word	1.4	20.8	0.0	7.1	15.05*
Bodily feelings	6.9	9.7	12.5	9.8	0.66
Visual SA (all)	5.6	15.3	12.5	11.2	1.83
Visual SA bright/shiny	0.0	8.3	7.5	5.4	3.03
Bodily SA	5.6	5.6	7.5	6.3	0.17
Nothing	13.9	19.4	17.5	17.0	0.41
Almost or barely containing phenomenon	11.1	26.4	7.5	14.7	5.94
Just doing, physical action	6.9	8.3	0.0	4.9	3.29
Seeing	12.5	19.4	20.0	17.4	0.89
Hearing	11.1	9.7	2.5	7.6	2.35
Words present without semantic meaning	5.6	16.7	6.3	9.4	3.33

[a] Note that % need not up add to 100 because a single sample can contain multiple phenomena.

* "significant" (recall that this analysis did not adjust for multiple tests) at $p < .05$

Analysis

We followed the usual analysis described in Chapter 3 (Method), Step 2: We first reviewed and "captioned" all samples together (blind to their associated cycle phase) and then separated sampling days by cycle phase and phenomenologically and quantitatively examined differences in experience across phases.

The Individual (blind to menstrual cycle phase). Across all her samples, Candy's experience was relatively simple, usually one or perhaps two ongoing phenomena. The phenomena themselves were typical by DES standards and included frequent inner speech and sensory awareness. However, we noticed that, while the sample captioning process was usually a simple task (we could easily write as a caption, for example, that Candy was engaged in "inner speech" or "sensory awareness, visual, brightness"), it was sometimes not as simple.

With Respect to Menstrual Cycle Phase. After "binning" Candy's sample captions by cycle phase, we phenomenologically observed evidence of what we had experienced during the sample captioning process: Captions appeared to be longer in the ovulation "bin" than in the other bins, particularly more than in the late luteal/premenstrual bin. That is, we apparently had needed, during the sample review meeting, to use more words to characterize the ovulation-phase experiences than the late luteal/premenstrual-phase experiences. To test that notion, we compared [using exploratory analysis of variance (ANOVA)] the caption character count across the three cycle phases, finding that they were significantly different, $F(2, 99) = 7.36$, $p = 0.001$. Inspection, justified by considering these as exploratory, showed that the ovulation caption mean (35.38 characters) was indeed the largest and the late luteal/premenstrual caption mean was the smallest (16.19 characters); the traditionally non-symptomatic mean was intermediate (26.64

characters). We speculated that this reflected how Candy's experiences during ovulation were somehow more complex/less straightforward than the others.

We then deviated slightly from the usual analysis in that we designed a brief experiment to test our hypothesis that candy's ovulation-phase experiences were more complex/unclear than her late luteal/premenstrual-phase experiences. We asked Candy to wear the beeper twice more, once during ovulation and once in the late luteal/premenstrual phase (these became Candy's sampling days 19 and 20). For these final two sampling days, the present author was aware of cycle phase, but RTH continued to be fully blind. Upon completion, we reviewed and captioned those day 19 and 20 samples in the same way we had for the earlier review and captioning with the goal of understanding and identifying the emergent/salient characteristics of Candy's experiences at each sample. We were sensitive as best we could be to the pressures our hypothesis put on this process (e.g., that we might be tempted to use more words to describe the ovulation beeps to fit our observation about the complexity/lack of clarity). In the end, our earlier hypothesis was supported: Candy's experiences on sampling day 19 (ovulation) were more complex and more difficult to classify (*and* required longer captions) than were her experiences on sampling day 20 (late luteal/premenstrual).

Then, and finally, we conducted the usual exploratory chi-squared tests to examine whether the frequency of individual phenomena varied across cycle phases. Because this study was exploratory, we did not correct for the multiple chi-squared tests, and what we will call "significant" implies only that the frequency differences were relatively large. For Candy, there was one significant finding: "Word-by-word" experiences (in which Candy was aware of only a single word even though the word belonged within a longer stream of words such as during inner speech) were far more frequent during ovulation (20.8% of samples) than they were across other

cycle phases (1.4% of traditionally non-symptomatic and 0.0% of late luteal/premenstrual samples), X^2 (2) = 15.05, p = .001. One other finding was suggestive: Candy had more experiences coded as "almost or barely containing some phenomena" (i.e., close to nothing in experience) during ovulation (26.4% of samples) than the traditionally non-symptomatic (11.1% of samples) and late luteal/premenstrual (7.5% of samples) phases, $X^2(2) = 5.94$, $p = 0.051$.

Thus, on the basis of 20 days of natural-environment sampling and careful description of 112 individual moments of private inner experience, it appeared that Candy's experience did fluctuate with her menstrual cycle. Specifically, we observed that Candy's experiences during ovulation were more complex, unclear, and difficult to classify neatly than were her experiences during the late luteal/premenstrual phase. this ovulation complexity did not appear to be an artifact of the method or a failure of language but rather reflected the experiences themselves. That is, Candy's actual lived experiences during ovulation were more complex—sometimes because phenomena were sort-of-but-not-fully-present and sometimes because a phenomenon was similar to a common phenomenon but somehow "less" present/full/rich. In contrast, Candy's experiences during the late luteal/premenstrual phase were much more straightforward with clearly and fully present common phenomena. In brief, candy's late luteal/premenstrual phase experiences generally had a clear "figure" apprehended against a less clear "ground" (borrowing the terms from Gestalt Psychology), whereas the figure of her ovulation phase experiences was not as clearly distinct from the ground.

The concept of "figure-ground" was introduced by Gestalt psychologists and is typically applied to visual perception. The idea, though revolutionary at the time, is actually quite simple: To make sense of our complex and often chaotic world, people combine separate elements into a unified whole with a central figure (focus) distinguished from the ground (background). The

figure emerges clearly and distinctly: It tends to appear larger, closer, isolated from other elements, and with clear details, edges, and contrast. The ground, in contrast, is indistinct, blurrier, and has few details. As we extend that concept here with respect to inner experience, we note that the experiential figure tends to capture us, grabs our interest and involvement, and has apprehended force or power, whereas the ground disappears or is perceived mostly in how it holds or surrounds the figure.

With respect to Candy, during the late luteal/premenstrual phase, her experiences had, in general, a clear central "figure": a sample was, without equivocation, the experience of innerly speaking while reading; another sample was, without equivocation, a sensory awareness of brightness; another sample was, without equivocation, the experience of innerly seeing (seeing a detailed image). These phenomena were, without her having any doubt or difficulty, present to her as ongoing at the moment of the beep. For example, sample 12.2:

> 12.2: [Candy is staring at her rose gold glitter iPhone case.] She is drawn to the glitteriness of the case. This is a sensory awareness of the glitteriness [*not* the color] of the case with little or no experience of the fact that it is a phone case or its purpose/functionality.

That sample was an example of what DES calls "sensory awareness," the experience of attending to a particular sensory aspect of an object (internal or external) without particular regard for instrumentality (Hurlburt, Heavey, & Bensaheb, 2009). Candy's experience was fully, singularly, and unequivocally aimed at the glitteriness of her phone case. The glittery visual sensation was unabashedly the figure of her experience; it emerged clearly and completely; the phone, its potential function, and the rest of the universe had disappeared from her experience. As another example, consider sample 15.6:

15.6: [Candy is watching a video of Kylie Jenner applying makeup.] She is drawn to the motion of Kylie's hand [as it applies the eyeshadow], a sensory awareness of the stroke-y motion [ambivalent to the fact that the motion is to apply eye shadow]. At the same time, Candy feels calm/relaxed in her body all over, head-to-toe. [The calm is apparently created by watching Kylie's motion/strokes.]

As in sample 12.2, at sample 15.6, a sensory awareness (in this case, of stroke-y motion) clearly and fully emerged as the figure of Candy's experience. She was aimed squarely at the motion made by Kylie's hand, an awareness of a specific visual sensory/motion quality. Her experience was not aimed at eye shadow application (instrumentality) but rather, at the gentle, back-and-forth stroke-y motion of Kylie's hand (as she, in fact, applied eye shadow). That is, the stroke-y motion was the figure and the rest of the eye-shadow process had disappeared into the ground. At the same time, Candy felt calm, a bodily experience of emotion. Like the sensory awareness of the stroke-y motion, this calm feeling was a clearly present figure. She apprehended the feeling distinctly as *calm/relaxed* (not, for example, happy/sad/bored/etc.) and she apprehended it, without question, in her body (as opposed to mentally), all over from head-to-toe.

Those samples (12.2 and 15.6) were both in Candy's late luteal/premenstrual phase. by contrast, during ovulation, Candy's experiences did not generally include such distinct, clear, and dominant figures. Indeed, 26.4% (9.5 of 36) of Candy's ovulation samples were coded as "almost or barely" containing some phenomenon (in comparison to only 3 of 40, or 7.5%, of Candy's late luteal/premenstrual samples and 2.5 of 36 or 6.9% of all traditionally non-symptomatic samples). See, for example, from the ovulation phase:

9.4: [Candy is watching a video she had just taken of her and her brother.] Mostly (approximately 90% of the total experience), she sees her brother's face. This is an idle

seeing; she sees his face as it appeared on the video and is not drawn to or focused on anything in particular. In fact, in the video, her brother's entire body is shown, and he was dancing, but she isn't paying attention to (or even seeing) any of that at the moment. She simply sees, without much engagement, his face. At the same time but less salient (10% of the total experience), she hears idly or barely her brother singing in the video, "a tus amigas video."

Thus, at that sample, Candy's attention had a directed quality (she saw her brother's face but not the rest of his body) but did not have the clarity, force, power, or interest that characterized the figures of the late luteal/premenstrual phase. She was watching a video, seeing with little engagement her brother's face (in reality, a small aspect of the video) and hearing with hardly any engagement what he was singing. She saw his face but didn't really care about it—it had no force for her. Contrast that with the glitteriness of the phone case in 12.2, where, despite its real insignificance, the glitteriness powerfully dominated her experience. Experiences of this sort-of-watching-the-video-of-me-and-my-brother kind were relatively common for Candy, and we came to understand them best as "idle" seeings and hearings. They were coded as "almost or barely" containing some phenomena (in this case, barely seeing and barely hearing). Here is another example from the ovulation phase:

10.4: [Candy is about to check the weather via the Weather app on her phone. However, she is side-tracked in the process when the Calendar icon catches her attention.] At the moment of the beep, she is seeing the Calendar icon (which happens to be white with black letters "18" for the date). Her experience is of seeing the icon as it is. She is not drawn to any particular sensory aspect nor is she having any accompanying cognitive or evaluative experience.

At that sample, Candy was (as in the video-watching sample 9.4) seeing idly, with little or no engagement. Her eyes were aimed at the Calendar icon and the icon registered, but with little force, power, or figural clarity, in her experience. The experience seemed almost accidental, happenstance, with no real directed attention or interest.

These "almost or barely" examples help illustrate the way Candy's ovulation-phase experiences lacked a fully present central figure. To further illustrate, consider sample 9.6:

> 9.6: [Candy is preparing to send a video to a friend. She is holding her phone about arms-length in front of her while making hand gestures to the phone camera with her other hand (as if the phone were a mirror). At the moment of the beep, Candy's arm is outstretched beside her head and she is twisting and twirling her hand.] In her experience, she sees (in the camera) her hand gesture. That is, she is watching her hand twist and twirl. The camera shows her entire arm and hand (and maybe also her face), but she is paying attention mostly or only to the hand. There is no accompanying evaluation/analytic experience, no thought about the hand or her friend or anything else.

Thus, at that sample, Candy was watching in her phone camera as she twisted and twirled her hand, but her experience was not of doing the twirling, nor was she in any way thinking or cognizing about how she looked or what she was doing. Her experience was of seeing her hand, which was, phenomenologically speaking, a perception (seeing), yet it would not be accurate to classify her experience as *only* perception. She was slightly more experientially involved. Her seeing was not idle in the way we described for samples 9.4 and 10.4; she was watching her hand with some apparent interest. But while this hand-twirling experience was more than idly seeing, it did not reach the powerful, gripping sensory awareness of, for example, the stroke-y hand motion in sample 15.6 or the glitteriness of the phone case in sample 12.2. Like sample 15.6,

Candy was watching motion but, unlike 15.6, she was not fully, clearly, unequivocally noticing any particular quality of the motion. Her interest was not, for example, grabbed by the twirling motion or the daintiness of her hand or its color or any other sensory quality. The twirling-hand sample 9.6 was, like others of her ovulation-phase experiences, difficult to neatly classify. The experience seemed to be inching toward sensory awareness but yet, no sensory quality emerged as the distinct central figure. Sample 6.5 during ovulation was another example of the failure of a figure to emerge clearly:

> 6.5: [Candy is erasing her whiteboard.] She is mostly (approximately 70% of the total experience) trying to get everything completely erased. Simultaneously (approximately 30% of the total experience), she is visually and motorically noting the pleasantness of the erasing [That is, it's cool/nice/satisfying both to be performing the action of erasing and to see all of the writing wash away.]

Here again Candy's experience seemed to be "in the ballpark" of but just shy of sensory awareness. She experienced more than merely the act of erasing—there was something bodily and visually pleasant about it—but the figure of that pleasantness did not emerge clearly or dominantly. She was not, for example, drawn to the contrast of the white board and the color of the marker or of the shape created by her erasing or the circular motions of her hand or any other sensory quality. Again, it seemed the experience was in the direction of sensory awareness, but the figure did not fully emerge. Moreover, other samples (such as the glittery phone case) demonstrated unequivocally that Candy could apprehend and describe sensory awareness when it emerged as a central figure in her experience. Thus, her almost-but-not-quite sensory awareness experiences, such as of her twirling hand or erasing the white board, were apparently not the

result of lack of skill or descriptive ability, but rather, we think, were the result of differences in the experiences themselves.

These examples have centered primarily on sensory awareness, but the difference between Candy's ovulation and late luteal/premenstrual phase experiences extended to other phenomena as well. For example, let us consider examples of inner speech. Sample 4.1 was an example of inner speech during the late luteal/premenstrual phase and, consistent with what we observed of that phase, was clear and straightforward:

> 4.1: Candy hears the bell on her dog's collar [meaning the dog was approaching her, following her, probably wanting something from her]. She innerly says in her own voice in a slightly annoyed/exasperated tone, "How annoying." [Her annoyance is aimed mostly at the bell sound.]

That sample was a straightforward, unambiguous, garden-variety example of inner speech. "How annoying" was unequivocally the figure of her experience apprehended clearly in a voice with specific tone and specific words in a way that without question fit the DES nomothetic category "inner speaking." See also sample 2.2 of inner speech while reading (a fairly common experience for Candy occurring in 7.6% of all samples):

> 2.2: [Candy is watching an Instagram story] and reading the text on the story, "Autism Awareness Month," which she simultaneously sees on the screen and innerly says in her own voice but in a monotone/flat tone. She is comprehending the meaning as she reads; that is, she understands what "Autism Awareness Month" means/alludes to/etc.

Like the "How annoying" sample before, this was a straightforward example of inner speech. Candy said in her own voice "Autism Awareness Month" as she read it. Again, the figure was

clearly present, apprehended in her own voice, with specific words, in a specific tone, and with meaning.

In contrast, sample 10.1, during ovulation, was a subtly—but importantly—more complex example of inner speech:

> 10.1: [Candy is reading a comment on a YouTube video.] She is reading with some comprehension—getting, at least, the 'gist' of the comment—and innerly speaking the words in her own voice as she reads them. At the moment of the beep, her experience is of innerly speaking "innovative." This is a single word experience; that is, her experience is of "innovative," not, at that moment, of any other words, including those in the larger sentence to which "innovative" belongs. [We believe that Candy understood the distinction between apprehending word-by-word as opposed to apprehending the arc of the sentence and was, herself, surprised at the word-by-word characteristic. We probed about this repeatedly with skill and adequate bracketing (see also samples 9.5, 10.2, 10.6).]

Thus, as with the late luteal/premenstrual "How annoying" and "Autism Awareness Month" samples, Candy innerly spoke while reading; however, unlike those samples, her experience was of only a single word (what we ultimately categorized as "word-by-word" experiences) and limited meaning. Even though "innovative" belonged to a larger sentence, none of the surrounding words were present in Candy's experience. It was as if her experience didn't care to gather up the surrounding words to make a meaningful whole (figure). She confidently and with adequate skill and consistency asserted that only the word "innovative" was present. Moreover, whereas in the "Autism Awareness Month" sample, she had comprehended the meaning of the

phrase, in the "innovative" sample, she was only somewhat comprehending, grasping the "gist" of the reading.

The single-wordedness of Candy's "innovative" ovulation sample 10.1 is relatively remarkable by DES standards: Typically, when the beep "catches" people engaged in inner speech, they confidently assert that an entire sentence or phrase is present. Those (sometimes many) words are "held in experience," so to speak, even when, in some cases, as many words could not simultaneously exist at a single microsecond in time. Sample 9.3, also during ovulation, was perhaps an even more remarkable example:

> 9.3: [Candy has some free time and is going through her text messages responding to people she has not texted back. A friend asked, "How are you?"] and now, at the moment of the beep, Candy is typing "I'm good." She innerly says the words in her own voice as she types them: "I'm goo—". [The beep interrupts her such that she only innerly says "I'm goo—" even though, had she not been interrupted, she would have continued on to say "I'm good."] [Her experience is of saying the words at a normal rate of speech, even though in actuality they would have to be said slower to match her texting rate.]

This sample was thus of the same word-by-word ilk as "innovative" sample 10.1 except that, in this sample, the discreteness of the word was even more extreme. Her experience was of *even less than* a single word; it was a single sound. Candy split the word "good," only experiencing at the moment of the beep "goo" even though she was clearly intending to type and say "good." It would be much more typical for a DES participant to report innerly saying the entire phrase "I'm good" even if he or she had not yet completed typing "good"; such disconnect-between-inner-words-and-typed-words experiences are common, in fact. We conceptualized these word-by-word experiences as yet another manifestation of the complex, non-fully-figural quality of

Candy's ovulation-phase experiences. That is, during ovulation, words (the figure) did not always fully emerge as a unified whole of a phrase like they did in late luteal/premenstrual samples. The chi squared analyses supported that conceptualization: In fact, whereas this remarkable single-worded experience was frequent for Candy during ovulation (7.5 of 36 samples, or 20.8% of samples), there were no examples of single-worded experience during the late luteal/premenstrual phase (and only one possible example during the traditionally non-symptomatic phase), X^2 (2) = 15.05, p = .001.

Summary

At the time of her participation, Candy was a Hispanic, undergraduate university student between the ages of 18 and 25. Her screening responses indicated she experienced clinically significant symptoms of premenstrual distress. She agreed to participate in DES sampling and ultimately did so 19 times across a total of four menstrual cycles, collecting a total of 112 beeped experiences. Her menstrual cycles were regular during the course of her participation with an average length of 29 days; however, it is possible Candy was not regularly ovulating given that the saliva ovulation test only definitively detected ovulation on one occasion (other explanations are also possible, for example, that the test was insensitive or that she used it improperly). On the basis of those 112 moments of experience, it seemed that Candy's experience differed across menstrual cycle phases. Specifically, her experiences during ovulation were more often unclear, complex and almost or barely containing some phenomenon that had not, as we analogized, fully emerged as a figure against the ground. In contrast, her experiences especially during the late luteal/premenstrual phase were clear, unambiguous, and straight-forward. The complexity of Candy's ovulation-phase experiences was striking, consistent, and observed across different phenomena.

Chapter 6: Lane

Lane is a Caucasian female. At the time of sampling, she was between 25 and 35 years old. She was employed full time while attending school part-time for an undergraduate degree in the social sciences.

Lane's chapter differs from the others in that it will proceed in two parts. The first part is the usual analysis, an exploration of menstrual-cycle-related differences in inner experience. The second part will focus on the potential impact of medications on experience because, after completing 12 days of DES sampling, Lane chose to suspend her participation so that, she said, she could focus on schoolwork. When she returned approximately three months later, she informed us that she had undergone a psychiatric evaluation and was diagnosed with Attention-deficit/Hyperactivity Disorder (ADHD) and Bipolar II Disorder and prescribed Adderall (for attentional symptoms) and Lamotrigine (for mood stabilization). Lane stopped menstruating after she began taking these medications, as is a common side effect of antipsychotic medications like Lamotrigine (Seeman, 2011). We continued sampling with Lane for four more sampling days (days 13-16) even though she was no longer regularly menstruating; As a result, we could not make the same inferences about her menstrual cycle phase (and, by deduction, hormone levels) on those days as we usually did for this study. We could, however, compare those four with-medication days to Lane's first 12 without-medication days to explore whether the introduction of psychotropic medications had any impact on her inner experience. This was an unexpected avenue by which to approach the study's broader interest, which is how biology relates to inner experience.

Step 1: Screening

Lane's screening results indicated she was appropriate for the study. She reported she had regular menstrual periods. She denied any medical conditions, behaviors (e.g., shift work), or

medications (including birth control) that would alter her hormone function. She endorsed a prior episode of depression (approximately three years prior) for which she was treated with antidepressant medication. Lane's responses indicated she experienced clinically significant symptoms of Premenstrual Dysphoric Disorder (PMDD). She endorsed all 11 DSM-5 symptoms of PMDD and noted that those symptoms profoundly impacted her functioning at work and school. On the Premenstrual Assessment Form (PAF), Lane earned a score of 47, which translates to a *z* score of 1.7 and therefore placed her score higher than approximately 95% of those in the normative, non-clinical sample. On the Visual Analogue Scales of PMDD symptoms, she reported that her mood symptoms were, on average, 72.25% worse during the premenstrual phase as opposed to the rest of her cycle. She reported all PMDD symptoms (mood *and* behavioral) were, on average, 85% worse during the premenstrual phase as opposed to the rest of her cycle.

