THE RECIPROCAL DYNAMICS OF NORMATIVE AFFECTIVE STATES AND PATHOLOGICAL MOOD WITH FEMALE SEXUAL PROBLEMS: A DAILY STUDY OF YOUNG WOMEN

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INTRODUCTION

In the United States, depression, anxiety, and sexual dysfunction pose important public health concerns. Depression is among the most prevalent of all psychological disorders, with recent estimates indicating that approximately 20% of the U.S. population will experience a major depressive episode (Gotlib & Hammen, 2002). Estimates show 6.7% of American adults suffer from major depression in a 12-month period (Kessler, Chiu, et al., 2005), with as many as 19 million new cases being diagnosed each year (Kupfer, 1999). Further, data indicate that women are 70% more likely than men to suffer from a mood disorder (Kessler, Berglund, et al., 2005). Not only is depression prevalent in the population, but individuals with depression are particularly at risk for chronic suffering as the chance of relapse increases with each episode (Solomon et al., 2000). Recent epidemiological studies have found depression to be associated with poor physical health, such as high rates of cardiac problems and higher rates of smoking (Sullivan, LaCroix, Russo & Walker, 2001). Greenberg et al. (2003) estimated that, in the United States, depression-related medical, mortality, and workplace costs surpassed 83.1 billion dollars.

Anxiety disorders are the most prevalent mental health disorders in the United States, with as much as 18.1% of American adults suffering from anxiety in a 12-month period (Kessler, Chiu, et al., 2005). Of these individuals, just fewer than 25% of these
cases are considered severe. Similar to depression, women are at a 60% higher risk of suffering from an anxiety disorder than men. Given the high prevalence rates of depression and anxiety in American women, it is important to further our understanding of these public health problems and how they impair aspects of their sufferers’ everyday living.

Laumann, Paik, and Rosen’s (1999) analysis of the National Health and Social Life Survey’s data reported one-year prevalence rates of sexual problems and dysfunctions of 43% for women. More recently, Lewis and colleagues (2004) estimated that 40-45% of women suffer from at least one difficulty with sexual functioning. These alarmingly high rates of sexual problems were associated with poorer physical and emotional health. A link between poor emotional health and sexual problems is perhaps not surprising, as a loss of sexual interest has long been viewed as a symptom or result of unipolar depression (Beck, 1970). Rates of sexual problems have been reported as 30-70% in depressed populations (Saks, 1999).

Given the biopsychosocial conceptualization of female sexual health, the comorbidity between pathological mood and female sexual dysfunction is an important topic of research in understanding the psychological components of sexual health (Atlantis & Sullivan, 2012; Laurent & Simons, 2009). Elucidating the nuances of how mood impacts sexual function and how sexual function influences mood allows for improvement in understanding how impairments in these aspects of health are developed and maintained. Though a large body of research has shown mood disorders to be related
to poorer sexual function, certain methodological concerns have limited our understanding of certain aspects of these relations, such as temporal precedence and directionality. Also, though past research has examined these relations between mood and various aspects of sexual health, the field has been comparatively less concerned with moods other than depression or anxiety. This over-emphasis on pathological mood has resulted in a lack of understanding of how other affective states, such as happiness, confidence, and anger, may be related to sexual desire, arousal, and orgasmic function. Lastly, though sexual distress is an important aspect of sexual health (DeRogatis et al., 2011), the literature suffers from a dearth of studies examining how sexual distress is related to mood. As such, to provide a more nuanced understanding of the interplay between mood and sexual function, the present study sought to prospectively assess daily levels of depression, anxiety, and normative affective states to examine their temporal relations with daily fluctuations in sexual health. Further, we investigated the impact of female sexual distress on later mood. The present study is an extension of our prior investigations regarding the comorbidity between affective and sexual problems.

In a recent investigation, Kalmbach and colleagues (2012) used Clark and Watson’s (1991) tripartite conceptualization of anxiety and depression to examine the relations between affective and sexual problems. The tripartite model conceptualizes anxiety and depression as shared, but distinct, constructs. Specifically, Clark and Watson describe anxiety and depression as sharing high negative affect; a factor they labeled general distress, which includes features such as sadness and subjective fear.
Importantly, the tripartite model describes symptoms that are unique to each syndrome as well. Unique to depression is anhedonia, which is defined as blunted positive emotion and diminished appetitive drive. Specific to anxiety is anxious arousal, which is defined as somatic hyperarousal (e.g., increased heart rate, muscle tension). Using this approach, Kalmbach and colleagues (2012) examined the unique aspects of anxiety and depression and how they were related to various sexual problems. Their findings revealed depression to be more consistently related to female sexual problems, such that women who indicated greater severity of depression also reported greater severity of sexual difficulties (i.e., inter-individual differences). Regarding anxious arousal, they found anxiety to be more uniquely related to physiologically-based sexual problems, such as lubrication difficulties and vaginal pain. However, their cross-sectional design precluded the examination of temporal precedence and intra-individual change.