After meeting Lane, we learned of several factors that may have complicated her health and hormone function. Specifically, Lane described a prominent history of distressing menstrual-related symptoms for which, she said, she had unsuccessfully sought treatment for more than ten years. She reported that, within the last year, she underwent elective tubal ligation surgery for endometriosis. Endometriosis is a disease characterized by the growth of endometrium-like tissue outside the uterus, most typically in pelvic organs, including the ovaries. The most commonly cited consequences of endometriosis are pain and infertility, though many other quality-of-life aspects are affected (Agarwal et al., 2019). Endometriosis is associated with elevated levels of estrogen (Kitawaki et al., 2002) and may impair spontaneous ovulation, though research on the impact of endometriosis on ovulation is mixed (Benaglia et al., 2009; Maggiore et al., 2015). Tubal ligation, in contrast, generally has little effect on ovarian hormone function

and is not known to disrupt ovulation (Fagundes et al., 2005; Tiras et al., 2001). Lane's fairly confident impression was that she was still ovulating post-surgery.

If Lane's health complications had, in fact, disrupted her ovarian hormone function, then she was not the ideal candidate for our study. In another manner of speaking, however, the severity of Lane's premenstrual symptoms made her the ideal candidate for our study. Ultimately, we chose to engage Lane in sampling and interpreted her results (wherever possible) separated by cycle phase. We also, however, acknowledge the possibility that, when we separated Lane's experiences by cycle phases, those cycle phases were not characterized by the same levels of and changes in hormones as would be expected for a woman with typical hormone function.

Recall that the status of Lane's biology became further complicated when, after her first 12 days of DES sampling, she began taking psychotropic medications for ADHD and Bipolar Disorder. We, of course, did not and could not have anticipated that at the time of Screening.

Step 2: DES Sampling & Cycle Tracking (the usual analysis, without-medication)

Lane completed 16 days of DES sampling; however, because psychotropic medications caused her to stop regularly menstruating after sampling day 12, only the first 12 sampling days could be classified according to menstrual cycle phase and analyzed in the usual way. During those first 11 days of natural-environment DES sampling, Lane collected a total of 66 beeped experiences. (this count excludes day 1 which was discarded as training, as is typical of DES). [This first analysis (Step 2) will consider only those 11 days with the usual menstrual-cycle-related analysis but recall there will be a second analysis (Step 2b) that compares Lane's experience with- and without-medication.]

With only one exception during those 11 sampling days, Lane shared daily pictures of her ovulation test kit results. Across the three menstrual cycles, her average cycle length was 25 days, therefore estimating ovulation around days 10-14. Consistent with that estimation, the two sampling days we identified by ferning as occurring in the ovulation phase were on cycle days 12 and 15. Thus, the ovulation test kit appeared to be effective for Lane.

Analysis

The Individual (blind to menstrual cycle phase). As usual, we completed all 16 days of DES sampling before reviewing or analyzing any samples. Then, we reviewed and captioned all 16 days of samples before conducting two separate analyses. This was the usual analysis: a consideration of cycle-related differences in experience during Lane's first 11 days of sampling (without-medication). The top panel of Table 7 displays the breakdown of Lane's sampling days by cycle phase for those 11 sampling days. The bottom panel displays the frequencies of Lane's salient experiential phenomena within each cycle phase and overall.

Table 7

Characteristics of Lane's inner experience overall and by cycle phase (the usual analysis, without-medication)

Menstrual Cycle Phase	Traditionally Non-Symptomatic	Ovulation	Late Luteal/ Premenstrual	Total	$X^2(2)$
Days of Menstrual Cycle	1-12 and 16-20	12-15	21+		
Number of Sampling Days	7	2	2	11	
Number of Samples	42	12	12	66	
Frequencies (%)[a] of Experiential Phenomena					
Inner speaking	35.7	25.0	66.7	39.4	5.02
Inner seeing	6.0	33.3	8.3	11.4	7.08*
Unsymbolized thinking	42.9	41.7	16.7	37.9	2.81
Feeling	14.3	25.0	12.5	15.9	0.93
Sensory awareness	38.1	33.3	62.5	41.7	2.71
Multiplicity	22.6	4.2	45.8	23.5	5.85
"Organismic apprehension"	41.7	25.0	50.0	40.2	1.67
Bodily feelings	4.8	8.3	12.5	6.8	0.93
Bodily + mental feelings	4.8	8.3	0.0	4.5	0.97
Multiple simultaneous sensory awarenesses	23.8	8.3	16.7	19.7	1.50
Bodily sensory awareness	28.6	25.0	37.5	29.5	0.50
Feeling/sense in specific body region	4.8	16.7	8.3	7.6	1.90
Tactile sensory awareness	11.9	16.7	16.7	13.6	0.29
Auditory sensory awareness	0.0	0.0	16.7	1.5	9.28*
Seeing	4.8	25.0	25.0	12.1	5.87
Hearing	7.1	0.0	8.3	6.1	0.97

[a] Note that % need not up add to 100 because a single sample can contain multiple phenomena.

* "significant" (recall that this analysis did not adjust for multiple tests) at $p < .05$

With Respect to Menstrual Cycle Phase (the usual analysis, without medication).

Once separated by cycle phase, Lane's experiences appeared clearer and simpler during ovulation as compared to other cycle phases, especially the late luteal/premenstrual phase. The ANOVA of caption lengths confirmed this observation, showing that the caption length differed "significantly" across cycle phases, $F(2, 63) = 4.20$, $p = 0.019$. Inspection (justified by considering these analyses exploratory) showed that ovulation captions were shortest ($M = 23.58$) and that traditionally non-Symptomatic ($M = 61.79$) and late luteal/Premenstrual ($M = 57.33$) captions were similar in length and longer than during ovulation. We speculated that this reflected how Lane's ovulation-phase experiences were clearer, simpler, and more straightforward than experiences during other phases, thus requiring fewer words to summarize.

We then conducted the usual chi squared analyses to test whether the frequencies of experiential phenomena differed across cycle phases. There were two "significant" (this was exploratory, and so did not adjust for multiple tests) findings:

- Inner seeing differed across cycle phases. By inspection, inner seeings were more frequent during ovulation (33.3% of samples) than they were in the other phases (6.0% of traditionally non-symptomatic samples and 8.3% of late luteal/premenstrual samples), (X^2 (2) = 7.08, $p = 0.029$).
- Auditory sensory awareness differed across cycle phases. By inspection, auditory sensory awareness never occurred during ovulation or the traditionally non-symptomatic phase, whereas it occurred in 16.7% of all late luteal/premenstrual samples, (X^2 (2) = 9.28, $p = 0.010$). However, note that, given the small number of late luteal/premenstrual samples, 16.7% only corresponds to 2 total experiences.

Two other findings were suggestive:

- Multiplicity seemed to differ across cycle phases (X^2 (2) = 5.85, p = 0.054). By inspection, multiplicity was less frequent during ovulation (4.2% of samples) than it was in the other two cycle phases (22.6% of traditionally non-symptomatic samples and 45.8% of late luteal/premenstrual samples).
- Seeing seemed to differ across cycle phases (X^2 (2) = 5.87, p = 0.053). By inspection, seeing was more frequent during ovulation and the late luteal/premenstrual phase (25.0% of samples in each of those phases) than it was during the traditionally non-symptomatic phase (4.8% of samples).

To illustrate this clarity-during-ovulation observation, let us first consider examples of unclear, highly complex experiences in non-ovulation phases, such as this one from the late luteal/premenstrual phase:

> 10.6: [Just before the beep, Lane was reading a Reddit thread that began with the question, "What was the black market of your high school?" Other users' answers had been, to her ear, "innocent" things like "PB&J sandwiches," which surprised her because, at her school, Xanax was the black-market item.] At the moment of the beep, she somehow experiences being in her high school courtyard, a sort of collage of rememberings/re-experiencings. She experiences simultaneously many different aspects of the courtyard and her experiences there (e.g., seeing the courtyard, focusing on a particular memorable shaded region, recalling a girl who used to sell Xanax). The re-experiencings are rich in that they include senses of where things were, what they looked like, who was there, how it felt, all of which is present to her simultaneously, but none of which is fully articulated for any of the simultaneously present aspects. Her experience at this moment is entirely captured by this re-experiencing-collage of the courtyard. [She

cannot even recall where she was or what she was doing in reality at the time the beep occurred.]

Notice that, at the moment of that beep, Lane's experience was rich and complex but not well-articulated. For example, it had visual details (the shaded region of the courtyard for instance), yet she did not have the experience of imaginarily *seeing* anything. She somehow, without actually innerly *seeing*, imagined the shaded courtyard. Another part of the complexity of this high-school-courtyard sample was its multiplicity. "Multiplicity" refers to experiences in which there are several simultaneous but different (and often disjointed) aspects ongoing at a single moment—what Lane herself called a "collage." That is, Lane directly apprehended (though how was not entirely clear) what the courtyard looked like, how it felt to be there, who was typically there, and even specific memories such as a classmate selling Xanax. Each of those aspects was simultaneously present to her and yet none was apparently the central focus or "figure" of her experience.

Sample 7.5 during the traditionally non-symptomatic phase was another of Lane's "messy" experiences:

> 7.5: [Lane is lying down.] Mostly (60% of the total experience), she feels pains in her hip, leg, and knee. [It's the same pain, probably, by origin] but is differentiated in her experience such that there seem to be separate sensations in each location and each sensation is appreciably (even if only minorly) different from the others [She cannot say exactly how they differ at the moment of the beep. In each location there is a lightly pulsating sensation, but perhaps the knee feels a little sharper at the moment whereas the hip is duller and perhaps these differences are changing moment to moment]. At the same time (40% of the experience), she wonders in a cognitive way without words or pictures

whether yoga has been helping with the pain. As part of that experience, she remembers how it felt to be in her yoga class earlier that day. This is a mostly physical recollection/re-impression or sense of being-there-in-yoga-class but is not specific. That is, it is not that she re-experiences any specific feeling, interaction, or body sensation that happened during the class. Rather, she remembers *how it was* where the *it* is more-or-less inchoate/unarticulated in her experience. Thus, this is one yoga experience with a cognitive aspect aimed at yoga generally and a more (as best we could say) physical aspect aimed at how it was to be in a specific yoga class earlier.

Like the high-school-courtyard sample before, the complexity in this sample arose from two features: (1) the unarticulated/undifferentiatedness of the being-there sense which, though difficult to describe, was without question present to Lane at the moment, and (2) the multiple ongoing phenomena (three simultaneous but separate physical sensations of pain + a thought process + a being-there sense/remembering). Consider also sample 4.2 during the traditionally non-symptomatic phase:

4.2: [Lane is typing "Jan" into her weekly to-do list for Saturday.] She is somehow cognitively anticipating that Jan and Jan's boyfriend are coming over to her house on Saturday to swim and, simultaneously, somehow cognitively recalling the last time Jan had come over to swim and had FaceTimed this boy (whom Jan had just met but who is now Jan's boyfriend) for several hours. This is one experience with two aspects – one imaginary anticipatory awareness/thought of Jan and her boyfriend coming over and one recollective imaginary awareness/thought of the last time she was with Jan and (by unintended FaceTime) Jan's boyfriend. [There was perhaps something comparative about these two aspects—comparing the last time to this upcoming time, but if or how

comparison was present was not clear]. This experience is not visual; that is, she does not see them at the pool either in the past or future. Nor, is it very specific: Lane knows they will be in her backyard on Saturday—that part is specified—but, beyond that, the thought/awareness is unspecific.

That sample was, again, a complex, highly undifferentiated experience. Lane definitely had some "awareness" of her last visit with Jan and, simultaneously, her upcoming visit with Jan, but how, exactly, those awarenesses presented themselves was not clear. It would not be faithful to say that Lane was innerly *seeing* her past or upcoming visits with Jan because—even though there were details that seemed visual (e.g., remembering that they had been previously and would be this time in her backyard)—she did not experience herself as *seeing* at the moment. It would not be faithful to say Lane was *thinking* (like an unsymbolized thought process) of Jan because her experience was not distinct and explicitly cognitive in the way unsymbolized thought processes typically are. And it would not be faithful to say that Lane had some *feeling* about her past and upcoming visits with Jan because there was apparently no emotion ongoing.

Thus, as those examples illustrate, Lane's non-ovulation samples were often highly complex, usually multiple, and often not well-articulated/differentiated. in contrast, let us now consider some of lane's ovulation samples, which were more often clear and relatively simple with a central "figural" phenomenon (such as sample 5.5):

5.5: [The wind has been blowing Lane's office door open and closed, triggering the door alarm to beep.] At the moment of the beep, she hears the door beep, sees on the security video that the front door is flapping with no one entering or leaving, and innerly says in her own voice with a slightly annoyed tone, "I wish the door would stop beeping." The inner speaking is experienced as equally spoken and heard.

Ovulation samples 5.3 and 6.2 were also clear and straightforward despite containing multiple phenomena:

> 5.3: [Sometime before the beep, Lane let a man into her office so that he could drop off boxes. Now, she is preparing her lunch,] and (90% of the total experience) is wondering in a cognitive way without words or pictures something like, *Will he [the man with the boxes] be done by the time I'm done prepping my lunch? Will he say goodbye or just leave on his own?* At the same time but much less prominent (10% of the experience), she's looking at the grapes she's washing, trying to spot moldy ones so she can remove them from the bunch. She is not particularly drawn to any visual or tactile aspects of the grapes.
>
> 6.2: [Lane gathers her DES beeper, notepad, and pen and starts to walk toward the bathroom.] At the moment of the beep, she innerly says to no one in particular, "Unfortunately, I have to carry this thing [referring to the awkwardness of having no pockets and therefore having to carry the beeper with her to the bathroom]." This is in her voice in a matter-of-fact tone, and her experience is of speaking, of producing the words. At the same time and equally present, she feels a pins-and-needles sensation [her leg is asleep] in her lower left leg from the top of her foot to her knee. This is an entirely sensory experience; she is not analyzing or otherwise thinking about the sensation, just feeling it.

Lane's experience at these three beeps was clear, well-articulated, and relatively simple. Note that Lane's clarity during ovulation was apparently not due only to a lack of multiplicity as, even during ovulation, she had experiences with multiple simultaneous phenomena (such as in the wondering-about-the-delivery-man sample 5.3 and beeper-carrying sample 6.2). However,

the multiplicity at those moments was noticeably less complex than that of the non-ovulation-phase experiences described earlier. For example, at the delivery-man sample 5.3, the two simultaneous phenomena (an unsymbolized thought process about the delivery man as well as looking with intention at the grapes) were each well-articulated and neatly constrained: The aspect about the delivery man was without question and exclusively an unsymbolized thought process, and the aspect about the grapes was without question and exclusively a visual perception. This was in stark contrast to, for example, the non-ovulation high-school-courtyard sample 10.6, during which Lane was somehow experiencing many aspects of the courtyard yet none of those aspects was well-articulated.

Moreover, at the ovulation delivery-man sample, there was a clear focus: Lane was far more interested in the delivery man than the grapes (90% compared to 10%). The delivery man was clearly the figure whereas the grapes were the background. In contrast, during some non-ovulation samples, there did not seem to be a single aspect that was the most salient, central figure. For example, at the late luteal/premenstrual 10.6 high-school-courtyard beep, no single aspect of the courtyard was most important. Similarly, at the Traditionally Non-Symptomatic three-simultaneous-pains sample, Lane was only slightly more interested in the physical pain sensations than the being-there sense about the yoga class (60% compared to 40%)[1]. Moreover, the "60%" of her experience aimed at the physical sensations was, itself, divided among three separate but simultaneous sensations each in a different bodily location.

Thus, there seemed to be, during ovulation, a striking clarity and simplicity in Lane's experiences as compared to other phases of her cycle which were characterized more frequently

[1] Note that the percentages themselves are arbitrary; by "60% and 40%," we understand Lane to mean something like, "I'm just a little more into the pain than the yoga class" whereas "90% and 10%" convey something like, "I'm way more into the delivery man than the grapes."

by multiple phenomena including phenomena that were inchoate, unarticulated, or otherwise difficult to describe. And, indeed, there were fewer samples coded as "multiple" during Ovulation as compared to the other phases, a finding that was suggestive ($p = 0.054$).

To illustrate the clarity and simplicity of lane's ovulation-phase experiences further, let us narrow in on Lane's visual experiences. Typically, when DES participants have a visual experience, they experience themselves as seeing and can describe, often in great detail, what they see. DES calls this phenomenon "inner seeing" (elsewhere called "having a mental image," "visualizing," etc.). In total, 7.5 (11.4% of all 66 without-medication samples) of Lane's experiences were coded as "inner seeing." Inner seeings were more frequent during ovulation: 4 of the 12 ovulation samples (33.3%) were inner seeings compared to 3.5 of the 54 non-ovulation samples (6.5%). During non-ovulation phases, Lane's experience was sometimes (4 samples in total, or 7.4% of non-Ovulation samples) seemingly but not explicitly visual (i.e., in the direction of an inner seeing), which is *not* the same phenomenon as what DES calls "inner seeing." Lane had no such in-the-direction-of-seeing experiences during ovulation; when Lane's experience was visual during ovulation, it was an unequivocal inner seeing.

For example, at sample 3.1, during the non-ovulation late luteal/premenstrual phase, Lane had a nearly but not explicitly visual experience:

> 3.1: [Lane is looking at herself in the mirror.] At the moment of the beep, she is looking at her eyebrows, noticing that they are uneven, that one is higher than the other. More than simply noticing, she somehow imagines a line extending from the top of each eyebrow (that is, as if there were a line continuing from the top of each eyebrow horizontally across her forehead). She recognizes the position of the imagined lines and that they do not overlap perfectly. Lane's experience was of lines, even though the lines

were not seen in any form, inner or outer. [Lane often used visual language like "picturing" during this description but was believably consistent that there was nothing explicitly visual about this experience.] Simultaneously in experience, Lane feels an itch just inside her ear (a sensory awareness).

Lane's experience was of imaginary lines extended across her forehead from each of her eyebrows; however, she did not *see* those lines at the moment. For Lane, there seems to exist a continuum of visual experiences with one end being explicitly visual (i.e., seen) and the other not (i.e., known to be visual but not seen); this experience belonged on the latter end.

Consider also sample 11.3 during the non-ovulation traditionally non-symptomatic phase. At this beep, Lane's experience *was* of innerly seeing; however, the details of the inner seeing were not elaborated. This experience therefore belonged somewhere in the middle of the continuum from not at all explicitly visual to explicitly visual.

11.3: [Lane is talking to her boyfriend who has just asked about the possibility of throwing a party at their house. Lane has surmised that the party will include visitors from out-of-town who will likely stay with them, which means she would have to give up the guest bedroom and bathroom for a couple nights. There is a pause in the conversation – it's Lane's turn to speak, but she hasn't yet.] In her experience, Lane innerly sees (though not clearly, more like hintily) the guest bedroom (which she uses as a closet/dressing room) and guest bathroom (where she gets ready in the morning). Unclearly and with very few explicit visual details, she (innerly) sees the doors to these rooms from the perspective of standing in the hallway facing them (the doors are adjacent). It is not merely a knowing or awareness of the rooms—it is (slightly) visual. Even though she does not explicitly see these details, also present to her are the facts that

the guest bedroom contains all of her clothes, that her toiletries are in the bathroom, that she gets ready there in the morning so she can be out of the way of her boyfriend who is still sleeping, etc. These known details are in the direction of a cognitive experience but less explicit, more sensed/felt than explicitly thought. Simultaneously present to Lane is a cognitive/affective (maybe slightly more cognitive) sense or idea that she likes having those rooms to herself and that it would be sad to give them up. There is no explicit feeling ongoing (i.e., she does not feel sad about giving up the rooms), but there is an experienced affective tinge to the thought, similar to what we have, in the past, called a "thought/feeling."

Neither of these samples (eyebrows or guest rooms) is a typical (by DES standards) inner seeing. Sample 3.1 (about her eyebrows) seemed visual but was not experienced as visual (i.e., Lane did not experience herself as *seeing*); and sample 11.3 (about the guest rooms), though she did experience herself as seeing, had very few seen details. Instead, the details were "known" in some cognitive way short of a thought process. These samples exemplify the complexity that characterized Lane's non-ovulation-phase experiences generally.

In contrast, during ovulation, one-third of Lane's experiences were inner seeings and those inner seeings contained explicitly visual details and elaboration as is typical of a full-blown inner seeing. For example:

5.4: [Lane is listening to music but is not at all attending to the music at the moment. In her words, she is "totally daydreaming": She imagines a place that she believes she "goes to often" when daydreaming—it's a green, shaded courtyard with cement ground surrounded by vine-covered buildings.] At the moment of the beep, Lane innerly sees herself walking into one of the buildings. There are two simultaneous perspectives: She

(innerly) sees herself from behind (third-person perspective as if following herself into the building) and experiences herself as *in* the inner seeing (first-person perspective) She has an anticipatory sense that she is going into the building to see another person [but she doesn't see anyone, nor does she know who it is that she will see.] [Though she knows she is walking into a building, the inner seeing is not in motion. Rather, she thinks it is more like a series of still pictures, first of the courtyard without her in it and now of her walking into a building]. She sees this clearly and in color.

Notice the dramatic differences between this ovulation visual experience and the non-ovulation hintily or nearly visual experiences described before. At this sample, Lane definitely experienced herself as seeing (unlike at sample 3.1 about the eyebrows) and, moreover, she saw clearly and in detail an entire scene (unlike at sample 11.3 about the guest rooms). Also notice the dramatic difference between this clear and detailed image of a courtyard and the much more nebulous, complex high school courtyard experience at sample 10.6; the contrast exemplifies what we observed about clarity around ovulation. Consider also sample 6.4 during ovulation:

6.4: At the moment of the beep, Lane feels her legs (lower thighs above her knee) sticking to the chair [she's wearing a dress]. There is nothing evaluative about this—she simply feels her skin being stretched by the sticky leather, a sensory awareness. At the same time and equally present, she thinks that she should get medicine because her hip hurts. This is a cognitive experience without words, pictures, or other symbols. That is, her experience is a thought about hip pain, *not* a sensation of hip pain. [Note that, around this time in her last cycle, Lane also had hip pain. She believes both pain events to be the result of inflammation triggered by ovulation.] Also, at the same time and equally

present, Lane innerly sees the spot in her bathroom where the pain medications are: She sees the bottle with its red cap and the paper towels and cleaning supplies next to it. Here again, Lane definitely experienced herself as seeing (the explicitly visual end of the continuum) and the seen details were explicitly present to her and far more detailed and clear than, for example, the guest rooms experience at sample 11.3. That is, at this beep, Lane saw the details of the bottle (its spot in the bathroom, the red cap, the things next to it), whereas, at sample 11.3, Lane was somehow aware of some vague details about the guest bedroom and bathroom but did not see them. For whatever reason, during ovulation, the details of Lane's experience were clearly present—in this case, seen—whereas, during non-ovulation phases, the details of Lane's experience were sometimes vaguely present in inchoate, non-explicit ways.