To address these limitations, Kalmbach and colleagues (under review) next conducted a prospective study of premenopausal women that assessed weekly levels of depression, anxiety, and sexual function. By using a repeated measures design, they were able to examine state-level (i.e., intra-individual) fluctuations in mood and sexual health, as well as the directionality of these relations. Again, they found depression to be more consistently related with measured indices of sexual function. Further, evidence consistent with the prior study was found suggesting that anxious arousal was more uniquely connected with physiologically-based sexual problems, such as vaginal pain. Notably, when examining lagged effects of mood predicting next-week levels of sexual
functioning (and vice versa), they found some evidence of temporal precedence between mood and sexual health. However, most of these relations between mood and sexual health were more proximal than distal. That is, the immediate effects were stronger than the observed lagged effects. Further, the observed lagged effects did not illustrate a coherent picture of how mood impacts later sexual function or how sexual function influences later mood.

Two potential limitations may account for the greater number of significant immediate relations between mood and sexual function as compared to lagged effects in Kalmbach and colleagues’ (under review) study. One potential explanation concerns the duration of the impact of one construct on the other, which, methodologically, concerns the duration between assessments (Cole, 2006; Cole & Maxwell, 2003). That is, if the impact of one construct on the other is more proximal than a week, then the previous study was ill-designed to capture this causal effect. By extension, the assessment window itself is a potential concern. That is, if meaningful causal relations between mood and sexual function manifest in a time period shorter than one week, such as from day to day or hour to hour, then an assessment window of one week fails to capture this important variability. Of relevance, the previous investigation highlighted the importance of intra-individual change in mood and sexual health. That is, the preponderance of studies examining mood and sexual problems has focused on between-person differences; that individuals with greater depression severity also experience greater sexual dysfunction. Yet, Kalmbach and colleagues’ (under review) study demonstrated that, irrespective of
trait levels of depression or anxiety, state fluctuations in mood were accompanied by changes in sexual problems. These findings speak directly to potential predisposing and maintaining factors of impairments in sexual function. However, the one-week assessment window may have failed to capture some of these important intra-individual changes in mood and sexual health, thus limiting the ability to capture and characterize much of these fluctuations.

Another important limitation of prior investigations has been the lack of interest in how moods other than depression and anxiety are related to sexual health. Though other emotions have been explored to modest degrees, such as anger (Beck & Bozman, 1995; Bozman & Beck, 1991) and happiness (Laumann, Paik, & Rosen, 1999), the field has largely ignored the importance of positive and normative negative affective states in the relation to sexual health. By only focusing on clinical mood disorders, such as depression and anxiety, while neglecting the impact of normative affective states on sexual functioning, the field is potentially overlooking a great amount of information as to how experiences of sexual desire, arousal, lubrication, orgasmic function, and vaginal pain may relate to more normal, day-to-day emotions, like happiness, sadness, fear, confidence, calmness, and anger.

Finally, the importance of sexual distress deserves greater attention when focusing on the relation between mood and sexual health. Sexual distress is conceptualized as sexually related personal distress (DeRogatis et al., 2002) and is thus, by definition, related to both mood and sexual health. Experiences of sexual distress
include unhappiness about one’s sexual relationship, embarrassment about sexual problems, and concern regarding low sexual desire (DeRogatis et al., 2002; DeRogatis et al., 2008). Indeed, individuals experiencing higher levels of sexual distress also experience greater sexual dysfunction and depression (Dennerstein et al., 2008; Hayes et al., 2008). However, it is unclear as to how sexual distress might be related to other aspects of mood. Given the relevance of sexual distress to both affective and sexual problems, understanding how sexual distress impacts individuals’ mood will provide us with a better understanding of the reciprocal dynamics between these two important aspects of health. Furthermore, it may be telling to evaluate whether or not the impact of sexual function on mood is unique when controlling for sexual distress.

The present study is an extension of our prior investigations and was designed to address some methodological limitations of past research on the topic of psychological and sexual health. Using Clark and Watson’s (1991) tripartite model of anxiety and depression and several indices of normal, everyday emotions, we conducted a two-week-long prospective study using a non-clinical sample of young adult women to examine how daily experiences of pathological mood and normative affective states are related to various aspects of sexual health. By assessing mood and sexual function daily, we aimed to better capture normative fluctuations to allow for a better demonstration of temporal precedence.

Summary of confirmatory hypotheses.
Pathological mood syndromes.

1. The impact of between-person differences in depression and anxiety on female sexual problems – the examination of inter-individual differences.
   a. Women who indicate greater severity of depression at baseline will experience worse sexual functioning than women who report lower levels of depression (when controlling for anxiety). Further, depression will be more consistently and robustly related to more psychologically-based sexual problems than anxiety.
   b. Women who report greater severity of anxiety at baseline will experience worse sexual functioning than women with less severe anxiety (when controlling for depression), and anxiety will more consistently impact physiologically-based sexual problems.

2. The relations of state levels of depression and anxiety with female sexual problems – the examination of intra-individual changes.
   a. Daily fluctuations in anhedonic depression will be accompanied by daily changes in sexual difficulties. These relations will be strongest when proximal (i.e., concurrent > lagged). Further, state severity of anhedonic depression will be more consistently and robustly related to changes in psychologically-based sexual problems than general distress and anxious arousal.
b. Daily changes in anxious arousal will be uniquely associated with some of the more physiologically-based sexual problems such as lubrication difficulties and vaginal pain, when accounting for effects of anhedonia and general distress. Again, we predict that these relations will be stronger when the relations are more proximal.