Summary, (the usual analysis, without-medication)

At the time of her participation, Lane was between the ages of 25 and 35. She was an undergraduate student who also worked full-time. Her Screening responses indicated she experienced severe and clinically significant symptoms of PMDD. Indeed, we learned that Lane had been medically evaluated many times over the past 10 years for premenstrual distress. Within the last year, she had been diagnosed with endometriosis for which she underwent an elective tubal ligation surgery. Because endometriosis is associated with atypically high levels of estrogen and may also impact ovulation (though research is mixed), Lane's menstrual cycle and associated hormone fluctuations may not have been typical. Thus, it was possible that our determinations of cycle phase were not always accurate and/or that, even if we were accurate with respect to phase, Lane's hormones were not at the levels typically expected for each phase.

Lane initially participated in the study across three menstrual cycles (11 sampling days, 66 samples). During that time, her average cycle length was 25 days, estimating ovulation

around approximately days 10-14. Consistent with that estimation, the two sampling days confirmed by ferning as occurring around ovulation were on cycle days 12 and 15; thus, the test kit appeared to be effective at detecting ovulation for Lane.

On the basis of those 66 samples, Lane's experience did seem to fluctuate with her menstrual cycle. Specifically, her experiences were notably clearer and simpler around the time of ovulation as compared to non-ovulation phases. This observation was supported by the exploratory ANOVA showing that experience sample captions were more than half as long for ovulation than for other phases. Inner seeings offered a case study in this difference: Inner seeings were found to differ in frequency across cycle phases and were most frequent during ovulation (occurring in 1/3 of those samples). When inner seeing occurred during ovulation, it was clear and detailed with an obvious central figure. In contrast, during non-ovulation phases, experiences were sometimes hintily or inchoately visual either without the experience of actually *seeing* something or without clear details of what was seen.

Step 2b: DES Sampling & Cycle Tracking (the secondary analysis, including with-medication samples)

Recall that, after 12 days of DES sampling, Lane requested to postpone her participation in the study; she said she needed to focus on schoolwork. When Lane returned to the study, she explained that she had been newly diagnosed with ADHD and Bipolar II Disorder and was prescribed Adderall (a stimulant) and Lamotrigine (an anticonvulsant/mood stabilizer). In simplified terms, Lamotrigine dampens brain activity by interfering with intracellular signaling pathways (Grunze et al., 1999), whereas Adderall increases the activity of dopamine and norepinephrine neurotransmitters to improve attention, motor activity, and cognitive control (Arnsten, 2006). Taking these medications, she and we suspected, caused her to stop regularly menstruating.

Though Lane was no longer menstruating, we continued sampling with her for four more days (sampling days 13-16 which we will call "with-medication"), amassing an additional 22 samples, with the recognition that her experiences on those days could not be classified by menstrual cycle phase. However, given that we had already captured 12 days of Lane's without-medication experience, her experiences on sampling days 13-16 *could* offer a natural experiment into the effects (if any) of biology (in this case, of medications) on inner experience.

Analysis 2b (the secondary analysis, including with-medication samples)

Recall that we reviewed and captioned all 16 days of DES sampling together without regard for any biological or cycle factors. Then, as we have just seen, we conducted the usual analysis for Lane's first 11 days of sampling. Next, to explore the impact of medication on experience, we thoroughly re-reviewed the DES days 13-16 with-medication samples. Our goal was phenomenologically to note the overall characteristics of that with-medication "batch" of

samples. We noticed that Lane's with-medication samples seemed to be *even more* complex and messy than even her without-medication non-ovulation samples had seemed before. Furthermore, her with-medication samples were often highly unusual by DES standards.

To explore further these potential differences, we conducted the same ANOVA and chi squared analyses as in the usual analysis except that, in this secondary analysis, we included Lane's 22 with-medication samples as a fourth group. Thus, these analyses now compared four different biological statuses: 3 without-medication menstrual cycle phases and one with-medication/amenorrhea state. The exploratory ANOVA comparing sample caption lengths, now with four biological statuses instead of the usual three cycle phases, was significant ($F(3, 84) = 4.38$, $p = 0.007$). Inspection showed that ovulation captions were shortest and with-medication samples were longest ($M = 78.54$). Indeed, the average with-medication sample caption was considerably longer than the late luteal/premenstrual and traditionally non-symptomatic sample captions ($M = 57.33$ and 61.79 respectively). Thus, consistent with our phenomenological observation, this quantitative analysis suggested that the with-medication samples were messier and more complex even than non-ovulation samples were before Lane had started medications.

We also recomputed the chi-squared tests of independence to explore whether the frequencies of experiential phenomena differed across biological status, this time including the fourth with-medication state. There were nine "significant" (these were exploratory and so did not adjust for multiple tests) findings. Two of those findings were consistent with what had been found with the usual analysis:

- Inner seeing differed by biological status, X^2 (3) = 11.88, $p = 0.008$. Inspection showed that, as before, inner seeing was most frequent during ovulation (33.3% of samples) and occasional during traditionally non-symptomatic (6.0% of samples) and late

luteal/premenstrual (8.3% of samples) phases. Inner seeing did not occur at all during the 22 with-medication samples.

- Auditory sensory awareness differed by biological status, X^2 (3) = 12.96, p = 0.005. By inspection, auditory sensory awareness was most frequent during the late luteal/premenstrual phase (16.7% of samples) whereas it was non-existent during all states. However, note that, in total, only 2 late luteal/premenstrual phase samples contained auditory sensory awareness.

Seven findings were new with the four-status analysis; four of the findings centered on sensory awareness's being more frequent and/or more vivid in the with-medication phase:

- Sensory awareness differed by biological status, X^2 (3) = 14.54, p = 0.002. By inspection, sensory awareness was most frequent during with-medication samples (84.1% of samples) especially compared to ovulation (33.3% of samples) and the traditionally non-symptomatic phase (38.1% of samples). The late luteal/premenstrual frequency was intermediate (62.5% of samples).
- Bodily sensory awareness differed by biological status, X^2 (3) = 11.96, p = 0.008. By inspection, bodily sensory awareness was most frequent in with-medication samples (70.5% of samples) and roughly twice as frequent as the other three cycle phases which were similar to each other (28.6% of traditionally non-symptomatic samples, 25.0% of ovulation samples, and 37.5% of late luteal/premenstrual samples.
- Sensory awareness of imaginary bodily sensations differed by biological status, X^2 (3) = 9.32, p = 0.025. By inspection, such experiences occurred in 13.6% of with-medication samples but not at all during other states.

- "Organismic apprehensions" in the direction of sensations differed by biological status, X^2 (3) = 9.32, p = 0.025. By inspection, such experiences occurred in 13.6% of with-medication samples but not at all during other states.

The remaining three "significant" findings suggested that simple, straightforward experience was least frequent in the with-medication samples:

- Inner speech (among the simplest and most straightforward experiential phenomena) differed by biological status, X^2(3) = 8.64, p = 0.035. By inspection, inner speech was least frequent during the with-medication samples (18.2% of samples) especially compared to the late luteal/premenstrual phase (66.7% of samples) and, less so, by comparison to the other states (35.7% of traditionally non-symptomatic samples and 25.0% of ovulation samples).
- Multiplicity (among the most complex of experiential characteristics) differed by biological status, X^2 (3) = 8.97, p = 0.030. By inspection, multiplicity was most frequent during the with-medication samples (45.5% of samples) and late luteal/premenstrual samples (45.8%). It was least frequent during ovulation, occurring in only 4.2% of samples. The frequency during the traditionally non-symptomatic phase was intermediate (22.6% of samples).
- Seeing differed by biological status, X^2 (3) = 7.84, p = 0.049. It was most frequent during ovulation and the late luteal/premenstrual samples (25.0% of those samples) and less so during the traditionally non-symptomatic and with-medication samples (4.8% and 4.5% of samples respectively).

Table 8 reproduces Lane's Table 7 but includes the with-medication samples and with updates to the Total and X^2 columns.

Table 8

Characteristics of Lane's inner experience overall and by biological status (including with-medication samples)

Biological Status	Traditionally Non-Symptomatic	Ovulation	Late Luteal/ Premenstrual	With-medication	Total	$X^2(2)$
N Sampling Days	7	2	2	4		
N Samples	42	12	12	22	88	
	Frequencies (%)[a] of Experiential Phenomena					
Inner speaking	35.7	25.0	66.7	18.2	34.1	8.64*
Inner seeing	6.0	33.3	8.3	0.0	8.5	11.88**
Unsymbolized thinking	42.9	41.7	16.7	29.5	35.8	3.38
Feeling	14.3	25.0	12.5	13.6	15.3	1.02
Sensory awareness (SA)	38.1	33.3	62.5	84.1	52.3	14.54**
Multiplicity	22.6	4.2	45.8	45.5	29.0	8.97*
"Org app"	41.7	25.0	50.0	63.6	46.0	5.28
"Org app" sensory	0.0	0.0	0.0	13.6	3.4	9.32*
Bodily feelings	4.8	8.3	12.5	2.3	5.7	1.74
Bodily + mental feelings	4.8	8.3	0.0	4.5	4.5	0.97
Multiple SA	23.8	8.3	16.7	45.5	26.1	6.90
Bodily SA	28.6	25.0	37.5	70.5	39.8	11.96**
SA imaginary	0.0	0.0	0.0	13.6	8.0	9.32*
Feeling/sense in specific region	4.8	16.7	8.3	9.1	8.0	1.87
Tactile SA	11.9	16.7	16.7	22.7	15.9	1.28
Auditory SA	0.0	0.0	16.7	0.0	2.3	12.96**
Seeing	4.8	25.0	25.0	4.5	10.2	7.84*

[a] Note that % need not up add to 100 because a single sample can contain multiple phenomena.

* "significant" (recall that this analysis did not adjust for multiple tests) at $p < .05$

** "significant" (recall that this analysis did not adjust for multiple tests) at $p < .01$

In sum, we observed that, after Lane began taking medications, her experience seemed to be messier, more complex, and more unusual than it had been without-medication; this observation was confirmed by the exploratory ANOVA (which showed that sample captions were longest for the with-medication samples) and by the exploratory chi-squared analyses of experiential frequencies (which suggested that with-medication samples more frequently included multiple phenomena and nearly-but-not-explicitly sensory experiences, both of which are markers of complexity/lack of clarity). Additionally, with-medication samples less frequently included inner speaking and inner seeing, both phenomena that are generally clear and straightforward. In fact, whereas she had clear and explicit inner seeings during 11.4% of all 66 without-medication samples, she had no such clear and explicit imagery post-medication but, instead, had 3 inchoately but not explicitly visual experiences (accounting for 13.6% of with-medication samples). The chi squared analyses also revealed that Lane's experience after she began taking medication was dominated by sensory awareness. Whereas Lane's experience without-medication was fairly frequently sensory (41.7% of those samples), her experience with-medication was *almost always* sensory (84.1% of with-medication samples), especially with respect to her body (70.5% of with-medication samples).

We have seen that Lane's without-medication experiences, particularly around ovulation, could be clear and straightforward with an obvious central figure. Recall, for example, sample 5.3 in which Lane was (90% of the experience) wondering whether a man at her office would say goodbye before he left while simultaneously (10%) looking for moldy grapes among a bunch. This experience was relatively clear and simple with one predominant and well-articulated figure (the unsymbolized wondering). We have also seen that Lane's without-medication non-ovulation-phase experiences were often more complex and inchoate. Recall, for example, the late

luteal/premenstrual sample 10.6: At that moment, Lane was aware of a "collage" of not-well-articulated rememberings about her high school's "black market." Lane's with-medication samples were even more complex than her without-medication non-ovulation samples, especially with respect to figure-ground. Sample 13.1 (with-medication) helps exemplify this difference:

> 13.1: [Lane is reading a Reddit thread.] At the moment of the beep, she is reading with comprehension, "…dress as a woman and just walk around at the mall," but the reading is not very salient (between 5 and 25% of the total experience). Much more salient (70% or more of the total experience), she imagines a generic, stereotypical mall and a cross-dressing man walking through the mall. This imagining has some innerly seen details: She innerly sees part of an escalator and a square fixture with water [she understands this to be part of a fountain, but she does not see an actual fountain]. She sees this from the perspective of being on the second floor of the mall looking down at the main floor. [She does not experience herself as *in* the mall; she just sees from the perspective *as if* she were in the mall.] Though she does not explicitly innerly see the rest of the mall, she experientially knows what is there, including a masculine, hairy man wearing a woman's red dress and carrying several (five or so) shopping bags. That is, whereas she innerly *sees* the escalator and fountain, she does *not* innerly *see* the man, yet she knows specific visual details of the man. Additionally, she knows there are plants, store windows, and other people. The plants, windows, and other people are less specified by comparison to the man (e.g., she does not know the colors of the other peoples' clothes like she does the man's dress) but are no less in her experience.

Sample 13.1 was obviously complex: Lane imagined a highly specific scene with many different elements, some of which were explicitly seen and some of which were known (sometimes in

elaborate visual detail) but not explicitly seen. Perhaps the most remarkable feature of sample 13.1 was the seemingly neglected central figure. That is, sample 13.1 was Lane's private illustration of a man wearing a woman's dress while walking through the mall. Yet, instead of innerly seeing the man in the dress (as would be the expected focal point), what she saw were insignificant background details—an escalator and part of a fountain. It was as if Lane's experience "missed the point" of her own interest. Sample 16.6 (also with-medication) was similar:

> 16.6: [Lane is watching a movie scene about a prisoner's release.] She is thinking about how hard it must be to be in prison and away from society for 15 years. This wondering is aimed at understanding in a descriptive, rational, cognitive way how that would feel. [It is *not* that she is trying to actually *feel* how it would feel. She wants to understand cognitively how it would feel.] At the same time, she hears music and, in some cognitive/mental way, recognizes it as early 90s hip hop. Thus, this is more than simply hearing—there is a cognitive recognition accompanying/connected to her hearing. At the same time, [the movie is showing a close-up of Denzel Washington with his hair dyed gray to appear older.] Lane sees the individual gray hairs (within his otherwise not-gray head of hair) and also the uneasy way he's moving his mouth. These are focused seeings, perhaps better-categorized as visual sensory awarenesses.

As with the man-in-the-dress sample 13.1, Lane seemed to miss the expected figure in 16.6. She was trying to glean from the movie what it would be like to return to society after 15 years in prison but, instead, focused on relatively unimportant details—90s music and grey hairs. It was as if her experience became distracted away from its own purpose.

With-medication sample 14.1 was also significant for its lack of clear figure-ground qualities. At sample 14.1, Lane's experience was divided between four separate and simultaneous sensations: popping on the right side of her neck [as she rolled her head back], a tight knot in her right shoulder, the elastic of her underwear cutting into her thigh, and the fabric of her waistband pressing against the skin of her abdomen. These four sensations were more or less equally salient. That is, there were essentially four figures of Lane's experience, as if she could not clearly "pick" or "commit herself" to one. Thus, the "messiness" of Lane's with-medication samples seemed distinct from (and more severe than) the earlier messiness of her without-medication non-ovulation samples, perhaps in large part due to her inability to "snap" to a clear and coherent figure.

Lane's with-medication samples were also noted to be highly unusual at times. For example, they were sometimes unusually specific, such as at sample 14.3:

> 14.3: [Lane's boss is in the warehouse smoking a cigarette. She has asked him many times not to smoke with the door open so she doesn't have to smell the smoke, but yet, the door is open, he's smoking, and she can smell the smoke in her office.] At the moment of the beep, she (mostly) smells cigarette smoke. Simultaneously, she feels a headache, a physical sensation with a highly specific shape and location—behind her left eye about 1-inch deep approximately aligned with the bottom of her eyebrow and about the size and shape of a grape. At the same time, she feels rising anger which is partly mental and partly bodily. In her body, she feels two fist-sized regions of inward pulling and inward twisting, one on each side of her chest. This is one bodily feeling of anger with two distinct regions. The entire smoke smelling-headache-anger experiences comprise about 70% of Lane's total experience at this moment. The other 30% (or maybe

less) involves Lane's innerly saying in her own voice "LBC" as she sees those letters on a package; she understands the letters to refer to the Long Beach (shipping port) Customs. In that sample, Lane had two bodily sensations that were highly specific— the headache and the anger, both of which had a specified shape, location, and even depth. Such intense specificity is rare in DES participants: emotion, when experienced bodily, is generally felt more diffusely.

Lane's with-medication sensations were sometimes unusual in that the sensations themselves were imaginary (a difference that was "significant," $X^2(3) = 9.32$, $p = 0.025$). See, for example, with-medication samples 14.4 and 15.6:

> 14.4: Lane takes a deep breath, inhaling through both nostrils. She smells cigarette smoke and, simultaneously, feels smoke coming up through her nostrils and moving through a specific physical tubelike-pathway [even though there is no such tube in her actual body] directly to a grape-sized region behind her left eye. She feels the grape area filling up with smoke—not expanding but becoming fuller. [We noted that this is a highly creative and highly specific experience. Hard to categorize without losing the richness.]
>
> 15.6 [Lane is brushing her teeth. Yesterday, she had over-flossed a region on the right upper side of her mouth and, today, her gums are inflamed in that spot.] At the moment of the beep, she feels her soft/tender gums [which are, in fact, being stimulated by her toothbrush, though her experience is not of the toothbrush, it's of her gums.] She simultaneously has an imaginary sensation (remembered from earlier) of the same area of her gums: She (imaginarily) feels the swollenness of her gums both in her gums and in her tongue [At the time this memory refers to, her tongue had been running over that part of her gums. At the moment of this beep, her tongue is doing no such thing; she's re-experiencing the earlier sensation.] Thus, at this moment, there are two separate

sensations of the same area—a real sensation in the gums only (not including the toothbrush which is, in fact, touching the gums) and an imaginary (remembered) sensation in both the gums and her tongue. At the same time, she hopes her gums don't start bleeding again, a cognitive thought process not in words, pictures, or other symbols.

Notice in sample 14.4 the highly specific sensation in the imagined "tube" running from her nostrils to the "grape" region. And, in sample 15.6, notice the remarkable co-occurrence of one real (tender gums) and one imagined (tongue running over swollen gums) sensation in the same spot in her mouth at the same moment. Such sensory experiences are unusual by DES standards and, by comparison to some of Lane's other experiences, seemed almost hyper-figural in their specificity.

Summary, Step 2b (the secondary analysis, including with-medication samples)

Lane took a break in participation after 12 days of DES sampling. When she returned, she reported she had been diagnosed with Bipolar II Disorder and ADHD and had started psychotropic medications which (presumably) caused her to stop menstruating. We decided to continue sampling with Lane for four more days (sampling days 13-16), amassing an additional 22 samples (88 grand total). These samples were referred to as her "with-medication" samples. We recognized that, given her amenorrhea, Lane's day 13-16 samples would not be relevant with respect to menstruation cycle phase but would be highly relevant with respect to this study's larger question—how do changes in biology (in this case, the onset of medications) impact pristine inner experience?

Without medication (sampling days 1-12), Lane's experiences showed a range of complexity: least complex in the vicinity of ovulation and more complex elsewhere in her cycles. With medications (sampling days 13-16), Lane's experiences were the most complex she

experienced in this study. Lane's with-medication samples usually contained several simultaneous phenomena and were often "messy," failing to "snap" to a clear, central figure. Exploratory quantitative analyses supported this qualitative observation. The ANOVA (now conducted with the with-medication samples as a fourth biological state) showed a significant difference in caption lengths across phases. With-medication captions were the longest on average, suggesting the experiences themselves were the most complex and difficult to neatly categorize. Moreover, exploratory chi squared analyses revealed that several markers of complexity differed by cycle phases and, by inspection, those more complex phenomena were most frequent in the with-medication samples. Sensory awareness was also notably more frequent in the with-medication samples, occurring in 84.1% of those samples. Moreover, the with-medication sensory awareness experiences were unique, often with highly specific shapes, sizes, locations, or movement, and sometimes with imagined sensations.

In general, across psychological science, the impact of medications on directly apprehended, conscious inner experience is not descriptively known. Studies utilizing methods such as DES may shed light on how medications achieve (or not) their desired effect: perhaps medications do not "clear up" experience but may actually disorganize and complicate experience, and yet, still lead to a desired external behavioral change. Furthermore, such studies may illuminate what famously discourages patients with bipolar disorder from consistently taking their medications—disorganized/complex experiences may be unpleasant. Though this is only a small case study with a number of limitations, Lane's case suggests that careful studies of the effect of medications on experience might be of substantial value.

Chapter 7: Allison

Allison is a Hispanic female. At the time of sampling, she was between 18 and 25 years old and an undergraduate university student.

Step 1: Screening

Allison reported she had regular menstrual periods. She denied any medical conditions, behaviors (e.g., shift work), or medications (including birth control) that would alter her hormone function. Her screening results indicated normal levels of anxiety and depression.

Allison's responses indicated she experienced clinically significant symptoms of Premenstrual Dysphoric Disorder (PMDD). She endorsed 8 of the 11 DSM-5 symptoms of PMDD and noted that those symptoms profoundly impacted her functioning at school and work. On the Premenstrual Assessment Form (PAF), Allison earned a score of 31, placing her, essentially, at the mean of the non-clinical normative sample. On the Visual Analogue Scales of PMDD symptoms, she reported that her mood and overall symptoms are, on average, 38% worse during the premenstrual phase as opposed to the rest of her cycle. Thus, Allison's responses on self-report measures were mixed; it is possible that, while she experienced a wide range of PMDD symptoms, those symptoms were not particularly severe.

Step 2: DES Sampling & Cycle Tracking

Allison completed 19 days of natural-environment Descriptive Experience Sampling (DES), amassing 96 total beeped experiences (this count excludes day 1 which was discarded as training, as is typical of DES). She followed the typical DES sampling-interview procedure that is described in Step 2 of the Method section of this paper (Chapter 3). Due to the coronavirus pandemic, Allison's final two sampling days were conducted by Zoom or Skype (as opposed to in-person). However, given her substantial practice with the method by that time, we suspect this

had little impact on the quality of those interviews. The effects of the pandemic on Allison's inner experience more broadly are, of course, unknown.