3. The impact of sexual difficulties and distress on depression and anxiety.
   a. Daily fluctuations in sexual difficulties will predict greater next-day severity of depression and anxiety.
   b. Trait levels of sexual distress will be related to higher levels of depression and anxiety.

Normative affective states.

4. Positive affective states (i.e., happiness, self-assurance, and serenity) will be related to healthier sexual functioning. These associations will be more proximal than distal.

5. Negative affective states (i.e., fear, sadness, and hostility) will be related to greater severity of sexual problems. These associations will also be more proximal.
METHOD

Participants

Participants were recruited from various undergraduate psychology courses at Kent State University. Individuals had to meet the following inclusion criteria: 1) participants must be female, 2) have reliable internet access, and 3) be free of antidepressants for at least the previous month due to their interference with mood symptoms and sexual dysfunction (Rosen, Lane, & Menza, 1999). The Kent State University Institutional Review Board approved this study. All individuals provided written informed consent prior to participation.

One-hundred-seventy-one women participated in the present study. Participant ages ranged from 18 to 56 years old (M=20.07, SD=3.32). The sample was largely Caucasian (81.5%), though some ethnic diversity was observed (13.3% African American, 1.2% Latino or Hispanic, 2.3% Eastern Asian or Pacific Islander, and 1.8% “Other”). The majority of women in the study identified as either exclusively or mostly heterosexual (93.6%), whereas 1.7% reported being equally attracted to men and women, and the other 4.6% indicated being exclusively or mostly homosexual. Approximately half of the sample reported having a sexual partner at baseline (51.2%).

Regarding sexual history among participants who had been sexually active presently or in the past, the average age of first sexual activity was 15.72 years (SD=2.22) and the average number of lifetime sexual partners was 4.28 (SD=4.72), whereas the
The average number of sexual partners in the prior month was .73 (SD=.57). Slightly more than half of the sample (56.2%) reported having a sexual partner at baseline. Among our participants who reported having sexual partners, these relationships ranged from less than a week to six years (in months: M=19.18, SD=18.14).

**Procedure**

The present study consisted of one baseline assessment followed by 14 daily assessments. At baseline, participants provided informed consent, then reported demographic information and sexual histories, as well as symptoms of depression, anxiety, and sexual distress over the past month. After completing baseline measures, participants were instructed on web-delivered questionnaires which were sent to participant email addresses each night after midnight. Participants were instructed to complete these daily assessments upon waking. These questions asked respondents to reflect on the experiences of the past 24 hours regarding their mood, sexual health, and presence of menstruation.

**Measures**

**Baseline measures.**

*The Center for Epidemiologic Studies Depression Scale* (CESD; Radloff, 1977) is a 20-item self-report inventory used to assess various cognitive, emotional, and physiological symptoms of depression. In the present study, all items were modified to ask about the experiences over the past month and participants indicated the severity of
existing symptoms on a 1-4 scale with higher scores indicating greater severity of depression. Internal consistency in the present sample was high ($\alpha=.90$).

*The Female Sexual Distress Scale-Revised* (FSDS-R; DeRogatis et al., 2008) is a 13-item self-report questionnaire used to assess sex-related personal distress in women. In the present study, respondents indicated the extent to which they experienced sexual distress over the past month on a 1-6 with higher scores indicating higher levels of sexually related distress. Example items include ‘How often did you feel:’ ‘distressed about your sex life,’ ‘inferior because of sexual problems,’ and ‘sexually inadequate.’ Internal consistency in our sample was adequate ($\alpha=.74$).

*The State-Trait Anxiety Inventory Form X* (STAIX; Spielberger, Gorsuch, & Lushene, 1970) is a 40-item self-report inventory intended to assess state and trait levels of anxiety. For the present study, we focused exclusively on the *State-Trait Anxiety Inventory Form X – State Anxiety Scale* (STAIX-S). Contrary to the scale’s intended use, the STAIX-S in the present study is not intended to measure state levels of anxiety. Rather, we used the STAIX-S to characterize our participants’ anxiety over the prior month. We chose to use the state anxiety scale, rather than the trait anxiety scale, because the former places a larger emphasis on somatic arousal, which is unique to anxiety. In the present study, participants indicated the severity of anxiety symptoms on a 1-4 scale with higher scores indicating greater severity of anxiety. Internal consistency in the present sample was high ($\alpha=.94$).

Repeated daily measures.
To assess the presence of menstruation, participants were asked to indicate whether or not they had menstruated the previous day. Specifically, individuals were asked “Were you menstruating within the past 24 hours?” and were provided with “Yes” (coded as 1) and “No” (coded as 2) response choices.

**Sexual behaviors and functioning.**

The *Profile of Female Sexual Functioning* (PFSF; McHorney et al., 2004) is a self-report measure of sexual functioning that was modified for daily use in the present study. The PFSF was originally validated in a sample of postmenopausal women for the assessment of various sexual problems. However, the PFSF has been validated for use in non-clinical samples (Kalmbach, Ciesla, Janata, & Kingsberg, in press). Specifically, we used the PFSF to measure daily reports of sexual desire, arousal, avoidance, orgasm achievement, pleasure, and sexual self-image; the concerns scale was not administered. Higher scores on each scale indicate better sexual function, with the exception of the sexual avoidance scale. Items regarding sexual activity were provided with the response choice of “No Sexual Activity.” These responses were treated as missing data. For individuals who had less than 25% missing data in a given scale, proration using participants’ individual mean scores (within that same scale) were used to estimate total factor scores. However, individuals’ scale scores were treated as missing if more than 25% of data in a given factor was missing. Our rationale was that we believed treating a response of “No Sexual Activity” as zero would artificially bias scores into indicating higher dysfunction, whereas proration allows us to estimate the total scale score based on
their other responses within the same scale. However, we decided to only prorate when the response rate was 75% and above as to minimize the impact of our estimation on the data. Internal consistencies for the scales ranged from adequate (self-image: $\alpha=.81$) to very high (arousal, pleasure, avoidance: $\alpha=.99$).

The *Female Sexual Function Index* (FSFI; Rosen et al., 2000) is a 19-item self-report measure of sexual functioning that was modified for daily use in the present study. The FSFI was originally validated in a sample of women with female sexual arousal disorder and matched controls for the assessment of various sexual problems. However, the FSFI has also been validated for use in normative samples (Carvalho, Vieira, & Nobre, 2012; Kalmbach, Ciesla, Janata, & Kingsberg, in press; Opperman, Benson, & Milhausen, 2013). To both avoid construct overlap with the PFSF to maximize the brevity of our daily assessments, only the lubrication and pain scales were administered to participants. In the present study, higher scores on the lubrication scale indicate better sexual functioning, whereas higher scores on the pain scale indicate higher levels of pain. FSFI items were presented with a “No Sexual Activity” response option and treated as missing. Proration for FSFI scores followed the same guidelines as outlined for the PFSF. Both the lubrication ($\alpha=.86$) and pain ($\alpha=.83$) scales demonstrated good internal consistency.

Affect.

The *Mini-Mood and Anxiety Symptom Questionnaire* (mini-MASQ; Clark & Watson, 1995) is a 26-item self-report measure of depression and anxiety that was
modified for daily use. Respondents reported their experience of various symptoms on a five-point scale from “not at all” to “extremely.” There are three main factors assessing the facets of the tripartite model: general distress (e.g., “Felt depressed,” “Felt uneasy”), anxious arousal (“Hands were shaky,” “Was short of breath”), and anhedonia (e.g., “Felt nothing was really enjoyable,” “Felt really happy,” the latter of which is negatively keyed). All scales exhibited good internal consistencies (general distress: $\alpha=.89$; anxious arousal: $\alpha=.85$; anhedonia: $\alpha=.86$).

The *Positive and Negative Affect Schedule – Expanded Form* (PANAS-X; Watson & Clark, 1994) is a self-report measure that assesses levels of various types of positive and negative affective states. The present study modified the measure for daily use and used an abbreviated form in order to keep our daily assessments brief. Scales administered included: happiness, serenity, hostility, sadness, fear, and self-assurance. Internal consistencies in the present study ranged from ($\alpha=.82-.95$).

**Data analysis plan**

The data collected in this study involved repeated measures of study variables within participants. In order to account for the nested structure of the data, analyses were conducted using hierarchical linear modeling (HLM; also known as multilevel modeling). HLM allows for the simultaneous examination of inter-individual differences and intra-individual changes. Further, this approach permits examination of the temporal relation between affect and sexual function through examining the concurrent and lagged effects that exist between these constructs. Importantly, HLM is robust to the presence of
missing data, which are common in studies using repeated measures (Singer & Willet, 2003).

**Hypothesis 1.** To examine the impact of inter-individual differences in depression and anxiety on female sexual problems (for individual \(i\) at time \(t\)), each outcome variable is predicted by baseline measures of depression and anxiety (for individual \(i\)), controlling for daily presence of menstruation (for individual \(i\) at time \(t\)).

Example 1:

\[
\text{Desire}_{it} = \beta_{0i} + \beta_{1}\text{Depression}_{i} + \beta_{2}\text{Anxiety}_{i} + \beta_{3}\text{Menstruation}_{it} + \zeta_{0i} + \epsilon_{it}
\]

- **Desire\(_{it}\)**: Desire levels for person \(i\) at observation \(t\).
- **Intercept \(\beta_{0i}\)**: Desire levels for person \(i\) when all predictors equal zero.
- **\(\beta_{1}\text{Depression}_{i}\)**: Expected difference in sexual desire for greater baseline depression.
- **\(\beta_{2}\text{Anxiety}_{i}\)**: Expected difference in sexual desire for greater baseline anxiety.
- **\(\beta_{3}\text{Menstruation}_{it}\)**: Expected change in sexual desire for person \(i\) at observation \(t\) due to the presence of menstruation at observation \(t\) (i.e., the same day).
- **\(\zeta_{0i}\)**: Level-1 stochastic parts.
- **\(\epsilon_{it}\)**: Level-2 stochastic parts.