Allison participated in the study across menstrual cycles with an average cycle length of approximately 29 days. Allison struggled to develop the habit of taking the ovulation test daily. Therefore, she was encouraged to prioritize ovulation testing *at least* around the time of DES sampling days. This was a largely successful improvisation: She provided pictures of her ovulation test kit results surrounding 17 of her 20 sampling days. For Allison, the ovulation ferning pattern appeared frequently, including on days for which she was clearly not ovulating (e.g., the first day of a menstrual cycle). We do not know the explanation for why this occurred. It might suggest that Allison had higher baseline levels of estrogen than would be expected for typical hormone function. However, it might also be explained by other biological factors, such as the levels of sodium and potassium chloride in Allison's saliva (both of which contribute to salivary ferning). Because of this lack of specificity, we considered a number of factors when determining when ovulation was likely to have occurred, including day of cycle, test result on that day, pattern of test results surrounding that day, cycle length, and so on. For example, for Allison's second menstrual cycle (the first cycle that included a DES sampling day), ferns began to appear on her test results as early as cycle day 11. However, around cycle day 19 or 20, the ferning pattern became qualitatively different: The ferns were clearer and more plentiful, consistent with detection of ovulation. We therefore estimated ovulation for that cycle as around cycle day 20 or 21, which included DES sampling day 4. Days 20 and 21 are later than the theoretical midpoint of her average cycle length (which would be between days 12 to 16); however, this was also one of Allison's longer menstrual cycles (31 days) and thus, it made sense that ovulation would occur somewhat later within that cycle.

Using a similar process, ovulation was determined as occurring around cycle days 19-22 for cycle 3 (which included DES sampling day 8), cycle days 16-17 for cycle 4, and cycle days 13-16 for cycles 5 and 6 (which included DES sampling days 13 and 17). There were therefore four sampling days associated with ovulation; however, those sampling days occurred on disparate cycle days. Because we did not use a consistent range of cycle days for Allison's ovulation phase, the cycle days classified within each phase were similarly varied. For example, the Traditionally Non-Symptomatic phase generally included cycle days 1-13 (for cycles 1, 3, 5, and 6) but also included cycle days 15 and 17. Given that our primary biological marker of ovulation (the test kit) was ineffective for Allison, these determinations of cycle phase were potentially inaccurate. Moreover, if Allison's test results really did indicate, for example, atypically high baseline levels of estrogen, she may not have been an ideal candidate for the present study. Regardless, we made the determinations as best we could—with careful consideration, integrating multiple sources of information, and blind to the associated inner experience characteristics.

The top panel of Table 9 displays the breakdown of Allison's sampling days by cycle phase. The bottom panel displays the frequencies of her salient experiential phenomena within each cycle phase and overall.

Table 9

Characteristics of Allison's inner experience overall and by cycle phase

Menstrual Cycle Phase	Traditionally Non-Symptomatic	Ovulation	Late Luteal/ Premenstrual	Total	$X^2(2)$
Days of Menstrual Cycle[a]	1-11 and 15-17	13, 21, 22	20-29		
Number of Sampling Days	8	4	7	19	
Number of Samples	36	19	41	96	
	Frequencies (%)[b] of Experiential Phenomena				
Inner speaking	2.8	0.0	0.0	1.0	1.68
Inner seeing	0.0	2.6	0.0	0.5	2.04
Unsymbolized thinking	1.4	0.0	6.1	3.1	2.17
Feeling	22.2	23.7	26.8	24.5	0.23
Sensory awareness (SA)	48.6	68.4	46.3	51.6	2.74
Bodily SA	29.2	34.2	34.1	32.3	0.26
Tactile SA	9.7	10.5	11.0	10.4	0.03
SA of her own smile	8.3	18.4	2.4	7.8	4.63
Emotional or SA of face	9.7	26.3	6.1	11.5	5.40
Visual SA	8.3	15.8	2.4	7.3	3.52
Taste SA	8.3	10.5	2.4	6.3	1.88
SA that moves her	11.1	13.2	0.0	6.8	5.28
Multiplicity	11.1	21.1	14.6	14.6	0.99
Bodily feelings	6.9	7.9	3.7	5.7	0.59
Mental feelings	12.5	10.5	20.7	15.6	1.45
Nothing	9.7	0.0	15.9	10.4	3.53
Watching TV	11.1	0.0	4.9	6.3	0.18
Seeing	8.3	10.5	7.3	8.3	0.18
Hearing	5.6	21.1	0.0	6.3	9.87**
Low engagement	2.8	15.8	2.4	5.2	5.38

[a] See Cycle Tracking and DES Sampling section above for explanation of variability in which cycle days were associated with each menstrual cycle phase.

[b] Note that % need not up add to 100 because a single sample can contain multiple phenomena.

** "significant" (recall that this analysis did not adjust for multiple tests) at $p < .01$

Analysis

We followed the usual analysis described in Chapter 3 (Method), Step 2: We first reviewed and "captioned" all samples together (blind to their associated cycle phase) and then separated sampling days by cycle phase and phenomenologically and quantitatively examined differences in experience across phases.

The Individual (blind to menstrual cycle phase). Overall, Allison's experience was most frequently (51.6% of all samples) populated by sensory awareness, the experience of attending to some sensory aspect of her internal or external environment without particular regard for the aspect's instrumentality or function (Hurlburt et al., 2009). Her experiences were generally quite simple and driven by internal and external sensations (either for their own sake as in sensory awareness or as part of an emotional feeling). It was somewhat more common for Allison to have nothing ongoing in experience than it is for the typical DES participant (approximately 10% of all of Allison's samples).

With Respect to Menstrual Cycle Phase. Allison's experiences when "binned" by cycle phase did not seem (by phenomenological observation) to differ with respect to clarity across cycle phases. However, the exploratory ANOVA comparing the average length of experience-sample captions across cycle phases was significant, $F(2, 63) = 4.97$, $p = 0.009$. Inspection showed that ovulation captions were longest on average (65.89, $SD = 56.84$), especially compared to late luteal/Premenstrual phase captions ($M = 31.66$, $SD = 25.98$). Traditionally non-symptomatic phase captions were intermediate ($M = 45.14$, $SD = 40.94$). one ovulation sample caption included a lengthy note/commentary that rendered the caption an outlier at more than three standard deviations above the group mean (271 characters). Therefore, the ANOVA was recomputed excluding the commentary from that caption (then only 75 characters); the resulting

test was still significant, $F(2, 63) = 3.86$, $p = 0.025$. This suggests that there was indeed some aspect of Allison's experience that differed across phases, but that our phenomenological exploration was (for whatever reason) not directly sensitive to it.

We then conducted the usual chi squared analyses to test whether the frequencies of experiential phenomena differed across cycle phases. For Allison, there was one "significant" (recall these were exploratory and so not adjusted for multiple tests) finding: External hearing differed across cycle phases ($X^2(2) = 9.87$, $p = .007$) and, by inspection, was more frequent during ovulation (21.1% of samples) especially when compared to the late luteal/premenstrual (0.0% of samples) and, less so, to the traditionally non-symptomatic (11.1% of samples) phase. Three other findings were suggestive:

- Emotional or sensory awareness of her face, including of her smile, differed across cycle phases. Inspection suggested that it was somewhat more frequent during ovulation (26.3% of samples) than in late luteal/premenstrual (6.1%) or traditionally non-symptomatic (9.7%) phases, X^2 (2) = 5.40, $p = .067$.
- Sensory awareness that moves her/affects her being differed across cycle phases. Inspection suggested it was more frequent during ovulation (13.2% of samples) and in the traditionally non-symptomatic phase (11.1% of samples), but somewhat less frequent in the late luteal/premenstrual (0.0% of samples), X^2 (2) = 5.28, $p = .071$.
- Low engagement (i.e., little attention or energy directed toward the phenomenon) differed across cycle phases. Inspection suggested it was somewhat more frequent during ovulation (15.8% of samples) than during the late luteal/premenstrual (2.4% of samples) and traditionally non-symptomatic (2.8% of samples) phases, X^2 (2) = 5.38, $p = .068$. Note, however, that all three examples of low engagement during ovulation occurred on

the same sampling day and may be more a reflection of Allison on that particular day than of her ovulation-phase experiences more generally.

Overall, Allison's experience did not seem to differ in dramatic ways across cycle phases. Though the exploratory ANOVA comparing caption lengths (a possible indicator of sample complexity) was significant, differences in clarity/complexity were not obvious. Moreover, none of the major experiential phenomena seemed to differ significantly by phase.

However, Allison's sensory awareness experiences did seem to differ in subtle ways across cycle phases. For example, Allison had somewhat more frequent awareness of feelings (emotion) and sensations in her face, including of her own smile, during ovulation (26.3% of samples) especially compared to the late luteal/premenstrual phase (2.4% of samples). That is, whereas more than one-quarter of her ovulation samples (26.3%) involved some awareness of her face, only approximately 2% of her late luteal/premenstrual phase samples had such a focus. Allison's awareness of her face was almost always sensory in nature. For example, at sample 8.2 during ovulation, she was drinking coffee and laughing with friends. In her direct experience, she felt herself smiling, a physical sensation in her face and cheeks. Allison also sometimes attended to her face for its emotional significance; for example, at sample 13.3 also during ovulation, Allison was walking into the mall. She felt cold, a bodily sensation, and, simultaneously, happy, a mostly bodily feeling that centered on her smile. And, sometimes her awareness of her face was not related to smiling but rather, to laughing (samples 4.1, 11.1, and maybe 19.3) or other emotion states such as at sample 3.4 when she was playing a video game and felt competitive, an emotion experienced in her face which donned a mean/serious/competitive expression.

Additionally, Allison's ovulation sensory awarenesses differed from late luteal/premenstrual sensory awarenesses in that, around ovulation, Allison's sensations seemed

to “move her” and “affect her whole being” (13.2% of samples compared to 0.0% of Late Luteal/Premenstrual samples). That is, in some of Allison’s ovulation-phase samples, sensory awarenesses seemed to grab her in ways that were uncommon by DES standards, whereas her late luteal/premenstrual-phase sensory awarenesses were typical, experienced as a discrete part or facet of her experience. To illustrate, consider the contrast in the following samples. Samples 9.4 and 10.4 below are from the late luteal/premenstrual phase and are typical sensory awarenesses by DES standards.

> 9.4: [Allison is lying down.] She feels cold on the surface of her arms. [She is, in fact, wearing long sleeves, but that isn’t part of her experience. She doesn’t feel her sleeves—she feels cold on her arms.] At the same time and equally present, her eyelids feel droopy [she’s tired]. Thus, at this moment, there are two separate bodily sensory experiences—cold arms, droopy eyelids.
>
> 10.4: [Allison is eating a Mexican dish with tortilla chips, sauce, eggs, and sour cream (she couldn’t think of the English translation for the dish’s name).] At the moment of the beep, she tastes the good taste of the food, [no flavor in particular. It’s a salty dish and the salt is cut by the sour cream, but she’s not particularly attending to the saltiness or the sour creaminess or any other aspect.] She’s simply tasting what she’s eating, and she likes it. At the same time, she feels the soft-yet-still-a-little-hard and cold texture of the food, particularly the tortilla chips, which is also good. Thus, Allison’s experience at this moment is entirely wrapped up in the sensations of her food—the taste and texture, specifically—all of which is apprehended as good/to her liking.

In contrast, sample 4.2 is from the ovulation phase and represents what we called “sensory awareness that moves her, affects her being.”

> 4.2: [Allison is fooling around with filters on Snapchat. At the moment of the beep, she applies a filter, is looking at herself, and] feeling adorable, a mushy feeling that is mental but also physical, embodied in the way she is her holding her cheeks in her hands [in a cutes-y way]. Note that Allison's experience is about her own feeling of adorable, *not* that the picture of her is adorable; it was decidedly *not* of noticing/thinking/whatever that the picture on Snapchat is adorable, but rather, of her *feeling* adorable.

Our understanding of Allison's experience at 4.2 was unequivocal: This was not a garden-variety sensory awareness. A garden variety sensory awareness would have been, as we alluded to in the final sentence of the description, "noticing [visually]…that the picture on Snapchat is adorable." Instead, Allison *felt adorable* in seeing the picture. And the adorable feeling was not discrete; it was not faithful to Allison's experience to call this a mental feeling or a bodily feeling or even a visual sensation, for example. Nor would it have been faithful to say that Allison felt some adorable but discrete sensation in her face, such as her smile. Her feeling adorable was all of those things and, moreover, was embodied, felt in the way she was holding her face in her hands.

Sample 13.5 was another ovulation example of the way sensory awarenesses seemed to grab Allison and affect her whole being. At that sample, Allison was shopping in a clothing store. She described herself as "feeling upbeat" while singing and dancing along with the music in the store. The interview came to reveal that, by "upbeat," Allison was not referring to a feeling but rather, to the fact that the music was moving her (literally but also, experientially) in "upbeat"-esque ways. We understood Allison's experience to be different from merely "I'm singing and dancing along with music"; her experience was not at all that agentic; she did not experience herself as singer and dancer; she experienced herself as *into the music*, consumed by the music, and *pulled into* singing and dancing by its sound. Similarly, at sample 13.4, also while

clothes-shopping and also during ovulation, Allison stumbled upon a sweatshirt emblazoned with one of her favorite anime characters. She was drawn to the design and colors of the sweatshirt (a garden-variety visual sensory awareness) but was also "lit up," "beaming" in response to the sweatshirt which was either a bodily feeling and/or a bodily sensory awareness of her face (we could not be sure). Again, we understood Allison's experience in this sweatshirt sample as more than merely "I'm smiling and feeling my smile" (indeed, she had several other experiences that were like that); beaming was not a discrete or well-differentiated characteristic of her face; she was overtaken by some apparently-not-directly-experienced happiness about the sweatshirt and experienced that as beaming.

Thus, while there were not obvious and statistically convincing differences in clarity or experiential phenomena between Allison's cycle phases, there were potential subtle differences in her sensory awareness across cycle phases. Specifically, compared to the late luteal/premenstrual phase, Allison's sensations around the time of ovulation were more often focused on her face and smile and sometimes seemed to grab her/consume her/move her entire being. This latter difference was apparently not the by-product of fewer sensory experiences; in fact, during the late luteal/premenstrual phase, sensory awareness was still frequent for Allison (occurring in 46.3% of those samples) but all were of the typical garden-variety where the sensory aspect was but a part or facet of the overall experience (as opposed to something affecting her entire being).

Summary

At the time of her participation, Allison was an undergraduate university student between the ages of 18 and 25. Her Screening responses indicated she experienced mild but clinically significant symptoms of premenstrual distress. She agreed to participate in DES sampling and

ultimately did so for 19 days across six menstrual cycles, collecting a total of 96 beeped experiences. Her menstrual cycles during that time were regular with an average length of 29 days. However, the ovulation test kit did not appear to be effective for Allison. The test frequently produced what seemed to be "false positive" results, which might have indicated atypical hormone function, such as high levels of estrogen. Cycle phases were therefore determined by considering the best available evidence, sometimes crudely, with an increased potential for inaccurate classifications.

Though cycle-phase-related differences in experiential complexity were not phenomenologically obvious to us, the exploratory ANOVA of caption lengths suggested such differences might well exist (the caption length differences probably do reflect something). Cycle-related differences in experience were, for Allison, only suggestive and subtle. It seemed that her sensory awarenesses differed somewhat by phase, especially between ovulation and the late luteal/premenstrual phase. That is, during ovulation, Allison was more frequently aware of her face for (usually) its sensations and (occasionally) its emotional significance. Additionally, more than 10% of Allison's ovulation-phase experiences involved sensory awarenesses that seemed to grab her, move her, and affect her whole being. In contrast, this sensory-awareness-that-moves-her feature never occurred during the late luteal/premenstrual phase despite frequent sensory awareness; her sensory awareness during that phase was typical by DES standards with a discrete focus on some sensory aspect but without the broader impact on her person.

Chapter 8: Lee

Lee was, at the time of sampling, between the ages of 18 and 25 and an undergraduate university student who also worked part-time. She did not identify with any of the available categories for ethnicity.

Step 1: Screening

Lee reported she had mostly regular menstrual periods but had experienced at least one missed period within the last year. Indeed, Lee missed one menstrual period during the time she was engaged in our study. She denied any medical conditions, behaviors (e.g., shift work), or medications (including birth control) that would alter her hormone function. Her screening results indicated normal levels of anxiety and depression.

Lee's responses indicated she experiences clinically significant symptoms of premenstrual distress. She endorsed 6 of the 11 DSM-5 symptoms of PMDD and noted that those symptoms profoundly impacted her functioning at school and work as well as tasks of everyday living. On the Premenstrual Assessment Form (PAF), Lee earned a score of 26, placing her, essentially, at the mean of the non-clinical normative sample. On the Visual Analogue Scales of PMDD symptoms, she reported that her mood and overall symptoms were, on average, 66% and 57% worse respectively during the premenstrual phase as opposed to the rest of her cycle.

Step 2: DES Sampling & Cycle Tracking

Lee completed 21 days of natural-environment Descriptive Experience Sampling (DES), amassing 111 total beeped experiences (excluding day 1 beeps which were discarded as training, as is typical of DES, and day 9 beeps which occurred around the time of a missed menstrual period and therefore could not be classified within any menstrual cycle phase). She followed the typical DES sampling-interview procedure that is described fully in Step 2 of the Method section of this paper (Chapter 3). She completed her first 13 sampling interviews in-person but, due to

the coronavirus pandemic, the remainder were conducted by Skype or Zoom. Given that Lee had substantial experience with DES sampling before switching to virtual interviews, it seemed she adjusted easily to the virtual environment. However, the impacts, if any, of virtual interviews (and of the pandemic more broadly) on Lee's experience are, of course, unknown.

Lee participated in the study across a total of eight menstrual cycles. During that time, she missed one menstrual period and had an average cycle length (excluding the cycle with the missed period) of approximately 34.5 days, therefore estimating ovulation as approximately between days 15 and 19. Lee was fairly inconsistent in providing daily pictures of her ovulation test results; she failed to provide pictures surrounding 9 of her 21 sampling days. Because we did not have ovulation test results for nearly half of Lee's sampling days, there was a greater possibility of inaccurately classifying the cycle phases associated with each sampling day. However, as with other participants, we used the best available data and judgment considering a number of factors to determine the occurrence of ovulation, including day of cycle, test result on that day, pattern of test results surrounding that day, cycle length, and so on, but blind to the characteristics of experience.

The top panel of Table 10 displays the breakdown of Lee's sampling days by cycle phase. The bottom panel displays the frequencies of her salient experiential phenomena within each cycle phase and overall.

Table 10

Characteristics of Lee's inner experience overall and by cycle phase

Menstrual Cycle Phase	Traditionally Non-Symptomatic	Ovulation	Late Luteal/ Premenstrual	Total	$X^2(2)$
Days of Menstrual Cycle[a]	1-15, 21	15-19	22+		
Number of Sampling Days	8	4	7	20[b]	
Number of Samples	48	24	39	111[b]	
Frequencies (%)[c] of Experiential Phenomena					
Inner speaking	27.1	31.3	19.2	25.2	1.29
Inner seeing	21.9	31.3	35.9	28.8	2.15
Unsymbolized thinking	21.9	14.6	19.2	19.4	0.55
Feeling	20.8	12.5	26.9	21.2	1.86
Sensory awareness (SA)	19.8	20.8	34.6	25.2	2.82
Inner speech while reading	6.3	8.3	2.6	5.4	1.09
Inner seeing of words	4.2	4.2	2.6	5.4	0.19
Inner seeing with SA	5.2	2.1	11.5	6.8	2.43
Inner seeing in slow motion	0.0	4.2	5.1	5.4	2.40
Inner seeing notable color	0.0	4.2	7.7	3.6	3.69
Inner seeing with sound	0.0	8.3	0.0	1.8	7.38*
Bodily feelings	6.3	0.0	17.9	9.0	6.62*
Mental feelings	14.6	10.4	6.4	10.8	1.50
Sensation not integrated with feeling	4.2	0.0	5.1	3.6	1.20
Feeling with specific location	3.1	0.0	6.4	3.6	1.81
Feeling experienced as color	0.0	0.0	5.1	1.8	3.76
Feeling outside body	0.0	0.0	5.1	1.8	3.76
Bodily SA	6.3	2.1	10.3	6.8	1.61
Visual SA	9.4	18.8	21.8	15.8	2.70
Skillful/creative experience	0.0	0.0	7.7	2.7	5.69
Unusual by DES standards	8.3	0.0	20.5	9.0	1.44*
Watching TV/video game	11.5	25.0	9.0	13.5	3.57

[a] See above for explanation of variability in which cycle days were associated with each menstrual cycle phase.

[b] Recall that Lee's day 9 could not be classified within a menstrual cycle phase (due to a missed menstrual period) and was therefore excluded from analysis.

[c] Note that % need not up add to 100 because a single sample can contain multiple phenomena.

* "significant" (recall that this analysis did not adjust for multiple tests) at $p < .05$

Analysis

We followed the usual analysis described in Chapter 3 (Method), Step 2: We first reviewed and "captioned" all samples together (blind to their associated cycle phase) and then separated sampling days by cycle phase and phenomenologically and quantitatively examined differences in experience across phases.

The Individual (blind to menstrual cycle phase). A notable quality of Lee's overall inner experience in general was its clarity of organization. That is, Lee's experience was generally unified with a clear and single focus. She could (and often did) have several separable aspects of experience, but those aspects were almost always connected/of the same rhythm as opposed to fragmented or disjointed. To illustrate, consider sample 16.2:

> 16.2: [Lee is watching a Red Hot Chili Peppers music video. She used to love this band and is now reminiscing.] She hears the Red Hot Chili Peppers playing from the video and, at the same time, innerly sees herself sitting on a sofa in her friend's house watching them play on TV. She sees from behind, as if she is in the same room but a few feet behind the couch. Part of the inner seeing is in slow-motion: the TV is slowly changing. On the TV, she just sees changing colors, not the band or anything else in detail, even though she understands it to be the Red Hot Chili Peppers. She sees the rest of the room, too, and it seems accurate of her friend's living room. [In fact, Lee does not recall watching the Red Hot Chili Peppers on TV at her friend's house, so this image is apparently her own creation but is the sort of thing that *could have* happened.] At the same time, Lee feels joy, a strong mental feeling.

Notice that in that sample, there were several simultaneous aspects of Lee's experience: hearing the real Red Hot Chili Peppers, innerly seeing them on TV, and feeling joy. While these were separable phenomena (an external hearing, an inner seeing, and a mental feeling), they were connected and unified, all aspects of one coherent reminiscing-about-this-band experience.

There was only one marked exception to the unity of Lee's experiences (sample 14.4 during the Traditionally Non-Symptomatic phase):

> 14.4: [Lee is planning to text a friend who is going through a hard time because of the COVID-19 quarantine. She can't think of what to say in the text.] She experiences her mind as full of a jumble of unarticulated thoughts of what she might say, which may have included some words or inklings of words or ideas but nothing specific at the moment. The jumbledness is by far the most salient aspect of this experience; if words are present, they are not nearly as important to her. Simultaneously, Lee experiences her face (primarily the region around her mouth) as blank, nothing. This is not a physical experience of the sensations or expression of her face—that is, it's not about a blank facial expression—but she somehow (not physical) recognizes or senses the nothingness/blankness of her face. [Thus, there is, at the moment of the beep, a disconnect between Lee's mind (jumble of thoughts) and face (blank), but she does not directly experience the disconnect. After the beep, she recognizes the disconnect, and was believably confident that it was about her mind and face specifically, not about her mind and body, for example.]

That sample was much busier and more fragmented than were Lee's typical experiences. Though the jumble of thoughts and blank face were apparently both spawned by her inability to articulate the text message, the two strands of experience were not coherently unified. Her mind was one

thing—busy, full, a jumble of not well-articulated somethings. And her face was quite another thing—blank, nothingness. Furthermore, she did not directly experience the two as manifestations of her texting trouble, nor did she directly experience their disconnect. They were two distinct streams ongoing in parallel. Note the contrast from Lee's other experiences, including in the Red Hot Chili Peppers sample 16.2: In that sample, there were three separate and simultaneous phenomena, all clearly unified in one reminiscing-on-my-relationship-with-this-band experience.

Lee's overall inner experience was well-characterized by what DES has called the "five frequent phenomena," or "5FP" (Kühn et al., 2014): inner speaking, inner seeing, unsymbolized thinking, feelings, and sensory awareness. Lee experienced each of the 5FP in roughly 20-25% of all samples, consistent with the frequencies Hurlburt and Heavey (2008) reported in a stratified sample of 30 college students.

Lee was innerly seeing in 28.8% of all samples, most of which were clear and detailed. Lee's inner seeings sometimes including a sensory awareness. For example, at the moment of sample 5.3, a song came on the TV that made Lee feel happy. Apparently as her own illustration of happiness, she innerly saw the bright and shiny pink, blue, and yellow colors of balloons in a room of people dancing. Her experience was not of innerly seeing a party, it was of innerly seeing and being drawn to *the bright colors of the balloons* that happened to be at a party (which DES calls sensory awareness). Sometimes Lee's inner seeings were in slow motion. For example:

> 6.2: [Lee is in class and planning to go to the library after.] At the moment of the beep, she innerly sees the unfolding, in-slow-motion (slower than normal walking pace) view of approaching the university's library from its east side. She sees in detail the entire

scene: the library, the trees, the path, the dirt and rocks, the tables and chairs outside, the food trucks that are usually there in the morning. (She does not see people, however.) The seeing is in accurate and realistic color [as if she had taken a video]. She sees from the perspective of walking toward the library but does not *feel herself* moving towards the library. [It's also not the case that the imaginary walker is *not* her; it's that the 'walker' is no one, it doesn't matter as far as her experience is concerned.]

On two occasions (both on sampling day 3 during Ovulation), Lee's inner seeings included sound like a movie playing in her mind. At sample 3.6, she innerly saw a pot of macaroni and cheese being stirred. She heard the sloshing sound as it was stirred. (Also note that, like sample 5.3 of the balloons, the macaroni was seen in hypervivid color, a sensory awareness). Consider also the sound within an inner seeing from sample 2 on that day:

3.2: [Lee is reading about *Miranda v. Arizona* and has just read about the "right to remain silent." Apparently spawned by those words,] Lee innerly sees a "cop" [her word] handcuffing a "victim" [also her word even though, presumably, someone being handcuffed would more aptly be called a "suspect" or "perpetrator"]. She innerly sees the cop straight on from eye level, but he is looking down and his stereotypical police hat obscures most of his face. She can see that he has dark hair, a mustache, and is wearing glasses. She sees the top of the victim's head but nothing really of his face. She sees his hands in handcuffs raised up by his face. The inner seeing is not in motion, yet simultaneously, she innerly hears the cop say, "You have the right to remain silent." It's a generic male cop's voice with a stern tone that she knows to belong to the cop even though she does not see the cop's mouth moving. Thus, this is a very clear, realistic inner seeing with sound of a police officer reviewing someone's Miranda rights.

Thus, for Lee, inner seeing was frequent with similar characteristics across all menstrual cycle phases (with the possible exception of inner seeings including sound which may have been more frequent around Ovulation). Her inner seeings were usually clear, detailed, and could be quite elaborate, including with details such as slow motion, innerly seen words, or embedded sensory awarenesses of hypervivid color.

Lee was innerly speaking in 25.2% of all samples. Her inner speech was sometimes in accompaniment with reading or writing. For example:

> 20.4: [Lee is typing.] She innerly says in her own voice at a faster than conversational speed, "it helps them gain" [In fact, she's trying to remember that phrase so she can type it later, but the remembering aspect is not directly experienced.]

Other times Lee's inner speech was more self-generated, like a running commentary. For example:

> 21.5: [Lee is watching a TV show. On the show, they're holding up a lychee fruit and referring to it as a nut.] Lee (60 or 70% of the total experience) thinks that lychees are fruit, [not nuts]. That is, she knows that lychees are fruit and directly experiences that knowledge without explicit words, pictures, or other symbols at the moment. At the same time, she (30 or 40%) innerly says in her own voice in an incredulous tone, "What the heck are lychee nuts?"

In 25.2% of all samples, Lee's experience included sensory awareness, the focus on some sensory aspect without particular regard for instrumentality. She was most often drawn to visual characteristics (17.5 of 28 sensory awarenesses, or 62.5%) such as color. For example:

> 9.4: [Lee is watching a movie. The scene is of waves crashing on a beach.] She sees the whole scene but, mostly, is noticing/drawn to (equally) the bubbly texture and white

color of the seafoam produced by the waves. [She is not following the plot of the movie at this moment.]

Similarly, at sample 21.1, she noticed the blue aura surrounding the main character on a TV show; at sample15.3, she was drawn to the weird appearance of Mr. Potato Head's eyes in an Instagram video; and, at sample 9.6, she noticed the braided hairstyle of a character in a movie. Lee could also attend to non-visual sensations, such as physical sensations in her body (7.5 of 28 sensory awarenesses, or 26.8%). For instance:

> 5.6: [Lee is really warm. She's wearing too many layers of clothing.] She feels a spark-y hot sensation "sprinkling" on the surface of and inside her torso (below neck, above waist, not including arms). Sprinkling is intended to convey that the sparky sensation sprinkles/peppers her body not all at once but like rain drops. The sprinkly-sparky sensation rises in patches and then fades, immediately followed by a cooling sensation. Thus, there will be a patch in her lower left torso followed by cooling, then another patch near her belly button followed by cooling; it's not necessarily one patch at a time; there can be several simultaneous sensations. At the same time, she knows she wants to change her clothes. Perhaps it could be said that she is *thinking* she wants to change her clothes, but it felt more faithful to Lee to say she *knows* (thus this aspect is apparently something cognitive but short of an unsymbolized thought process).

Lee had unsymbolized thoughts in 19.4% of all samples. Her unsymbolized thoughts were generally straightforward and uncomplicated, of the garden-variety typically seen in DES. For instance, at sample 15.2, she heard her mom's work phone ringing and wondered (a directly experienced thought process not in words, pictures, or other symbols) whether she should bring her mom the phone. Similarly, at sample 8.6, she was planning a karaoke gathering for her

birthday and was thinking without words, pictures, or other symbols, who she needed to text with directions to the venue. At the moment of the beep, she was specifically wondering about her friend, Shannon.

Finally, Lee had feelings (the direct experience of emotion) in 21.2% of all samples, roughly half of which were experienced in her body and half mentally with no bodily component.

With Respect to Menstrual Cycle Phase. We did not observe phenomenologically that there were any differences in clarity between Lee's cycle phases and the non-significant ANOVA of caption lengths supported that observation, $F(2, 109) = .538$, $p = .586$.

We also conducted the usual exploratory chi squared tests to determine whether the frequency of phenomena differed across phases. For Lee, there were two "significant" (recall that these were exploratory and thus did not correct for multiple tests) findings:

- Experiences considered "unusual by DES standards" differed across cycle phases ($X^2(2) = 7.02$, $p = 0.03$). This "unusual" category includes the following: feelings experienced in color; feelings experienced outside her body; feelings with non-integrated sensations; imaginary sensations; and one particularly unusual example of innerly seen words. By inspection, these "unusual" experiences were entirely absent during ovulation but frequent during the late luteal/premenstrual phase (20.5% of samples) and occasional during the traditionally non-symptomatic phase (6.3% of samples).
- Inner seeings including sound differed across cycle phases (X^2 (2) = 7.38, $p = 0.025$). In fact, inner seeings with sound only occurred only twice, both around ovulation; however, both instances were on sampling day 3; thus, it is difficult to determine whether sound in

inner seeings was a characteristic specific to ovulation broadly or just somehow specific to Lee on that sampling day.

- Bodily feelings (emotional, not only sensory) differed across cycle phases (X^2 (2) = 6.62, p = 0.036). By inspection, bodily feelings were entirely absent during ovulation but occurred moderately frequently in the late luteal/premenstrual phase (17.9% of samples) and, less so, in the traditionally non-symptomatic phase (6.3% of samples).

There was one other finding that was suggestive: Experiences were coded as "skillful/creative" (explained more fully below) in 3 of the 39 late luteal/premenstrual samples (7.7%), but not at all during either of the other two cycle phases (X^2 (2) = 5.69, p = 0.058).

With Respect to Menstrual Cycle Phase. As we have seen, the characteristics and frequencies of Lee's experience were generally consistent across her menstrual cycle; for example, the 5FP were common for Lee and each occurred at roughly the same frequency within each cycle phase and overall. Lee's feelings (emotion) were one notable exception. That is, whereas bodily feelings occurred in 9% of all samples, there were no instances of bodily feelings during ovulation compared to 17.9% of late luteal/premenstrual samples and 6.3% of traditionally non-symptomatic samples. This was a "significant" (albeit exploratory) difference: X^2 (2) = 6.62, p = 0.036. In contrast, mental feelings occurred at roughly the same frequency overall (10.8% of samples) as within each phase (14.6% of traditionally non-symptomatic samples, 10.4% of ovulation samples, and 6.4% of late luteal/Premenstrual samples).

In addition, Lee's experiences were notably more unusual by DES standards in the late luteal/premenstrual phase (and less so, during the traditionally non-symptomatic phase) by comparison to ovulation, a difference that was "significant" (X^2 (2) = 7.02, p = 0.030). Those "unusual" experiences were so striking that we created a category to capture them, which

included unusual feelings (feelings in color, outside her body, and non-integrated with sensations), imaginary sensations, and one particularly unusual example of innerly seen words.

Let us first consider feelings. Feelings are among the most difficult phenomena for DES participants to describe. However, when feelings occur, they generally take one of two forms: They are experienced "mentally" (there is clearly an emotion ongoing but without any experienced bodily aspect) or "bodily) (there is clearly an emotion ongoing and it includes experienced internal bodily characteristics/sensations). Lee had typical feelings of those kinds; in fact, during ovulation, for example, when feelings were present, they were only and always of the garden-variety of mental feelings. In contrast, in two of Lee's 39 late luteal/premenstrual samples, feelings were experienced as outside her body/engulfing her and in color (though not visually, not seen). In sample 5.3 (mentioned above for its sensory awareness of the color of balloons), Lee felt happy, a "sparky"/energized feeling that had begun (before the beep) in the center of her chest and was, at the moment of the beep, radiating throughout the entire inside of her body and also outside her body in a yellow, dome-shaped "aura." Lee did not *see* a yellow dome and yet, without a doubt, her happy feeling included being surrounded in a yellow, dome-shaped aura. In fact, the domedness of it was quite specific: an egg-like shape with his 'edges' roughly six inches away from Lee's body. See also Late Luteal/Premenstrual sample 6.6, in which Lee felt an emotion that, again, had specific color and engulfed her (though not in a specific shape as with the dome in sample 5.3):

> 6.6: [Lee has been texting her boyfriend's sister, reminiscing on how they both (separately—they did not know each other then) had been mega-fans of the band One Direction. They are recounting embarrassing moments, such as crying about the band.] At the moment of the beep, Lee (90% of the total experience) feels

happy/funny/laughing, an emotional experience. She feels the corners of her mouth and cheeks pulling and tight (but not uncomfortably so) as she laughs aloud. At the same time, she experiences this happy/funny/laughing feeling outside of her and engulfing her entire body. The engulfing feeling is understood to be static-y and orange-ish/yellow-ish in color. Her description is not metaphorical: The feeling is definitely present and has those visual and sensory qualities even though she does not directly experience the qualities in the expected way (e.g., she does not see orange-ish/yellow-ish). At the same time, (10%) she sees and reads her friend's text message, *HAHAHA*. She reads it exactly as *HAHAHA* even though she suspects the actual text may have included more iterations of HA (e.g., *HAHAHAHAHA*) or had typos/insertions (e.g., *HAJHAKSA*).

Lee's feelings were also at times unusual in their failure to integrate physical sensations (what we called "non-integrated feelings": 3.6% of all samples), meaning she had a mental feeling and, in parallel but not connected to the mental feeling, a physical sensation. Again, this never occurred during ovulation, but did occur in both the traditionally non-symptomatic (4.2% of samples) and late luteal/premenstrual phases (5.1% of samples). Typically, when people experience emotion, their physical sensations are integrated with/part of the emotion (what DES calls a "bodily feeling"). Lee, in contrast, could have a purely mental feeling and, in tandem, a physical sensation that certainly seemed like it ought to be related to the feeling but was decidedly not or, at least at the moment, not *yet*. For example, see sample 21.4 during the late luteal/premenstrual phase:

21.4: [Lee is watching a TV show. An unfamiliar voice indicates that a new character has arrived in the scene. Lee looks around the scene and] notices that there's a man hiding in a dark doorway. She feels really, extremely startled/scared by this man. This is an

entirely mental feeling. Separately [but apparently also spawned by the startling man], she feels a static-electricity-like sensation in her abdomen. It's a light, not painful sensation. Thus, at this moment, Lee experiences an emotion that, though mental, is strong and clear. And, in tandem, she experiences a bodily sensation that is likely related to the startled feeling but not (or perhaps not yet?) fully integrated.

See also sample 14.3 during the traditionally non-symptomatic phase:

14.3: [Lee is watching the news. A song played as the station went to commercial and it was familiar to Lee, somehow reminding her of her younger years, yet not bringing her back to any specific memory, age, or time.] She feels nostalgic, a mental feeling, and, at the same time, has chills on the left side of her abdomen (a physical sensation). The nostalgia and chills are not, at the moment, two aspects of the same thing (the feeling) but yet, they are not entirely separate. [Perhaps if the beep had occurred slightly later, the chills would have been experienced as part of the nostalgia.]

Lee's non-integrated feelings were fairly unusual by DES standards and, like the other unusual characteristics of her feelings, they occurred most frequently in the late luteal/premenstrual phases and not at all in the ovulation phase.

Imaginary sensations were another of Lee's unusual-type experiences. Sensory awarenesses of imaginary sensations occurred in three total samples (two during the late luteal/premenstrual phase and one during the traditionally non-symptomatic phase). For example, see sample 5.1 from the late luteal/premenstrual phase:

5.1: [Lee is watching TV. Before the beep, she cut fuzz balls off of her blanket and is now,] at the moment of the beep, rubbing the fuzz balls between her fingers. She feels the rubbing sensation in her fingers, a tactile sensation like cotton balls rubbing together.

> Simultaneously, Lee hears the sound of the fuzz balls rubbing [even though, in reality, there is no such sound. That is, another person in the room would not hear the fuzz balls.] The sound is difficult for Lee to describe but is intensely negative/unnerving and is specifically located in/connected somehow to the space between her back teeth. She hears the fuzz ball sound specifically in the space between her back teeth. Lee is, in fact, grinding her teeth at the moment, and the physical feeling of grinding is also part of her experience. [Lee maintained that, even though the sound seemed to be located in the place where she was grinding her teeth, the sound was *not* of teeth grinding; it was of the fuzz balls.] This entire experience is intensely uncomfortable/unnerving for Lee [and yet she continues to consciously, not mindlessly, rub the fuzz balls together.]

This fuzz-ball sample is extremely unusual by DES standards for several reasons: (1) the imaginary sound, (2) the specific and seemingly mismatched location of the imaginary sound, and (3) Lee's conscious, deliberate rubbing action to create the sound even though it bothers her (an example of what DES has called "the doing of sensory awareness").

Sample 7.5 (during the traditionally non-symptomatic phase) also included an imaginary sensory awareness: Lee had been reminded of a rambutan (a fruit similar to a dragon fruit) and, at the moment of the beep, imaginary felt herself tossing a rambutan around in her mouth with her tongue. She did not, in fact, have a rambutan in her mouth, but felt the smoothness of the rambutan on her tongue as if she did. Like feelings in color, imaginary sensations are not unheard of among DES participants but are rare enough to be considered unusual.

We also included in the "unusual by DES standards" category a particularly unusual example of innerly seen words.

15.1: [Lee is trying to remember something, but she doesn't know what it is, only that it is important.] She innerly sees *important* in a standard computer font, all lowercase, white lettering against black, no explicit borders. The word *important* is big—not big like a billboard but big enough to fill a piece of printer paper. At the same time, she innerly says in her own voice repeatedly "important… [1 second or so pause] …important." This inner speaking is more or less mindless and much less prominent compared to the inner seeing.

The most striking characteristic of sample 15.1 was not that Lee innerly saw a word (she did so in 3.6% of all samples, at least once in each of the three menstrual cycle phases) but rather, the *choice of word.* That is, Lee innerly saw a word that conveyed a sort of meta-commentary on her current situation. *Important* was not the word or even part of the sentence or whatever it was she was trying to remember; *important* was a comment on her own memory-failing; she was trying to remember something important. For a more typical inner seeing of words (by DES and Lee's standards), see sample 12.3 during the Traditionally Non-Symptomatic phase:

12.3: [Lee is in class. Her teacher is talking about Utah.] She innerly sees the word *Utah* in white, normal computerized font against a black background. The *U* is capitalized and the rest of the word is lowercase. The letters are relatively big—bigger than 12-pt font on a page but not as big as the text on a billboard. [Her experience is not at all about the state Utah or any other connotations—trees, Salt Lake City, her memories there, etc. It's just about the word *Utah.*]

Notice that in sample 12.3, the content of Lee's inner seeing is coherent; she seems to be illustrating her situation. Her teacher is talking about Utah and she sees the word *Utah.* However, in sample 15.1, it would have been more typical/expected for Lee to see something related to

what it was she was trying to remember (as that was the crux of the situation). Instead, she sees *important*, a meta-commentary on the situation.

We have seen that Lee's non-ovulation (especially, late luteal/premenstrual) experiences were often remarkable and unusual. Consistent with that, in three of Lee's 111 total samples (2.7%), all during the late luteal/premenstrual phase, her experiences were coded as "skillful/creative" (X^2 (2) = 5.69, p = 0.058), another somewhat "unusual" quality. In DES, experiences are considered "skillful/creative" if they contain a quality/element/characteristic that, on its face, may seem artifactual, but, upon closer examination, is rather savvy. To illustrate, consider sample 4.4:

> 4.4: [Lee has just read on social media, "Have you ever been attracted to somebody's voice?" Before the beep, she thought, *Yes.*] At the moment of the beep, she innerly hears a man's voice. She attends to the vocal characteristics of the voice—it's warm and comforting. She experiences the innerly heard man's voice to be speaking words, but the words are not important to her experience; that is, she understands him to be speaking probably in words, but she doesn't hear specific words or comprehend any meaning. The words are unimportant; her experience is aimed at *how his voice sounds.* At the same time, Lee innerly sees a black silhouette stepping into a room. [After the beep and in the interview, Lee speculates that the silhouette is a man and, indeed, he is shaped more like a man than a woman, but her experience is not of seeing a man. It's of seeing a silhouette.] The silhouette is seen from the side, stepping into a room with the door opening away from the room. The inner seeing is entirely flat, all aspects are of the same dimension; the background, the door, and the silhouette are all on the single flat "canvas"

so to speak. The inner seeing is dark: the silhouette and door are both black and set against a dark purple background.

On its face, several aspects of this experience appeared to be unclear or poorly articulated: She heard a voice but no words and saw a silhouette instead of seeing a man. However, upon closer examination, these were (we thought) highly skillful improvisations. That is, Lee was apparently trying to recreate attraction to a voice (the question that spawned her experience) and so heard a voice speaking words (as voices do) but also experientially discarded or ignored or denied the words because her experience was not about what the man said but about how his voice sounded. Moreover, she was apparently not aware of or interested in whom the voice belonged to and, therefore, instead of seeing someone specific or even seeing a man generally, she created an extremely vague silhouette of a generic man to be the voice's owner. Similarly, consider sample 11.4:

> 11.4: [Lee is half-asleep on the couch.] At the moment of the beep, she is immersed in (somehow both a part of and listening to) an inner debate. There are no words or sounds even though she definitely experiences herself as listening [which would seem to imply sound]. Moreover, the debate has no content—she doesn't know now in the interview and didn't know at the time what the debate was about [even in general—e.g., politics, favorite foods, etc.]. However, she does clearly apprehend that there are two sides—more like two different ideas as opposed to, say, Person A vs. Person B—and she apprehends those sides as passionately and frustratedly advancing their respective points. Both sides are frustrated and passionate, which are not meant to be synonymous; she apprehends passion distinctly as something like the gusto behind their position and frustration as something like trying to win. Additionally, Lee herself feels frustrated, an empathic, for-

the-debaters frustration. She does not experience herself as with a particular side of the debate—she's more witness than debater. Thus, at the moment of this beep, Lee apprehends a debate without any content; it was rather like the experienced affective bulwark of a debate.