The results of Example 1 will reveal inter-individual differences in sexual functioning between women with high vs. low levels of depression or anxiety at baseline.
**Hypothesis 2.** To examine concurrent relations of state levels of depression and anxiety with sexual problems, each measured aspect of sexual functioning (at time $t$) is predicted by depression and anxiety, while controlling for the presence of menstruation on the same day (at time $t$). The example below shows pathological mood predicting same-day levels of sexual desire, while controlling for presence of menstruation.

Example 2:

$$\text{Desire}_{it} = \beta_{0i} + \beta_1 \text{General Distress}_{it} + \beta_2 \text{Anxious Arousal}_{it} + \beta_3 \text{Anhedonia}_{it} + \beta_4 \text{Menstruation}_{it} + \zeta_{0i} + \epsilon_{it}$$

- **Desire$_{it}$**  
  Desire levels for person $i$ at observation $t$

- **Intercept $\beta_{0i}$**  
  Desire levels for person $i$ when all predictors equal zero.

- **$\beta_1 \text{General Distress}_{it}$**  
  Expected change in sexual desire for person $i$ at observation $t$ due to an increase in general distress at observation $t$ (i.e., the same day).

- **$\beta_2 \text{Anxious Arousal}_{it}$**  
  Expected change in sexual desire for person $i$ at observation $t$ due to an increase in anxious arousal at observation $t$ (i.e., the same day).

- **$\beta_3 \text{Anhedonia}_{it}$**  
  Expected change in sexual desire for person $i$ at observation $t$ due to an increase in anhedonia at observation $t$ (i.e., the same day).
$\beta_4 \text{Menstruation}_{it}$  Expected change in sexual desire for person $i$ at observation $t$ due to the presence of menstruation at observation $t$ (i.e., the same day).

$\zeta_{0i}$  Level-1 stochastic parts.

$\epsilon_{it}$  Level-2 stochastic parts.

Results of the concurrent HLM models, as seen in Example 2, will reveal any potential associations of depression and anxiety with sexual functioning as they relate to one another during the same day. To examine lagged relations of state levels of depression and anxiety with sexual problems, each aspect of sexual functioning (at time $t$) is predicted depression and anxiety on the previous day (at time $t-1$) and menstruation on the on the same day (at time $t$). The example below shows the previous day’s severity of general distress, anxious arousal, and anhedonic depression predicting levels of sexual desire, while controlling for presence of menstruation and the previous day’s sexual functioning.

Example 2.1:

$$\text{Desire}_{it} = \beta_{0i} + \beta_1 \text{General Distress}_{i(t-1)} + \beta_2 \text{Anxious Arousal}_{i(t-1)} + \beta_3 \text{Anhedonia}_{i(t-1)}$$

$$+ \beta_4 \text{Menstruation}_{it} + \beta_5 \text{Desire}_{i(t-1)} + \zeta_{0i} + \epsilon_{it}$$

$\text{Desire}_{it}$  Desire levels for person $i$ at observation $t$

$\text{Intercept } \beta_{0i}$  Desire levels for person $i$ when all predictors equal zero.
\[ \beta_1 \text{General Distress}_{i,t-1} \] Expected change in sexual desire for person i at observation t due to an increase in general distress at observation t-1 (i.e., the previous day).

\[ \beta_2 \text{Anxious Arousal}_{i,t-1} \] Expected change in sexual desire for person i at observation t due to an increase in anxious arousal at observation t (i.e., the previous day).

\[ \beta_3 \text{Anhedonia}_{i,t-1} \] Expected change in sexual desire for person i at observation t due to an increase in anhedonia at observation t-1 (i.e., the previous day).

\[ \beta_4 \text{Menstruation}_{i,t} \] Expected change in sexual desire for person i at time t due to the presence of menstruation at observation t (i.e., the same day).

\[ \beta_5 \text{Desire}_{i(t-1)} \] Expected change in sexual desire for person i at observation t due to an increase in sexual desire at observation t-1 (i.e., the previous day).

\[ \zeta_{0i} \] Level-1 stochastic parts.

\[ \varepsilon_{it} \] Level-2 stochastic parts.

Results of the lagged HLM models, as seen in Example 2.1, will reveal how depression and anxiety relate to next-day levels of sexual functioning.

**Hypothesis 3.** To examine the impact of state-level sexual difficulties and trait-level sexual distress on pathological mood, depression and anxiety (at time t) are
predicted by each aspect of sexual functioning (at time $t-1$) and sexual distress measured at baseline, while controlling for the previous day’s mood (at time $t-1$) and same day menstruation (at time $t$).