As with the attractive voice in sample 4.4 above, the inchoate/undifferentiatedness of Lee's experience in sample 11.4 seemed to be skillful. She was apparently not interested in any particular debate or even debate topic; rather, she was, for whatever reason, interested in the affective atmosphere and back-and-forth of a debate. Skillfully, then, she experienced that affective atmosphere perfectly void of the not-important-to-her details: There were no specified debaters; no specified topic; no specified words, even. There was only the feel, of which she was entirely immersed: She sensed the debaters' emotions with fine-grained distinction (i.e., passion versus frustration) and she herself felt empathically, vicariously frustrated.

Summary

At the time of her participation, Lee was an undergraduate university student between the ages of 18 and 25. Her Screening responses indicated she experienced clinically significant symptoms of premenstrual distress. She agreed to participate in DES sampling and ultimately did so for 21 days across eight menstrual cycles, collecting a total of 111 beeped experience samples. Her menstrual cycles were generally regular with an average length of 34.5 days, though she missed one menstrual period during her participation. Because she was inconsistent in providing daily ovulation test results, her cycle phases were estimated more crudely (usually based on average cycle length and cycle day of sampling, sometimes including a test result) and were therefore more vulnerable to inaccuracies. However, even with that crude estimation, there appeared to be some cycle-related differences in experiential frequencies. Whereas Lee's most

frequent phenomena (conveniently DES's "five frequent phenomena," or "5FP") did not differ by cycle phase, her more unusual experiences did. Specifically, unusual experiences (such as feelings experienced in color, outside one's body, or non-integrated, imaginary sensations, and innerly seen words) occasionally occurred during non-ovulation phases (especially the late luteal/premenstrual phase) but never during ovulation. Ovulation was therefore unremarkable in some respects (especially regarding feelings) compared to other cycle phases, whereas the late luteal/premenstrual phase was highly unusual (noted as such in 1 in 5 of those samples).

Chapter 9: Cat

Cat is an Asian female. At the time of her participation, she was between 18 and 25 years old and a full-time undergraduate university student.

Step 1: Screening

Cat's screening results indicated she was appropriate for the study. She reported she had regular menstrual periods and denied any medical conditions, behaviors (e.g., heavy alcohol use, shift work), or medications (including birth control) that would alter her hormone function. Cat's responses indicated she experienced clinically significant symptoms of Premenstrual Dysphoric Disorder (PMDD). She endorsed 6 of the 11 DSM-5 symptoms of PMDD and noted that those symptoms profoundly impacted her functioning at work, socially, and even with respect to activities of daily living. On the Premenstrual Assessment Form (PAF), Cat earned a score of 43, which translates to a *z* score of 1.3 and therefore placed her score higher than approximately 80% of those in the normative, non-clinical sample. On the Visual Analogue Scales of PMDD symptoms, she reported that her mood symptoms were, on average, 83.75% worse during the premenstrual phase as opposed to the rest of her cycle. She reported all PMDD symptoms (mood *and* behavioral) were, on average, 77.73% worse during the premenstrual phase as opposed to the rest of her cycle.

Step 2: DES Sampling & Cycle Tracking

Cat participated in the study across nine menstrual cycles. She completed 21 days of natural-environment DES sampling amassing a total of 126 beeped experiences (this count excludes day 1 which was discarded as training, as is typical of DES). Cat completed her first 7 sampling interviews in-person but, due to the coronavirus pandemic, the remainder of her sampling interviews were conducted over Skype or Zoom. Cat demonstrated skill at

apprehending and describing experience from very early in the process and seemed to acclimate easily to the virtual interview environment. However, the impact, if any, of virtual interviews (and of the pandemic more broadly) on Cat's inner experience are, of course, unknown.

Cat provided ovulation test results around all but three of her 21 DES sampling days; however, the days she missed were easily classified without those results (e.g., Sampling day 12 occurred on the 3rd day of that menstrual cycle, therefore clearly in the traditionally non-symptomatic phase). Moreover, the ovulation test kit appeared to be effective for Cat; that is, the fern pattern showed up predictably, including clear ferns or at least some ferns (an indicator that ovulation was *maybe/probably* occurring or about to occur) on each of the six days identified as occurring in the ovulation phase. Across all nine cycles, Cat's average cycle length was 29.5 days, therefore estimating ovulation around days 13-17. Consistent with that estimation, the six sampling days we identified by fern as occurring in the ovulation phase occurred between cycle days 13 and 18.

The top panel of Table 11 displays the breakdown of Cat's sampling days by cycle phase as determined by the day of her menstrual cycle and the results of the ovulation test kit. The bottom panel displays the frequencies of Cat's salient experiential phenomena within each cycle phase and overall.

Table 11

Characteristics of Cat's inner experience overall and by cycle phase

Menstrual Cycle Phase	Traditionally Non-Symptomatic	Ovulation	Late Luteal/ Premenstrual	Total	$X^2(2)$
Days of Menstrual Cycle	1-12, 19-20	13-18	21+		
Number of Sampling Days	8	6	7	21	
Number of Samples	48	36	42	126	
	Frequencies (%)[a] of Experiential Phenomena				
Inner speaking (IS)	33.3	27.8	35.7	32.5	0.58
Inner seeing	2.1	2.8	4.8	3.2	0.55
Unsymbolized thinking	3.1	5.6	3.8	4.4	0.31
Feeling	2.1	2.8	13.1	6.0	5.76
Sensory awareness (SA)	64.6	51.4	48.8	55.6	2.61
IS while reading or writing	21.9	12.5	16.7	17.5	1.28
Bodily feelings	2.1	0.0	9.5	4.0	5.34
Mental feelings	0.0	2.8	3.6	2.0	1.63
Tactile SA	31.3	19.4	19.0	23.8	2.37
Visual SA	14.6	15.3	19.0	16.3	0.36
Bodily SA	16.7	8.3	10.7	12.3	1.47
Multiple connected SA	10.4	13.9	7.1	10.3	1.51
Multiple separate SA	6.3	2.8	2.4	4.0	1.07
Physical action	8.3	29.2	9.5	14.7	8.47*
SA of her physical action	8.3	5.6	2.4	5.6	1.51
Emphasis on movement	5.2	6.9	9.5	7.1	0.63
Aware of her destination/goal	14.6	15.3	14.3	14.7	0.02
Watching TV	4.2	0.0	19.0	7.9	11.13**

[a] Note that % need not up add to 100 because a single sample can contain multiple phenomena.

* "significant" (recall that this analysis did not adjust for multiple tests) at $p < .05$

** "significant" (recall that this analysis did not adjust for multiple tests) at $p < .01$

Analysis

We followed the usual analysis described in Chapter 3 (Method), Step 2: We first reviewed and "captioned" all samples together (blind to their associated cycle phase) and then separated sampling days by cycle phase and phenomenologically and quantitatively examined differences in experience across phases.

The Individual (blind to menstrual cycle phase). In general, Cat's experience was dominated by sensory awareness, which occurred in more than half of all samples (55.6%) and in a variety of ways (bodily, tactile, visual, etc.). She also frequently engaged in inner speech (31.0% of all samples), especially along with reading or writing (22 of 39 inner speaking samples, or 56.4%).

Cat was consistently able to make fine experiential distinctions, especially regarding sensations. For example, note the skill with which Cat differentiated related sensory aspects in this excerpt of sample 16.4:

> 16.4: Cat notices the text [that she's currently reading] standing out. [In fact, the current text is red whereas the previous text was black, and it is the redness that causes the text to stand out, but her experience is not about the redness.] She's noticing the standing-out-ness (which happens to be caused by a difference in color). This is purely visual experience, nothing analytical, a visual noticing of standing-out-ness.

Sample 12.4 was another example of the fine-grained distinctions within Cat's experience. At the moment of that beep, there were two parallel strands in Cat's experience: innerly speaking the words that she was typing and seeing the letters that she typed appear on the screen. Cat was believably clear that the inner speaking was of *words* whereas what she saw appear on the screen were *letters*.

With Respect to Menstrual Cycle Phase. While reviewing Cat's samples, we noticed that there seemed to be differences in the complexity of her experience across sampling days. That is, on some sampling days, Cat's experience seemed overall clear whereas, on other sampling days, her experience seemed "messy" and unfocused. The usual exploratory ANOVA of caption character counts supported that observation, showing that caption lengths differed across cycle phases, $F(2, 123) = 3.06$, $p = 0.050$. Inspection, justified by considering the analysis exploratory, showed that the ovulation caption mean (67.31 characters) was the largest, the traditionally non-symptomatic caption mean was smallest (48.48 characters), and the late luteal/premenstrual caption mean was intermediate (65.27 characters). This suggested that Cat's experiences around the time of ovulation may have been more complex than during the other cycle phases, though the differences were not as phenomenologically obvious as they had been with other participants.

We then conducted the usual exploratory chi squared analyses to examine whether the frequency of a phenomenon differed across cycle phases. There were two "significant" (recall these analyses were considered exploratory and so did not adjust for multiple tests) findings:

- Cat's direct experience of her own physical action(s) differed across phases, $X^2(2) = 8.47$, $p = 0.015$. By inspection, those experiences were more frequent during ovulation (29.2% of samples) than in other cycle phases (8.3% of traditionally non-symptomatic samples and 9.5% of late luteal/premenstrual samples).
- Cat's TV-watching differed across phases, $X^2(2) = 11.13$, $p = 0.004$. Watching TV occurred in far fewer (in fact, none) of her ovulation samples (0.0% of samples) as compared to the late luteal/premenstrual phase (19.0% of samples) and the traditionally non-symptomatic phase (4.2%).

Two other findings were suggestive:

- Feelings seemed to differ slightly across cycle phases, X^2 (2) = 5.76, p = .056. By inspection, feelings were more frequent during the late luteal/premenstrual phase (13.1% of samples) than during ovulation (2.8% of samples) or the traditionally non-symptomatic phase (2.1% of samples).
- Similarly, bodily feelings seemed to differ slightly across cycle phases, X^2 (2) = 5.34, p = .069. By inspection, bodily feelings were most frequent during the late luteal/premenstrual phase (9.5% of samples), whereas they were nonexistent during ovulation and rare during the traditionally non-symptomatic phase (2.1% of samples).

Thus, on the basis of 21 days of natural-environment sampling and careful description of 126 individual moments of private inner experience, it seemed that Cat's experience, too, differed somewhat across cycle phases. Specifically, her experiences during Ovulation seemed to be somewhat more complex than during other phases. This complexity involved, at least in part, to the busyness/fragmentedness of those experiences. That is, whereas the majority of Cat's beeps were simple and straightforward with generally one or perhaps two simultaneous phenomena, some of Cat's beeps stood out as "busy," and those seemed to occur most frequently during ovulation. For example, consider two samples from sampling day 4 during the traditionally non-symptomatic phase. These samples are typical of Cat with a single, specific, finely distinguished sensory awareness:

> 4.1: [Cat is eating pasta.] She (60% of the total experience) notices the savory taste. This is more about the savoriness than about the taste generally. At the same time, she (40%) notices the chewy texture of the pasta between her top and bottom teeth [as she chews].

Thus, her experience at this moment is captured by two simultaneous and related sensory awarenesses.

4.4: [Cat is working on a homework assignment for her Chinese class. Chinese is not her native tongue; she is learning it as a foreign language. The assignment asks her to translate an English sentence into Chinese.] At the moment of the beep, she is innerly speaking in Chinese the translated sentence, and the beep interrupts her somewhere in the middle of the sentence. It's a smooth process—Cat has easily translated the sentence and more or less fluently says it in her inner voice.

In contrast, ovulation samples 9.3 and 9.5 were much busier:

9.3: [Cat is exercising.] At the moment of the beep, she's doing jumping jacks and experiences herself doing them. Most salient, she innerly counts the reps in her own voice, saying, at the moment of the beep, "…12...13...14…" Her experience is of speaking just as she would if speaking aloud with a normal, conversational tone and inflection. At the same time, she feels her heart beating in her chest. [It's beating fast, but she isn't particularly noticing the fastness at the moment of the beep—just feeling the heartbeat.] Also, at the same time, she feels herself breathing and notices that she's breathing heavily through her nose. Thus, whereas she does not directly notice the quickness of her heart beep, Cat *does* in some sensory way notice/recognize the qualities of her breath—that it's heavy and that it's through her nose [which is not how she typically breathes.] This is more than merely the sensation of breathing.

9.5: [Cat is singing along aloud to a Broadway song.] At the moment of the beep, there are several simultaneous and equally present strands in her experience. She is singing "not what I asked for" and is attending to/aware of the words [more to the words

themselves than to the message of the song.] At the same time, she feels vibration in her throat as she attempts to get the melody right—that is, this is a bodily sensation that she experiences as melody-related. Also, at the same time, she recognizes when to start and stop (an aspect of the rhythm), which is a cognitive/analytical experience. Thus, this is different than the bodily sensation in her throat—the rhythm experience is some sort of cognitive noticing/knowing when to start and stop [which is her attempt to get the rhythm right], whereas the throat vibration is sensory, not at all cognitive. Cat is trying to convey sadness in her voice. [She does not feel sad, but she experiences herself as trying to put sadness into her performance.] [Notice that Cat is really engaged in this "performance" almost as if rehearsing, even though, she said, she was just singing for fun.]

In "simple" samples (such as the traditionally non-symptomatic day 4 samples before), Cat was focused singularly with one or two related phenomena clearly dominant. In contrast, in more "complex" samples (such as the ovulation day 9 samples before), Cat's experience was split between several simultaneous phenomena that were related but highly distinct; for example, in 9.5, her experience included words, bodily sensations, a thought process about rhythm, and the conveyance of emotion. Such experiences were clearly "busy" by Cat's usual standards.

The complexity of Cat's ovulation-phase experiences may also have involved the difficulty in categorizing her physical experiences (specifically, her sometimes hyper-focus on seemingly mundane physical actions) which was more common during ovulation.

Summary

At the time of her participation, Cat was an undergraduate university student between the ages of 18 and 25. Her Screening responses indicated she experienced clinically significant symptoms of premenstrual distress. She agreed to participate in DES sampling and ultimately did

so for 21 days across nine menstrual cycles, collecting a grand total of 126 experience samples. During that time, her menstrual cycles were regular with an average length of 29.5 days. She consistently provided ovulation test results, and the ovulation test proved effective, identifying ovulation around expected times on six occasions.

We observed that Cat's experiences seemed to have been more complex around the time of ovulation than during other cycle phases. The exploratory ANOVA comparing caption lengths supported that observation: Caption lengths differed across cycle phases and, by inspection, were longest during ovulation. Whereas Cat's experiences were usually simple with one or perhaps two straightforward and focused phenomena, Cat's ovulation-phase experiences were more often busy, with multiple different phenomena present, and sometimes including an unusually specific emphasis on her physical actions.

Chapter 10: Across-Participant Discussion

The link between mind and biology is well accepted; yet, the specifics of that link, including how changes in biology affect directly apprehended conscious experience ("pristine inner experience") are not well-known. This is perhaps because researchers primarily study inner experience in temporally and experientially unspecific ways, such as with retrospective self-report questionnaires. The present study sought to rectify that by using a highly temporally and experientially specific, beeper-driven method to explore inner experience.

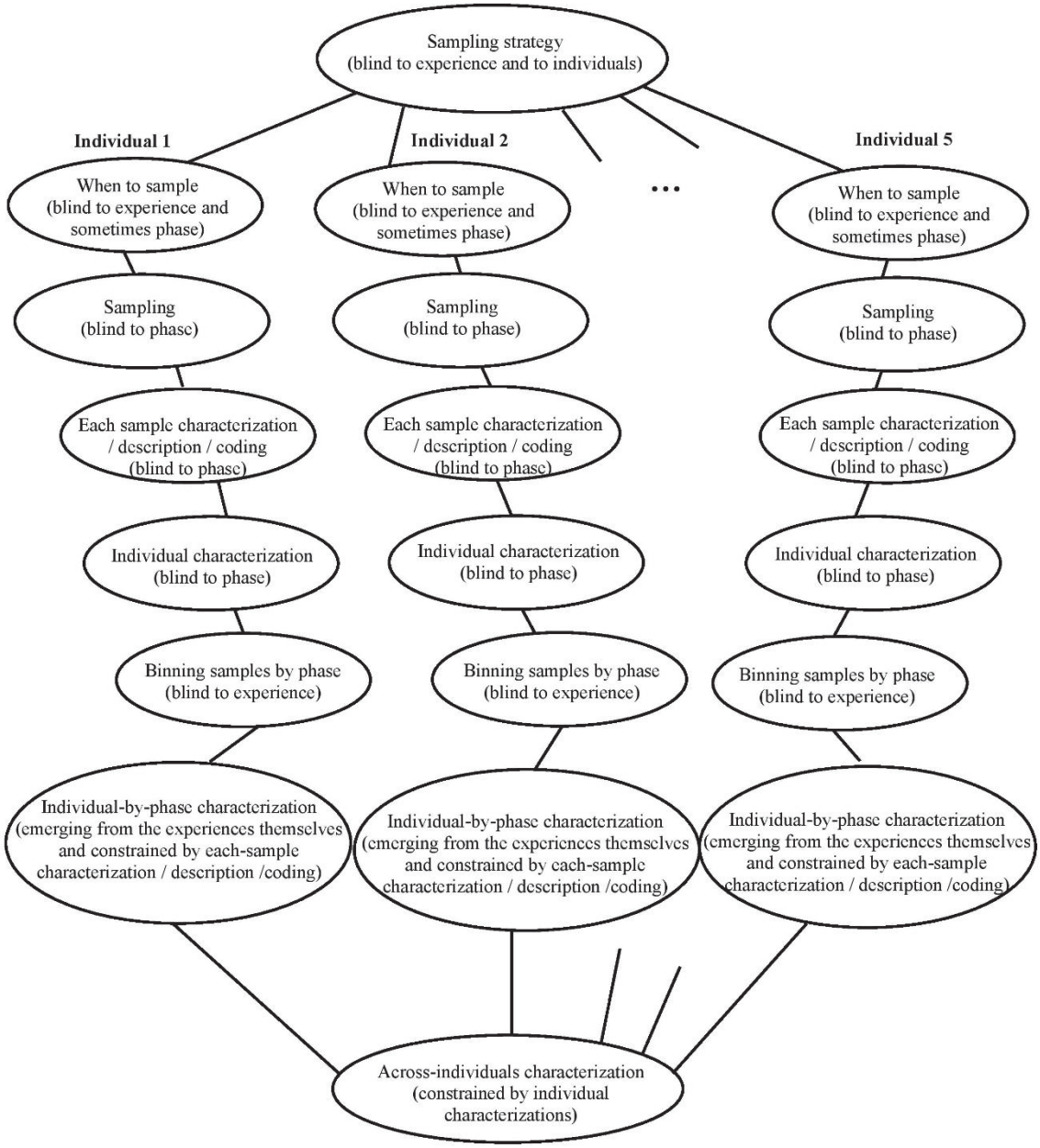
We aimed to explore inner experience in situations where biological aspects varied substantially. We could, for example, have administered psychoactive drugs and observed inner experience both before and after such administration. That would have had the advantage of knowing precisely what biological change had occurred but would have had the disadvantage of our administration of a foreign, unnatural agent. We could have starved participants and investigated inner experience before and during such privation. Beyond the ethical issues, we would have been investigating an unusual, unnatural biological condition. Instead of such unnatural manipulations, we chose to explore the potential inner experiential changes of women as they underwent the natural biological cycles of menstruation. We focused on menstruation because menstrual-cycle-related changes in biology (especially, in ovarian hormones) are thought to cause experiential changes (i.e., premenstrual distress) in some women.

We identified women who were generally healthy and who, by self-report screening, endorsed clinically significant levels of premenstrual distress. We engaged five of those women in approximately 20 days each of Descriptive Experience Sampling (DES) distributed across the phases of their menstrual cycles, thereby allowing for experiential differences (if any) to emerge

across cycle phases. Figure 7, shown above and reproduced below, summarizes the DES sampling procedure:

Figure 7 (reproduced)

Step 2 (DES Sampling & Characterization) Procedure



Because we wanted to sample experience within different phases of the menstrual cycle, we needed to track participants' positions within their menstrual cycles and did so using a daily at-home ovulation microscope test. The test detected a "ferning" pattern in dried saliva that has been shown to be indicative of ovulation. We aimed to sample more frequently in cycle phases associated with pronounced changes in hormone activity—specifically, the estrogen peak at ovulation and the progesterone rise and withdrawal in the late luteal/premenstrual phase. On occasion, the ovulation test helped us to do so: If the test detected ovulation and the participant was willing, we scheduled an additional immediate DES sampling day to capture experiences in the very brief (1-2 day) ovulation phase. However, sampling days were actually predominantly (an estimated 90% of the time) selected based on schedule availability, thereby keeping me blind to cycle phase throughout most sampling. Then, when a participant was nearing the end of her participation, I reviewed her sampling days to determine whether additional sampling was needed in any particular phase. For two participants, we agreed to sample once or twice more during a particular phase or phases and waited until cycle tracking data suggested that the identified phase was occurring; however, for most, it seemed we had captured an adequate number of experiences within each cycle phase by convenience-scheduling alone.

Thus, for all DES sampling, description, review, captioning and coding of experiences samples, I was largely (and RTH, entirely) blind to the associated menstrual-cycle phase. Only then did we separate sampling days by menstrual cycle phase so we could explore differences, if any, in inner experience across phases. Sampling days were separated into one of three cycle phases. Those phases are depicted in Table 5 which is reproduced below:

Table 5 (reproduced)

Menstrual Cycle Phase Classifications

Phase Classification	Part(s) of Typical Menstrual Cycle	Biological (Hormonal) Associations
"Traditionally Non-Symptomatic"	Follicular (beginning of cycle to ovulation) and Early Luteal (immediately post-ovulation to late luteal) phases; theoretically days 1-13 or 14; and 15 or 16-21	Estrogen and progesterone remain relatively stable; fluctuations, if any, are minor and gradual
"Ovulation"	Theoretical midpoint of cycle; theoretically 1-2 days surrounding day 14	Rapid spike in estrogen
"Late Luteal/Premenstrual"	Final 7-10 days of cycle, generally considered days 21+	Withdrawal of progesterone

Phase classifications were determined by considering the ovulation fern test result on that day, the pattern in ovulation test results around that day, day within the cycle, and length of the cycle. Sometimes, those considerations made phase classification easy: For example, if a participant was midway through a cycle and the ovulation test clearly showed fern (both indicators of ovulation), we could confidently identify the ovulation phase. Other times those considerations were not easy: For example, if a participant failed to provide the ovulation test result on that day or if the ovulation test had proven ineffective for her (e.g., no or excessive "positive" results). This was often the case for two of our participants (Allison and Lee) and, because of unavailable of unhelpful data, their phase classifications sometimes had to be made quite crudely, based on the cycle day and length of cycle alone, for example.

We explored possible differences in inner experience across phases first phenomenologically and then using exploratory quantitative analyses. We knew we wanted to assess differences or changes in experience across the menstrual cycle, but the specifics of that assessment were not planned. Instead, the analyses developed organically while trying to make

sense of the first participant, Candy's, inner experience across cycle phase. To observe phenomenological differences in experience across cycle phase, we needed to reconsider all samples separated by cycle phase. However, we could not visualize and/or recall each participant's 100 or more experiences simultaneously, so, instead, we relied on the much-briefer sample "captions" which, recall, were attempts to convey in a few words the salient phenomena and other relevant characteristics present in each experience. Captions are a routine aspect of DES characterizations and serve as signposts that point back to and reawaken investigators to the experiences themselves. For each participant, we created a table that displayed their sample captions "binned" by cycle phase. For the first participant, Candy, we observed that ovulation-phase captions seemed much longer especially by comparison to her late luteal/premenstrual-phase captions. Our attempt to quantitatively test that observation with Candy became standard procedure for all participants: We conducted an exploratory single-factor ANOVA comparing caption lengths across cycle phases. Because this analysis was exploratory, a "significant" statistic indicated only that differences were relatively large. Finally, we conducted chi-squared analyses to test whether the frequencies of individual phenomena differed across cycle phases. As with the ANOVA, those chi-squared analyses were exploratory and did not adjust for multiple tests, therefore, "significant" implied only that the differences were relatively large.

Though our primary interest was in within-person cycle-related fluctuations in experience, we are able to make across-person observations about experience in general (given that we collected, on average, more than 100 samples of experience for each of our five participants). Table 12 below compares the frequencies (across all samples, ignoring menstrual cycle phase) of common phenomena for each of our five participants.

Table 12

Comparing individuals (ignoring menstrual cycle phase)

	Candy	Lane	Allison	Lee	Cat
N Sampling Days	20	16	19	21	22
N Samples	112	88	96	117	126
	Frequencies (%)				
Inner speaking (IS)	27.2	34.1	1.0	25.2	32.5
Inner seeing	8.0	8.5	0.5	28.8	3.2
Unsymbolized thinking	1.3	35.8	3.1	19.4	4.4
Feeling	9.8	15.3	24.5	21.2	6.0
Sensory awareness (SA)	19.2	52.3	51.6	25.2	55.6
Bodily feelings	9.8	5.7	5.7	9.0	4.0
Mental feelings	0.9	2.3	15.6	1.8	2.0
Bodily SA	6.3	39.8	32.3	6.8	12.3
Tactile SA	0.0	15.9	10.4	2.7	23.8
Visual SA	11.2	3.4	7.3	15.8	16.3
IS while reading/writing	6.7	5.7	0.0	5.4	17.5
Nothing	17.0	0.0	10.4	1.8	0.0

First, note that, as DES studies consistently find, differences *between* participants were much greater than differences *within* participants across cycle phases. There were some commonalities between participants, however. For example, sensory awareness was frequent in our sample (occurring between 19% and 55% of the time). That is more frequent than might be expected from our previous DES research (e.g., Heavey & Hurlburt, 2008), although we should be reluctant to make too much of this given the limitations of our small sample. Furthermore, visual sensory awareness was not especially frequent in our sample, though it is the most common form of sensory awareness found in other DES studies. Inner speaking was also

frequent for four of our five participants (occurring between 25 and 34% of the time), though the fifth participant (Allison) almost never engaged in inner speaking (1% of her samples).

Cycle-related Findings

Turning to the study's main finding, inner experience did, indeed, fluctuate across the menstrual cycle for each of our five participants. This is quite remarkable given that our timing delineations of cycle phase were sometimes crude. It suggests that, at least among these women, the experiential changes were substantial, perhaps even more pronounced in reality than could be grasped by our method. It was also quite remarkable that we were able to quantitatively "confirm" differences in experience across phases by analyzing sample captions. Recall that sample captions are a routine step in DES characterizations and that we had not intended or suspected to consider captions in our analysis given that they are but an imperfect "snapshot" of the experiences themselves. Thus, the fact that differences were apparent even in the captions suggests that those fluctuations in experience may be quite robust. For some participants (e.g., Candy, Lane, Cat), a "significant" ANOVA comparing caption lengths seemed to suggest variation in experiential complexity such that longer captions signified messier or more complex experience and shorter captions signified clear and straightforward experience. However, a "significant" ANOVA did not only point to complexity (e.g., Allison's ANOVA was significant but there did not seem to be differences in experiential clarity/complexity across her cycle phases) or, even if it did, the nature of clarity/complexity differences varied by participant. For example, both Candy and Lane's ANOVAs were significant but, whereas Candy's "complexity" referred to a lack of clear figure-ground, Lane's "complexity" involved inchoately or hintily formed phenomena.

Perhaps surprisingly, our participants' experiential fluctuations were not primarily centered on differences in the frequency of particular "content" (e.g., it was not the case that we found, for example, imagery was more frequent during ovulation). Instead, fluctuations usually involved the experiential "process" (as is consistent with what Hurlburt (1993) found among mood-cycling patients). For example, several of our participants exhibited a continuum of complexity and/or clarity in experience. For Candy, experiences in the ovulation phase were more often unclear with not-fully-figural phenomena, whereas during other cycle phases, her experiences were generally clear and straightforward with one (or maybe two) phenomena. For Cat, by contrast, ovulation-phase experiences were more often "busy" with multiple simultaneous phenomena and sometimes an unusually specific focus on her physical actions, whereas those characteristics were less common during other cycle phases. Lane's experience around the time of ovulation also differed from other phases, but the direction was different from that of Candy and Cat: Lane's experiences during ovulation were *more* clear and *more* straightforward than during other cycle phases, especially the late luteal/premenstrual phase.

Those observations point to the second main finding: Ovulation seemed to be the time of most experiential difference. This finding should be considered only suggestive and requires further examination. Our exploratory quantitative analyses showed that there were differences *across phases*; they could not show which phase was *the most different*. However, as we have just seen, experiences during ovulation seemed phenomenologically (and with support from quantitative analyses) to differ in clarity/complexity from experiences in the other two phases for Candy, Lane, and Cat. Experiences during ovulation were prominent in other ways for the remaining two participants. Though Allison's experiences did not differ across phases with respect to clarity, they did differ specifically with respect to sensory awareness. By comparison

to the other cycle phases, Allison's ovulation-phase sensory experiences were more frequently focused on her face and more likely to "grab" her attention beyond what is typical of sensory awareness. Lee was perhaps the exception to this importance-of-ovulation characteristic. Lee's experiences were sometimes highly unusual by DES standards (e.g., feelings experienced in color or bizarre imaginary sensations), and the frequency of those unusual experiences did fluctuate across her cycle, occurring most often in the late luteal/premenstrual phase (20.5% of those samples) whereas not at all during ovulation (0.0%). We could, therefore, have concluded that Lee's experience differed most (was most unusual) in the late luteal/premenstrual phase; however, given that she had a small number of highly unusual experiences in the traditionally non-symptomatic phase as well (8.3% of those samples), perhaps it would have made more sense to conclude that her experience differed the most during ovulation (it was the least unusual, most normal). The choice between those seemed fairly arbitrary, and neither option changed the primary finding: Her experience differed in a fairly remarkable way across the menstrual cycle.

Other (non-cycle-related) Findings

Finally, Lane's participation demonstrated that experience fluctuated not only across the biological process of menstruation (as we have seen above) but also in response to the biological changes caused by medication. Partway through her participation, Lane was diagnosed with ADHD and Bipolar Disorder and began taking psychotropic medications. Her characterization therefore included a secondary analysis comparing her experience with medication (sampling days 13-16; 22 samples) to those without medication (sampling days 1-12, 66 samples). Recall that without medication, Lane's experiences during non-ovulation phases (especially the late luteal/premenstrual phase) were complex and disorganized by comparison to ovulation, which was much clearer and simpler. Now we observed that Lane's with-medication experiences were

even more complex and disorganized than her without-medication samples had been (including by comparison to her late luteal/premenstrual samples). For example, Lane's experience while on medication frequently contained multiple disjointed phenomena (45.5% of with-medication samples compared to only 23.5% of all without-medication samples and 45.5% of late luteal/premenstrual without-medication samples). Moreover, those phenomena were often inchoate and poorly differentiated (63.6% of with-medication samples compared to 40.2% of all without-medication samples and 50.0% of late luteal/premenstrual without-medication samples). Traditionally clear and straightforward phenomena like inner speaking and inner seeing were less common after Lane began taking medications. Instead, her with-medication samples were dominated by sensory awareness (84.1% of with-medication samples compared to 41.7% of all without-medication samples). And Lane's with-medication samples were less straightforward (more unusual) than her without-medication samples, including with imaginary sensations (13.6% of with-medication samples), an experience that never occurred in her without-medication samples.

Significance

Recall that our use of the Descriptive Experience Sampling (DES) method was intended to be an improvement upon the more-typical methods of retrospective questionnaire and clinical interview, which are temporally and experientially nonspecific. DES, in contrast, is highly experientially and temporally specific, focused in a principled manner on apprehending pristine inner experience (that which is directly present in the "footlights of consciousness" at a precise moment in time). Diagnostic criteria and clinical descriptions often refer to pristine inner experiences (e.g., the notion that women with PMDD *frequently feel irritable*), yet pristine inner experiences are rarely researched with the care required. Perhaps not surprisingly, then, our

participants' pristine inner experiences as apprehended by DES did not mirror the diagnostic expectations for premenstrual disorders. Though all participants reported prior to DES sampling that they experienced distressing premenstrual symptoms (such as irritable mood, bloating, cramping, food cravings, trouble sleeping, and so on), we saw very few examples of such classic premenstrual symptoms among their DES samples. This highlights that different methods capture different things. Experientially and temporally nonspecific methods, such as clinical interviews or self-report questionnaires, cannot possibly capture the symptoms they do not inquire about—those that are pre-defined by theory or observation—and are notoriously susceptible to the influence of biases and heuristics. In contrast, experientially and temporally specific methods like DES capture pristine inner experiences "in the wild" that have been perhaps elusive, overlooked, or misunderstood (such as Lane's almost-visual experiences around ovulation or Lee's unusual imaginary sensations in the late luteal/premenstrual phase).

These results highlight another fundamentally important aspect of the DES method—its idiographic nature. All of our participants showed difference across phases, *but because those differences were in different directions for several participants, group means would have shown* no *difference across phases*. For example, Lane's more-complex ovulation-phase experiences would have "cancelled out" Candy's less-clear ovulation-phase experiences. Most of psychological science relies on group means. It is well known but largely overlooked that a difference between group means does not at all imply that every individual, or even that the average individual, behaves in the same way as the group mean. The DES idiographic approach demonstrates the not-so-well-known fact that the group mean does not necessarily behave in the same way as any individual.

We make two final observations. First, we did not find, as the premenstrual distress literature would suggest, that experience differed most notably in the late luteal/premenstrual phase—if anything, across participants, experiences were most unusual during the ovulation phase. That finding is not surprising from a basic biological perspective: The rise and fall of estrogen around ovulation is as rapid, if not more rapid, than the progesterone rise and fall of the late luteal/premenstrual phase. It makes sense, therefore, to assume that, if the rate of change of hormone levels affects inner experience, ovulation would be a time of impact. If and how our participants' ovulation-phase fluctuations in experience relate to premenstrual distress remains to be determined. Only a minority of women report that their PMS-like symptoms begin around ovulation (and Lane was the only of our participants anecdotally to mention ovulation symptoms prior to her sampling). Is that evidence that experiential changes around ovulation are not noticeable? Or, if noticed, not perceived as distressing? Or is it merely an artifact of the typical assessment methods? Perhaps the changes associated with ovulation are difficult to "catch" or describe and therefore require an iterative method like DES. In addition, recall Bosman and colleagues' (2016) review of premenstrual symptom questionnaires: They found that most studies analyzed daily reports only for the late luteal/premenstrual phase, completely disregarding other times in the cycle including ovulation. Perhaps ovulation-phase changes are not actually absent but merely overlooked.

Second, the observation that our participants' experience often fluctuated in terms of clarity and complexity is significant for the intersection of biological and psychological research. The possibility that biological agents and natural fluctuations can clarify or obscure inner experience is not unheard of. For example, decreases in the level of blood sugar lead to fogginess and disorientation, and one of the DSM-5 criteria for PMDD is difficulty concentrating. Yet, to

our knowledge, no other study has demonstrated in the level of detail of the present study what are the characteristics of the disorganization/organization of directly apprehended conscious experience, and certainly no existing diagnostic criteria or assessment instruments inquire about such experientially specific symptoms as "messy" or "multiple" experience. Note also that our study (using DES) did not inquire specifically about "messy" or "multiple" experience either; we inquired about inner experience and then discovered messiness and multiplicity. As another example, psychiatric patients often describe feeling "cognitively sluggish" or "like a zombie" while taking psychotropic medications. Lane's sampling would suggest that perhaps the experiential correlate of that "zombie"-ness is a more chaotic and less clearly figural world. Of course, hers is only a single case study with many uncontrolled factors and additional research into the experiential effects of medication are sorely needed.

Limitations and Future Directions

The present study was exploratory in the truest sense of the word—a traveling into unfamiliar territory (in this case, each participant's private inner experience) with the goal of learning about and sensitizing ourselves to the landscape. This study demonstrates that long-duration DES studies of inner experience are possible (even though they are labor and skill intensive). It demonstrates the potential importance of studies that investigate phenomena in high fidelity: For example, there is nothing in the premenstrual-distress literature that suggests that among women who report premenstrual distress, some have inner experience that is clearer around ovulation, whereas others have inner experience that is less clear. However, this was a small study with substantial methodological limitations. It calls therefore for next steps—continued exploration but also mapping and excavation. And those next steps should improve upon our initial exploration in several ways. Of course, our sample size was extremely small, and

similar or improved versions of this procedure should be carried out with more women. However, we do note that the present sample size is consistent with recommendations for *idiographic* qualitative research [Robinson (2014) suggests 3-16 participants for such studies]. In addition, our method for detecting ovulation was not effective for all participants; future studies should consider using more accurate (and likely, more invasive or time-consuming) methods to ensure that cycle phases are correctly classified. Moreover, though we tentatively assumed relative hormone levels (e.g., low progesterone in late luteal/premenstrual), we did not directly measure hormone levels. Future studies should consider doing so, such as through blood tests. And, whereas we were able to say only that experience differed across phases, future studies should employ analyses (e.g., time-series) that might be able to "pin down" exactly which day and/or phase marks the time of most change. Finally, while we chose to focus on women who reported significant premenstrual distress, future studies might consider doing just the opposite. Perhaps inner experience fluctuates with the menstrual cycle as much as or even more in women who do not notice or report premenstrual symptoms. Above all, we hope that psychological science will come to share the values that uphold this study—basic scientific description, engaging with participants as individuals, and attempting despite the intensity of the work required to understand phenomena in high-fidelity.

Appendix A

Health & Eligibility Questionnaire

Please note that these questions are personal because we will ask about your health and your menstrual cycle. You are given the option to respond with *Prefer Not to Say*; however, selecting that response option may mean that we are unable to determine your eligibility for the study. Any information you provide will be kept confidential as outlined in the consent form.

What is your gender?

- Male
- Female
- Prefer Not to Say

Have you been on birth control pills or depo-provera or any other type of hormonal contraception in the last 3 months?

- Yes
- No
- Prefer Not to Say

What is the brand of pills or contraception you are using?

Note: Please write "Prefer Not to Say" if you do not want to answer. Please write "N/A" if this does not apply to you.

_____

Have you ever tried the pill *Yasmin*?

- Yes
- No
- Prefer Not to Say

Generally, what effects did you experience from taking Yasmin?

- Good effects - improvements in symptoms
- Bad effects - worsening of symptoms
- No noticeable changes in symptoms
- Don't remember or Prefer Not to Say

Do you have regular menstrual cycles? We define regular menstrual cycles as having a period about every 22-32 days for the past 6 months.

- Yes
- No
- Prefer Not to Say

Please describe how you consider your menstrual cycles to be irregular.

Note: Please write "Prefer Not to Say" if you do not want to answer.

_____

Have you skipped any periods in the past year?

- Yes
- No
- Prefer Not to Say

How many skipped periods occurred consecutively?

Note: Please write "Prefer Not to Say" if you do not want to answer.

_____

What was the date of your most recent period? By "date," we mean the first day of menstrual bleeding. If you are not sure, please guess to the best of your ability.

_____

What was the date of your *second most recent* period? By "date," we mean the first day of menstrual bleeding. If you are not sure, please guess to the best of your ability.

_____

Have you been pregnant within the last year?

- Yes
- No
- Prefer Not to Say

Have you breastfed within the last 6 months?

- Yes
- No
- Prefer Not to Say

Do you currently suffer from anorexia nervosa?

- Yes
- No
- Prefer Not to Say

Have you ever been diagnosed or treated for anorexia nervosa?

- Yes
- No
- Prefer Not to Say

When (roughly how many months/years ago) were you diagnosed and/or treated for anorexia nervosa?

Please write "Prefer Not to Say" if you do not wish to answer.

_____

Do you have any medical diseases or illnesses, such as diabetes, gestational diabetes, thyroid disorder, metabolic disorder, asthma, or any other chronic medical or genetic condition?

- Yes
- No
- Prefer Not to Say

Which conditions?

Note: Please write "Prefer Not to Say" if you do not want to answer.

_____

How often do you have a drink containing alcohol?

- Never
- Monthly or less
- Two to four times a month
- Two to three times a week
- Four or more times a week
- Prefer Not to Say

How many drinks containing alcohol do you have on a typical day when you are drinking?

Note: A standard drink would be 1 beer (12 oz.), 1 glass of wine (5 oz.), 1 shot of liquor.

- 1 or 2
- 3 or 4
- 5 or 6
- 7 to 9
- 10 or more
- Prefer Not to Say

Are you currently taking any sort of steroid medication? Steroid medication can be taken in pill form or as an injection and can be used to treat several things like asthma, arthritis or inflammation.

- Yes
- No
- Prefer Not to Say

Please record the steroid medications and dosages.

Note: Please write "Prefer Not to Say" if you do not want to answer.

_____

Are you currently taking any antibiotic medications (e.g., to treat acne)?

- Yes
- No
- Prefer Not to Say

Please record the antibiotics you are taking and how long you have been taking them.

Note: Please write "Prefer Not to Say" if you do not want to answer.

_____

Are you currently prescribed an antidepressant medication?

- Yes
- No
- Prefer Not to Say

Please record the name and dosage of the antidepressant you are currently taking.

Note: Please write "Prefer Not to Say" if you do not want to answer.

_____

Have you *ever* been prescribed an antidepressant medication?

- Yes
- No
- Prefer Not to Say

Please record the name of the antidepressant you were prescribed and roughly when (how many months/years ago) you were prescribed it.

Note: Please write "Prefer Not to Say" if you do not want to answer. Please write "N/A" if you the antidepressant you are currently prescribed is the only antidepressant you've ever been prescribed.

_____

Do you regularly work a 2nd or 3rd shift (3-11 PM or midnight to 8 AM)?

- Yes
- No
- Prefer Not to Say

What is your age? _____ (years)

_____

What is your ethnicity?

- Asian/Pacific Islander
- Black or African American
- Hispanic or Latino
- Native American/Alaska Native
- White or Caucasian
- Other
- Prefer Not to Say

What is the highest level of education you have received?

- Some high school
- Graduate high school
- GED or Adjusted high school diploma
- Some college
- Associate's (two-year) college degree
- Bachelor's (four-year) college degree
- Some graduate school
- Master's degree
- Doctorate degree
- Prefer Not to Say

What is your current employment status?

- Unemployed
- Part-time (20 hours or less per week)
- Full-time (approximately 40 hours or more per week)
- Prefer Not to Say

What is your first name? _____

What is the best phone number to reach you at? _____

What is the best e-mail address to reach you at? _____

Which days and times tend to work best to reach you by phone? _____

Appendix B

DSM-5 PMDD Symptom Checklist

In the **majority** of your menstrual cycles, do you experience the following symptoms

(a) during the final week before menses (bleeding)

(b) that improve during menses

(c) and are mostly absent in the weeks after menses:

Check yes only if (a), (b), and (c) are all true for that symptom.