Example 3:

$$\text{General Distress}_{it} = \beta_{0i} + \beta_1 \text{Desire}_{i(t-1)} + \beta_2 \text{Sexual Distress}_i + \beta_3 \text{Menstruation}_{it} + \beta_4 \text{General Distress}_{i(t-1)} + \zeta_{0i} + \epsilon_{it}$$

- $\text{General Distress}_{it}$: General distress levels for person $i$ at observation $t$.
- $\beta_{0i}$: General distress levels for person $i$ when all predictors equal zero.
- $\beta_1 \text{Desire}_{i(t-1)}$: Expected change in general distress for person $i$ at observation $t$ due to an increase in sexual desire at observation $t-1$ (i.e., the previous day).
- $\beta_2 \text{Sexual Distress}_i$: Expected difference in general distress for person $i$ at observation $t$ due to a greater baseline sexual distress.
- $\beta_3 \text{Menstruation}_{it}$: Expected change in sexual desire for person $i$ at observation $t$ due to the presence of menstruation at observation $t$ (i.e., the same day).
- $\beta_4 \text{General Distress}_{i(t-1)}$: Expected change in general distress for person $i$ at observation $t$ due to an increase in general distress at observation $t-1$ (i.e., the previous day).
- $\zeta_{0i}$: Level-1 stochastic parts.
Results of the lagged models of sexual functioning predicting mood, as seen in Example 3, will reveal how state fluctuations in sexual functioning and trait levels of sexual distress impact later severity of depression and anxiety.

*Hypothesis 4.* To examine concurrent relations of normative affective states (e.g., happiness, sadness) and sexual functioning, we will predict sexually functioning (at time t) by normative affective states and menstruation on the same day (at time t).

Example 4:

\[
\text{Desire}_{it} = \beta_{0i} + \beta_1 \text{Happiness}_{it} + \beta_2 \text{Menstruation}_{it} + \zeta_{0i} + \epsilon_{it}
\]

- **Desire}_{it}**: Sexual desire levels for person i at observation t
- **Intercept β_{0i}**: Sexual desire levels for person i when all predictors equal zero.
- **β_1Happiness}_{it}**: Expected change in sexual desire for person i at observation t due to an increase in happiness at observation t (i.e., the same day).
- **β_2Menstruation}_{it}**: Expected change in sexual desire for person i at observation t due to the presence of menstruation at observation t (i.e., the same day).
- **ζ_{0i}**: Level-1 stochastic parts.
- **ε_{it}**: Level-2 stochastic parts.
Results of these concurrent HLM models, as seen in Example 4, will reveal how normative affective states are related to \textit{same-day} levels of sexual functioning. Results of lagged effects models, as seen below in Examples 4.1 and 4.2, will test whether or not normative affective states are related to \textit{next-day} levels of sexual functioning, and if sexual functioning predicts \textit{next-day} levels of normative affective states.

\textbf{Example 4.1:}

\begin{align*}
\text{Desire}_{it} &= \beta_{0i} + \beta_{1}\text{Happiness}_{i(t-1)} + \beta_{2}\text{Menstruation}_{it} + \beta_{3}\text{Desire}_{i(t-1)} + \zeta_{0i} + \varepsilon_{it} \\
\text{Desire}_{it} &\quad \text{Sexual desire levels for person } i \text{ at observation } t \\
\text{Intercept } \beta_{0i} &\quad \text{Sexual desire levels for person } i \text{ when all predictors equal zero.} \\
\beta_{1}\text{Happiness}_{i(t-1)} &\quad \text{Expected change in sexual desire for person } i \text{ at observation } t \text{ due to an increase in happiness at observation } t-1 \text{ (i.e., the previous day).} \\
\beta_{2}\text{Menstruation}_{it} &\quad \text{Expected change in sexual desire for person } i \text{ at observation } t \text{ due to the presence of menstruation at observation } t \text{ (i.e., the same day).} \\
\beta_{3}\text{Desire}_{i(t-1)} &\quad \text{Expected change in sexual desire for person } i \text{ at observation } t \text{ due to an increase in sexual desire at observation } t-1 \text{ (i.e., the previous day).} \\
\zeta_{0i} &\quad \text{Level-1 stochastic parts.} \\
\varepsilon_{it} &\quad \text{Level-2 stochastic parts.}
\end{align*}
Example 4.2:

\[ \text{Happiness}_{it} = \beta_0i + \beta_1 \text{Desire}_{it-1} + \beta_2 \text{Sexual Distress}_i + \beta_3 \text{Menstruation}_{it} + \beta_4 \text{Happiness}_{it-1} + \zeta_{0i} + \epsilon_{it} \]

- **Happiness}_{it**: Happiness levels for person i at observation t
- **Intercept \( \beta_0i \)**: Happiness levels for person i when all predictors equal zero.
- **\( \beta_1 \text{Desire}_{it-1} \)**: Expected change in happiness for person i at observation t due to an increase in desire at observation t-1 (i.e., the previous day).
- **\( \beta_2 \text{Sexual Distress}_i \)**: Expected difference in happiness for person i due to greater baseline sexual distress.
- **\( \beta_3 \text{Menstruation}_{it} \)**: Expected change in happiness for person i at observation t due to the presence of menstruation at observation t (i.e., the same day).
- **\( \beta_4 \text{Happiness}_{it-1} \)**: Expected change in happiness for person i at observation t due to an increase in happiness at observation t-1 (i.e., the previous day).
- **\( \zeta_{0i} \)**: Level-1 stochastic parts.
- **\( \epsilon_{it} \)**: Level-2 stochastic parts.
RESULTS

Preliminary analyses

Regarding baseline mood, the average participant endorsed low levels of depression (CESD: 13.37 ± 9.78) and anxiety (STAIXS: 41.92 ± 10.98). Specifically, only 3% of the sample reported clinically significant levels of depression at baseline (Santor et al., 1995), whereas 16.79% of the sample reported clinically significant levels of anxiety (Kvaal et al., 2005). According to the Female Sexual Distress Scale-Revised (DeRogatis et al., 2002), 20.8% of our sample reported clinically relevant levels of distress due to sexual problems. For descriptive purposes, see Tables 1 for bivariate correlations between symptoms of depression and anxiety and sexual function, and see Table 2 for bivariate correlations between daily affect and sexual function.