1. Mood instability: mood swings, feeling suddenly sad or tearful, or increased sensitivity to rejection
2. Irritability or anger or increased conflicts with others
3. Depressed mood, feelings of hopelessness, or self-deprecating thoughts
4. Anxiety, tension, and/or feelings of being keyed up or on edge
5. Decreased interest in usual activities (e.g., work, school, friends, hobbies)
6. Difficulty concentrating
7. Lack of energy, easily fatigued, lethargy
8. Change in appetite: overeating or specific food cravings
9. Sleeping significantly more or less than usual
10. A sense of being overwhelmed or out of control
11. Physical symptoms such as breast tenderness or swelling, joint or muscle pain, bloating, or weight gain

How seriously do these symptoms interfere with your:

1.	Work	Not at all	Mildly Moderately	Severely	N/A
2.	School	Not at all	Mildly Moderately	Severely	N/A
3.	Social activities	Not at all	Mildly Moderately	Severely	N/A
4.	Relationships with others	Not at all	Mildly Moderately	Severely	N/A
5.	Daily activities of living (taking care of yourself, doing chores, etc.)	Not at all	Mildly Moderately	Severely	N/A

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Curriculum Vitae

Alek (Haugen) Krumm

alek.krumm@gmail.com
February 2021

EDUCATION

2021 — **Doctor of Philosophy in Clinical Psychology**
University of Nevada, Las Vegas (APA-Accredited) GPA: 4.00
Advisor: Russell T. Hurlburt, Ph.D.
Dissertation: *Is Pristine Inner Experience Linked to Biology?*

2019 — **Master of Arts in Clinical Psychology**
University of Nevada, Las Vegas (APA-Accredited) GPA: 4.00
Advisor: Russell T. Hurlburt, Ph.D.
Thesis: *Exploring the Pristine Inner Experience of Individuals in Psychotherapy*

2015 — **Bachelor of Science in Psychology**
Bachelor of Arts in Honors
University of North Dakota GPA: 4.00
Advisor: Andre Kehn, Ph.D.
Honors Thesis: *The Child Credibility Assessment Scale: Validity and Credibility in Child Sexual and Non-Sexual Abuse Cases*

SCHOLARSHIPS, GRANTS, HONORS, AWARDS

2018-2019
UNLV Graduate College Summer Doctoral Fellowship ($7,000)
UNLV GPSA Research Grant ($480)
American Group Psychotherapy Assoc. Foundation Scholarship ($209)

2017-2018
UNLV'S The PRACTICE Clinic Charles Schwab Scholarship ($3,077)
UNLV Graduate College Summer Access Grant ($2,000)
UNLV GPSA Research Travel Grant ($550)

2016-2017
UNLV Graduate College Summer Doctoral Fellowship ($7,000)
UNLV GPSA Research Travel Grant ($500)

2012-2015
North Dakota Academic & Burgum Presidential Scholarship ($34,000)
UND Department of Psychology Undergraduate Travel Award ($250)
UND Dept. of Psychology Outstanding Undergraduate Student ($250)
UND Dept. of Psychology Outstanding Undergraduate Student ($250)
Dean's List, University of North Dakota

PREDOCTORAL INTERNSHIP

Fargo VA Healthcare System (APA-Accredited)
Fargo, ND
August 2020 – August 2021
Training Director: Jessica Gustin, Ph.D.

Description: The Fargo VAHCS is a Joint Commission-accredited medical/surgical center with 36 acute care beds, a 38-bed Community Living Center, Primary Care and Specialty Clinics, and 10 Community Based Outpatient Clinics, serving over 34,000 veterans in North Dakota and northwest Minnesota.

Emphases: Adult military veterans; geropsychology; trauma; specialized assessment of decisional capacity

Clinical Activities:

Inpatient Psychology (4-month clinical rotation on medical service units, acute inpatient psychiatric unit, and transitional care/nursing home unit)

- Brief, behavioral-based counseling
- Long-term supportive therapies
- Weekly inpatient psychiatry group psychotherapy
- Participation on interdisciplinary treatment teams

Outpatient General Mental Health Services, including Trauma Team (year-long)

- Maintain a caseload of outpatient psychotherapy clients
- Maintain a small but consistent (1-2 veterans) caseload for evidence-based treatment of trauma, including Prolonged Exposure and Cognitive Processing Therapy
- Participation on multidisciplinary treatment team for consultation and staffing of trauma treatment referrals

Primary Care Mental Health Integration (4-month clinical rotation)

- Brief, behavioral-based counseling for health psychology concerns (e.g., illness anxiety, coping, chronic pain)
- Participation on Interdisciplinary Chronic Pain Team
- Specialized assessments in psychological fitness for organ transplant

Psychological Assessment Services (year-long involvement)

- Conduct psychological assessments for general mental health, personality, and cognitive concerns
- Specialized assessments in decisional capacity

Orientation: Integration of evidence-based interventions, in particular, Interpersonal Process, Dialectical Behavior Therapy, and trauma-focused treatments

SUPERVISED PRACTICUM EXPERIENCES

The Evidence Based Practice of Nevada (EBP) – Group Private Practice
Henderson, NV
August 2019 – May 2020
Supervisor: Whitney Owens, Psy.D., Owner

Description: The EBP is a group private practice whose mission is to address the behavioral healthcare crisis in Nevada by 1) providing state-of-the-art, evidence-based behavioral healthcare for children, adolescents, adults, and families and 2) providing state-of-the-art training in empirically supported behavioral health practices to trainees of all levels.

Emphases: Adults; couples; third-wave cognitive behavioral therapies; personality disorders

Activities: Individual therapy: Maintained a caseload of 10-15 adult individual and couples therapy patients.
Radically-open DBT group therapy: Co-facilitated (with Dr. Owens) a 30-week weekly RO-DBT group for issues of overcontrol.
Program development/Outreach: Served as a mentor-coach for a yoga teacher in Rwanda, Africa as part of a research study examining the effectiveness of a trauma-informed wellbeing program.
Consultation: Attended weekly DBT consultation group consisting of community professionals in psychology and social work.
Supervision: Weekly individual supervision

Orientation: Integration of evidence-based interventions, in particular, Interpersonal Process, RO-DBT, traditional DBT, and Acceptance and Commitment Therapy (ACT)

The PRACTICE – Community Mental Health Clinic located on UNLV Campus
University of Nevada, Las Vegas
August 2019 – December 2019
Supervisor: Michelle G. Paul, Ph.D.

Description: The PRACTICE is the training clinic of the UNLV psychology department, providing sliding-scale individual, family, and group therapy and psychological assessment to children and adults in the Las Vegas metropolitan area as well as telehealth services to children and adolescents in rural Nevada.

Populations: Adult college students referred from university Disability Resource Center and Academic Success Center for personality, learning, and attentional disorders

Activities: Psychological assessment and testing: Completed comprehensive psychodiagnostic assessments; wrote integrated reports including recommendations for university accommodations; provided therapeutic feedback

Southern Nevada Adult Mental Health Services (SNAMHS) – State Agency (Inpatient & Forensic)
Las Vegas, NV
August 2018 – August 2019
Supervisor: Shera D. Bradley, Ph.D., Director of Forensic and Civil Psychology Services

Description: SNAMHS is a state agency that provides services for individuals with serious mental illness. It has two hospitals: Rawson-Neal Psychiatric Hospital provides inpatient services to adults who are generally admitted via involuntary admission (average length of stay = a few weeks). Stein Hospital is a secure forensic facility that houses patients who have been found incompetent to proceed with their legal cases or who have been

found permanently incompetent and are deemed dangerous and thus committed to the hospital for up to 10 years.

Emphases: Forensic assessment; adult offenders; serious mental illness; personality disorders; substance abuse; assessment of malingering

Activities: Forensic evaluation: conducted interviews and evaluations under live-supervision and wrote court-ordered evaluations of competency to stand trial, violence risk, and risk to re-offend
Brief intervention, involving primarily modified DBT skills coaching and for behavioral disturbances
Long-term individual therapy utilizing DBT and ACT skills for serious mental illness
Behavior modification: Developed, maintained, and monitored individual positive behavior support plans and individualized token economies
Consultation: Responded to psychological consult requests for various needs (e.g., behavior plans, functional assessments, staff educations, etc.)
Psychological assessment and testing: Conducted and wrote integrated reports for brief, targeted assessments aimed at clarifying questions of psychopathology, intelligence, memory, personality, and malingering
Supervision: Weekly individual supervision; weekly live supervision

Orientation: Integration of evidence-based treatments with an emphasis on DBT and ACT.

The PRACTICE – Community Mental Health Clinic located on UNLV Campus
University of Nevada, Las Vegas
August 2017 - August 2018
Primary Supervisor: Noelle Lefforge, Ph.D., Assistant Director of Clinical Services and Research

Description: The PRACTICE is the training clinic of the UNLV psychology department, providing sliding-scale individual, family, and group therapy and psychological assessment to children and adults in the Las Vegas metropolitan area as well as telehealth services to children and adolescents in rural Nevada.

Emphases: Generalist; adults, children, and teens; individual and group psychotherapy for mood and anxiety disorders; suicidality

Activities: Individual therapy: Maintained a caseload of 4-7 weekly individual patients with a broad range of presenting concerns.
Skills group therapy: Co-facilitated weekly DBT skills group composed of 8-12 members for one year; met individually with group members for monthly case management
Process group therapy: Served as process observer in weekly interpersonal process group for 8 weeks
Telecounseling: Provided weekly teletherapy of DBT skills for emotion regulation with a child patient living in rural northern Nevada; coordinated care with patient's teacher, parents, and school counselor
Psychological assessment and testing: Completed comprehensive assessments for concerns related to memory, ADHD, and learning disorders; wrote integrated reports and provided therapeutic feedback

Intake interviews: Completed approximately 20 adult and child therapy intakes; presented on intake cases in a weekly multidisciplinary case rounds meeting; provided therapeutic feedback of treatment recommendations to patients
Multidisciplinary teams: Attended weekly case consultation and staff meetings with a team of trainees in clinical psychology, school psychology, clinical mental health counseling, and social work
Supervision: Weekly individual supervision, weekly didactic group supervision of group therapy

Orientation: Integration of evidence-based interventions, in particular Interpersonal Process Therapy, Short-term Psychodynamic Therapy, and Dialectical Behavioral Therapy.

SPECIALIZED CLINICAL TRAINING

August 2020 – Present — **Process Oriented Training Group for Therapists**
Bi-monthly online training meeting for therapists
Nate Page, PhD, LP, CGP (Group Therapy Central)

October 2019 — **DBT Part II: Skills, Skill Training, and Skill Coaching**
3-day training sponsored by Nevada Psychological Association
Armida Fruzzetti, Ph.D.

September 2019 — **DBT Part I: Theory, Structure, Targets, and Treatment Strategies**
3-day training sponsored by Nevada Psychological Association
Alan E. Fruzzetti, Ph.D.

April 2019 — **ACT II: Clinical Skills Building Intensive**
2-day training sponsored by Nevada Psychological Association
Steven Hayes, Ph.D.

March 2019 — **Interprofessional Education and Practice Workshop**
1-day training sponsored by University of Nevada, Las Vegas IPEP

February 2019 — **Experiential Institute: Process Group Training**
2-day experiential workshop at American Group Psychotherapy Association Annual Conference
Facilitated by Barbara Finn, Ph.D., CGP, FAGPA

February 2019 — **Sex Trafficking Identification and Treatment**
½ day training offered through Northern & Southern Nevada Adult Mental Health Services
Shera D. Bradley, Ph.D.

November 2018 — **Assessment of Competency Certification Training**
1-day training offered through Northern & Southern Nevada Adult Mental Health Services
Shera D. Bradley, Ph.D.

October 2018 — **ACT I: Introduction to Acceptance and Commitment Therapy**
2-day training sponsored by Nevada Psychological Association

Steven Hayes, Ph.D.

March 2018 **Interprofessional Education and Practice Workshop**
1-day training sponsored by University of Nevada, Las Vegas IPEP

Fall 2017 **Seminar on Integrated Health in Primary Care Settings**
Semester-course offered at University of Nevada, Las Vegas
Sarah Hunt, Ph.D., & Michelle Paul, Ph.D.

September 2017 **Doing Business as a Psychologist**
1-day training offered through Nevada Psychological Association
Larry Waldman, Ph.D., ABP

May 2017 **Workshop on Linear Regression Using *R***
1-week workshop offered through UNLV Psychology Department
Andrew Freeman, Ph.D.

April 2014 **Trauma-Focused Cognitive Behavioral Therapy (TF-CBT)**
2-day training offered through UND Psychology Department
Michael Gomez, Ph.D.

RESEARCH EXPERIENCE

Descriptive Experience Sampling Lab
University of Nevada, Las Vegas
2016 – present
Role: Graduate Research Assistant
Supervisor: Russell T. Hurlburt, Ph.D.

Descriptive Experience Sampling (DES) is a method that uses a random beeper to explore inner experience.

Activities: Training with the creator of DES in the art of DES interviewing: DES involves hour-long, repeated interviews aimed at understanding participants' experiences and describing them with fidelity. Projects have focused on exploring the inner experience of: adults in psychotherapy, women with premenstrual distress, women with bulimia nervosa, and combat veterans with PTSD.

See here for more information:
http://hurlburt.faculty.unlv.edu/lena/do_I_have_internal_monologue_sampling.html

University of Nevada, Las Vegas
Fall 2017 – Spring 2020
Role: Graduate Research Assistant
Supervisor: Christopher L. Heavey, Ph.D., Senior Vice Provost, UNLV

Activities: Collaborating with Dr. Heavey to review research and prepare and edit chapter drafts for a book targeted at a popular psychology audience.

Psychophysiology Lab
University of North Dakota Department of Psychology
Fall 2015
Role: Undergraduate Research Assistant
Supervisor: Dmitri Poltavski, Ph.D.

Activities: Trained in use of B-Alert X10 wireless EEG apparatus and software as part of a research project examining the effectiveness of Nike Sparq sports vision training for youth hockey players.

Te Rū Rangahau Māori Research Laboratory
University of Canterbury, Christchurch, New Zealand
Role: Visiting Research Assistant
Summer 2015
Supervisor: Angus Macfarlane, Ph.D.

Activities: Studied Dr. Macfarlane's methods for culturally responsive education and restorative justice; Attended workshops, presentations, and cultural events

Addictive Behaviors & Cognitions Lab
University of North Dakota Department of Psychology
Spring 2015
Role: Undergraduate Research Assistant
Supervisor: Alison Looby, Ph.D.

Activities: Delivered a motivational interviewing intervention as part of a study exploring student opinions regarding "study drugs"; Trained in the spirit of motivational interviewing from two clinical professionals; Administered questionnaires and led a detailed debriefing for a study exploring implicit attitudes and willingness to use marijuana

PEER-REVIEWED PUBLICATIONS

1. Hurlburt, R. T., Heavey, C. L., Lapping-Carr, L., **Krumm, A. E**., Moynihan, S. A., Kaneshiro, C., Brouwers, V. P., Turner II, D. K., & Kelsey, J. M. (in press). Measuring the frequency of inner experience characteristics. *Perspectives on Psychological Science.*

2. **Krumm, A.**, Macfarlane, A., & Duckworth, F., & Harris, F. (in press). The imperative of indigenous knowledge: Models and principles to support non-indigenous professionals. *the Behavior Therapist.*

3. Heavey, C. L., Moynihan, S. A., Brouwers, V. P., Lapping-Carr, L., **Krumm, A. E**., Kelsey, J. M., Turner II, D. K., & Hurlburt, R. T. (2019). Measuring the frequency of inner experience by questionnaire: The Nevada Inner Experience Questionnaire. *Frontiers in Psychology.* https://doi.org/10.3389/fpsyg.2018.02615

4. **Krumm, A. E.,** Ferraro, F. R, & Ingvalson, B. R. (2017). The relationship between autistic traits and body image, satisfaction, and competency. *The Journal of Psychology: Interdisciplinary and Applied, 6:* 566-579. https://doi.org/10.1080/00223980.2017.1372343

5. **Haugen*, A. E.,** Preszler, J. R., Cookman, M. L, & King, A. R. (2016). Sibling death

and adult maladjustment indices: A brief report. *Journal of Loss and Trauma, 21*(4): 265-274, https://doi.org/10.1080/15325024.2015.1048152

*Name changed from Haugen to Krumm 2016

MANUSCRIPTS UNDER REVIEW

1. **Krumm**, A. E., & Hurlburt, R. T. (under review October 2020). A complete unabridged DES investigation: The case of Lena. *Phenomenology and the Cognitive Sciences*.

OTHER PROFESSIONAL WORKS

1. Hurlburt, R. T., & **Krumm, A. E.** (2020). *Do I really have internal monologue? (Reality TV about inner experience).* http://hurlburt.faculty.unlv.edu/lena/do_I_have_internal_monologue_sampling.html

2. Lefforge, N. L., Paul, M., Nixon, J., & **Krumm, A.** (2018). Toward integration: Advancing interdisciplinary practice in community mental health. *May 2018 Association of Psychology Training Clinics Bulletin, 1,* 3-7.

PROFESSIONAL PRESENTATIONS

PAPERS/ORAL

1. **Krumm, A. E.** (April, 2019). *Motivational interviewing: Basic techniques and how to implement them in our setting.* One-hour workshop presented to staff at Southern Nevada Adult Mental Health Services. Las Vegas, NV.

2. **Krumm, A. E.** (February, 2019). *Does experience cycle with menstruation?* Paper presented at the 21st annual UNLV Graduate and Professional Student Association Research Forum.

3. **Krumm, A. E.,** & Hurlburt, R. T. (April, 2018). *Becoming a Mother: An Account from Everyday Inner Experience.* Paper presented at the annual conference of the Western Psychological Association, Portland, OR.

4. **Haugen, A. E**. (November, 2015). *The child credibility assessment scale: Validity and predictability in child sexual and non-sexual abuse cases.* Paper presented at the annual Northern Light Psychology Conference, Grand Forks, ND.

POSTERS

1. Barchard, K. A., Kaneshiro, C., **Krumm, A. E.** (February 2020). *Evaluating Validity is Harmful.* Poster presentation at the American Association of Behavioral and Social Sciences, Las Vegas, NV.

2. **Krumm, A. E**., Raymond, N. C., Reger, S. L., Hurlburt, R. T., & Heavey, C. L. (May 2019). *The Inner Experience of 15 Veterans with PTSD Symptoms as Discovered by Descriptive Experience Sampling.* Poster presented at the Southern Nevada Veterans Administration Research Week, Las Vegas, NV.

3. Fink-Armold, A., **Krumm, A. E.,** Shope, M. M., & Barchard, K. A. (April 2019). *Measuring perceptions of the prevalence of workplace sexual harassment.* Poster presented at the annual conference of the Western Psychological Association, Pasadena, CA.

4. **Krumm, A. E.,** Lapping-Carr, L., Kaneshiro, C., Moynihan, S., Heavey, C. L., & Hurlburt, R. T. (May 2018). *Subjective experience is not all the same: Private phenomena vs. inferred states.* Poster presented at the 30th annual meeting of the Association for Psychological Science, San Francisco, CA.

5. Kaneshiro, C., Lapping-Carr, L., **Krumm, A. E.,** Moynihan, S., Hurlburt, R.T., & Heavey, C. L. (May 2018). *Can first-person methods reliably apprehend inner experience? Lessons from eyewitness testimony.* Poster presented at the 30th annual meeting of the Association for Psychological Science, San Francisco, CA.

6. Looby, A., Holt, L.J., Engle, D., Heppner, B., **Haugen, A.,** & Ballard, A. (November 2015). *Efficacy of a group-based motivational interviewing intervention to prevent and reduce nonmedical prescription stimulant use among college students.* Poster presented at the 49th annual meeting of the Association for Behavioral and Cognitive Therapies, Chicago, IL.

7. **Haugen, A.E**., Ingvalson, B. R., & Ferraro, F. R. (October 2015). *Exploring body image and body satisfaction among college students with significant autistic traits.* Poster presented at the Annual Northern Lights Psychology Conference, Grand Forks, ND.

8. **Haugen, A. E**., Preszler, J.R., Cookman, M.L., & King, A.R. (April 2015). *Sibling death and adult maladjustment indices: A brief report.* Poster presented at the Midwestern Psychological Association Conference, Chicago, IL.

9. **Haugen, A.E.,** Preszler, J.R., Cookman, M.L., & King, A.R. (October 2013). *Childhood bereavement and antisocial tendencies: A brief report.* Poster presented at the Annual Northern Light Psychology Conference, Grand Forks, ND.

10. Preszler, J.R., **Haugen, A.E**., Cookman, M.L., & King, A.R. (October 2013). *Antisocial tendencies as a partial function of childhood developmental adversity.* Poster presented at the Annual Northern Light Psychology Conference, Grand Forks, ND.

TEACHING EXPERIENCE

Introduction to Statistical Measures (PSY210)
University of Nevada, Las Vegas
2016-2017
Role: Graduate Teaching Assistant
Supervisor: Russell Hurlburt, Ph.D.

SERVICE & LEADERSHIP

2018 - Present	Contributor/Team Member, Families in Psychology Project
2018 - 2019	Student Member, The PRACTICE CMH Clinic Advisory Board
2018 - 2019	Cohort Representative, UNLV Clinical Psychology Student Committee

2016 - 2018	Mentor, UNLV Outreach Undergraduate Mentorship Program
2013 - 2016	Youth Mentor, Grand Forks, ND YMCA Little Brother/Little Sister Program
2014 - 2015	Volunteer Assistant, Prevent Child Abuse North Dakota
2012 - 2015	Peer Service Mentor, UND Honors Program

PROFESSIONAL AFFILIATIONS

American Psychological Association (APA), Graduate Student Member (2016-present)
Nevada Psychological Association (NPA), Student Member (2017-2020)
American Group Psychotherapy Association, Student Member (2018-present)
APA Div 29 Society for the Advancement of Psychotherapy, Student Member (2019-present)
APA Div 24 Society for Theoretical and Philosophical Psychology, Student Reviewer (2017-present)
Supervising Reviewer: Dr. Samuel D. Downs, University of South Carolina Salkehatchie
Association for Psychological Science (APS), Student Affiliate (2016-2018)

RELEVANT WORK EXPERIENCE

Special Events Coordinator
Global Friends Coalition, Grand Forks, ND
2016 – 2018
Supervisor: Cynthia Shabb, Ph.D., Executive Director

Description: Global Friends is a 501 (c) 3 non-profit organization based in Grand Forks, ND. Global Friends' mission is to aid in refugee integration by providing mentorship and educational services to refugees and the greater community. The refugees served are primarily from Nepal/Bhutan, Somalia, and the Democratic Republic of Congo.

Activities: Consultation regarding grant writing, program design, program evaluation, recruitment/marketing strategy

Education & Outreach Coordinator
Global Friends Coalition, Grand Forks, ND
2015 – 2016
Supervisor: Cynthia Shabb, Ph.D., Executive Director

Activities: Researched the educational needs of refugees in the community and designed and implemented educational opportunities (e.g., English language classes, healthcare workshops, etc.) as well as informative community outreach events; designed evaluation measures for classes and events