1 This present study administered the Female Sexual Distress Scale-Revised using a 1-6 scale, which differs from the original 0-4 scale. As such, a clinical cutoff of 27, rather than 11, was used to adjust for the scaling difference.
Table 1: Correlations between anxiety and depression symptoms and female sexual functioning indices.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Desire</th>
<th>Arousal</th>
<th>Orgasm</th>
<th>Pain</th>
<th>Pleasure</th>
<th>Avoidance</th>
<th>Lubrication</th>
<th>Self-image</th>
<th>Anhedonia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxious Arousal</td>
<td>-0.76</td>
<td>-0.38</td>
<td>-0.28</td>
<td>-0.25</td>
<td>-0.33</td>
<td>-0.32</td>
<td>-0.28</td>
<td>-0.08</td>
<td>-0.35</td>
</tr>
<tr>
<td>General Distress</td>
<td>-0.22</td>
<td>0.07</td>
<td>-0.20</td>
<td>0.15</td>
<td>-0.12</td>
<td>-0.13</td>
<td>-0.35</td>
<td>0.07</td>
<td>-0.33</td>
</tr>
<tr>
<td>Self-image</td>
<td>0.07</td>
<td>-0.47</td>
<td>-0.16</td>
<td>0.37</td>
<td>-0.16</td>
<td>0.37</td>
<td>-0.47</td>
<td>0.37</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Note: Desire, arousal, orgasm, pleasure, avoidance, and self-image were measured using the Profile of Female Sexual Function. Lubrication and pain were measured using the Female Sexual Function Index. General distress, anxious arousal, and anhedonia measured using the mini Mood and Anxiety Symptom Questionnaire.
Table 2: Correlations between daily affect and female sexual functioning.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Happiness</th>
<th>Serenity</th>
<th>Self-Assurance</th>
<th>Fear</th>
<th>Sadness</th>
</tr>
</thead>
<tbody>
<tr>
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<td>.20</td>
<td>-.02</td>
<td>-.05</td>
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<tr>
<td>Arousal</td>
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<td>.05</td>
<td>-.00</td>
<td>-.27</td>
<td>-.24</td>
</tr>
<tr>
<td>Lubrication</td>
<td>.07</td>
<td>.05</td>
<td>.01</td>
<td>-.12</td>
<td>-.09</td>
</tr>
<tr>
<td>Orgasm</td>
<td>.12</td>
<td>.12</td>
<td>.10</td>
<td>-.34</td>
<td>-.33</td>
</tr>
<tr>
<td>Pain</td>
<td>-.03</td>
<td>-.18</td>
<td>-.01</td>
<td>.22</td>
<td>.20</td>
</tr>
<tr>
<td>Pleasure</td>
<td>.29</td>
<td>.17</td>
<td>.23</td>
<td>-.08</td>
<td>-.18</td>
</tr>
<tr>
<td>Avoidance</td>
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<td>-.04</td>
<td>.01</td>
<td>.13</td>
<td>.11</td>
</tr>
<tr>
<td>Self-Image</td>
<td>.48</td>
<td>.37</td>
<td>.50</td>
<td>-.09</td>
<td>-.20</td>
</tr>
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<td>Happiness</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Serenity</td>
<td>.64</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Self-Assurance</td>
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<td>.61</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Fear</td>
<td>-.20</td>
<td>-.26</td>
<td>-.15</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Sadness</td>
<td>-.32</td>
<td>-.27</td>
<td>-.24</td>
<td>.55</td>
<td>--</td>
</tr>
<tr>
<td>Hostility</td>
<td>-.27</td>
<td>-.27</td>
<td>-.21</td>
<td>.48</td>
<td>.53</td>
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</table>
Before testing our hypotheses, we examined proportions of total variance in our sexual functioning dependent variables due to both trait and state variability. That is, null HLM models (i.e., with no predictors) were run that showed the proportion of variance in the dependent variables due to inter-individual variance and intra-individual variance. Analyses revealed that, for each sexual functioning variable, there was marked parity of inter- and intra-individual variance (See Table 3). These findings empirically supported our use of HLM analyses to test our hypotheses. Furthermore, to reduce the possibility of menstruation confounding any relations between sexual function and mood, it was entered into each model as a covariate (as shown in the data analysis plan).

Table 3. Percentage of between-person and within-person variance for each dependent variable.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Between-Person Variance</th>
<th>Within-Person Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profile of Female Sexual Function</td>
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<td></td>
</tr>
<tr>
<td>Desire</td>
<td>45.65</td>
<td>54.35</td>
</tr>
<tr>
<td>Arousal</td>
<td>55.93</td>
<td>44.07</td>
</tr>
<tr>
<td>Orgasm</td>
<td>57.06</td>
<td>42.94</td>
</tr>
<tr>
<td>Avoidance</td>
<td>45.64</td>
<td>54.36</td>
</tr>
<tr>
<td>Pleasure</td>
<td>55.86</td>
<td>44.14</td>
</tr>
<tr>
<td>Self-Image</td>
<td>57.70</td>
<td>42.30</td>
</tr>
<tr>
<td>Female Sexual Function Index</td>
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<td></td>
</tr>
<tr>
<td>Lubrication</td>
<td>51.88</td>
<td>48.12</td>
</tr>
<tr>
<td>Vaginal Pain</td>
<td>54.37</td>
<td>45.63</td>
</tr>
</tbody>
</table>

**Depression, anxiety, and sexual functioning.**

*Regressing sexual functioning on trait depression and anxiety.* We first examined the predictive ability of baseline depression and anxiety on sexual difficulties while controlling for menstruation. Contrary to our hypotheses, neither baseline levels of depression or anxiety were predictive of levels of desire, arousal, orgasmic function, pleasure, vaginal lubrication, or pain. However, analyses revealed that women who
reported greater depressive symptoms at baseline experienced less favorable sexual self-image ($\beta=-.13$, $z=-3.02$, $p<.01$), and that women with higher levels of trait anxiety experienced greater severity of vaginal pain ($\beta=.06$, $z=2.21$, $p<.05$). Additionally, a relation of anxiety predicting greater sexual avoidance approached significance ($\beta=.05$, $z=1.86$, $p=.06$).

Regressing sexual functioning on same-day depression and anxiety. Next, we examined concurrent relations between same-day levels of depression and anxiety and sexual functioning. Consistent with our hypotheses, depression and anxiety were concurrently related to sexual problems (see Table 4). Specifically, daily levels of anhedonia were related to same-day levels of sexual desire, pleasure, and sexual self-image. Anxious arousal was associated with diminished arousal and increased sexual avoidance, and was consistently related to peripherally-based sexual function such as greater lubrication difficulties and vaginal pain. General distress was related to worse orgasmic function and sexual self-image. Further, a relation between general distress and diminished subjective arousal trended toward significance ($p=.06$). Notably, the presence of menstruation was related to lower levels of sexual desire and pleasure.

Regressing sexual functioning on previous-day depression and anxiety. To examine temporal precedence in the relation between mental and sexual health, we examined lagged models of mood predicting next-day sexual functioning (see Table 5). As expected, fewer lagged effects were observed in comparison to the concurrent relations. Anhedonia was predictive of decreases in sexual desire, pleasure, and sexual self-image, whereas anxious arousal was related to later orgasm difficulties. General
distress predicted decreases in sexual self-image. Other indices of sexual health were not predicted by previous day’s depression or anxiety.
Table 4. *Regressing sexual functioning on same-day depression and anxiety.*

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Predictor</th>
<th>β</th>
<th>Z</th>
<th>p-value</th>
<th>Chi-Square</th>
<th>p-value</th>
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<td></td>
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<tr>
<td>Menstruation&lt;sub&gt;i&lt;/sub&gt;</td>
<td>1.66</td>
<td>3.20</td>
<td>&lt;.01</td>
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<td></td>
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<td>Level 1</td>
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**Female Sexual Function Index**

<table>
<thead>
<tr>
<th></th>
<th>Level 1</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lubrication_1</strong></td>
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</table>

Note: In multilevel modeling, the chi-square statistic reflects the difference between the tested model and a null model with no predictors. Thus, a significant chi-square is desirable, as it is indicative of a model that accounts for significant variance in the outcome. This is in contrast to the use of chi-square in structural equation modeling, in which significant chi-square statistics are undesirable and reflect a lack of model fit.
Table 5. Regressing sexual functioning on previous-day depression and anxiety.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Predictor</th>
<th>β</th>
<th>Z</th>
<th>p-value</th>
<th>Chi-Square</th>
<th>p-value</th>
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</tr>
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<td>20.77</td>
<td>11.20</td>
<td>&lt;.001</td>
<td>65.89</td>
<td>&lt;.001</td>
</tr>
<tr>
<td></td>
<td>Menstruation&lt;sub&gt;t&lt;/sub&gt;</td>
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<td>3.08</td>
<td>&lt;.01</td>
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**Female Sexual Function Index**

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Regressing mood on previous-day sexual functioning and trait sexual distress.

After examining mood predicting changes in sexual functioning, we then investigated sexual functioning predicting changes in mood depression. First, we predicted general distress and found that higher levels of subjective sexual arousal predicted increases in general distress (β=-.24, z=-2.79, p<.01) while controlling for baseline sexual distress which was also significant (β=.06, z=2.29, p<.05). In addition, greater sexual pleasure predicted decreases in general distress (β=-.04, z=-2.27, p<.05); once again, baseline sexual distress was significant in the same model (β=.07, z=2.58, p<.05), showing women with greater sexual distress experience greater levels of general distress later on.

Next, we examined sexual functioning and sexual distress predicting anhedonic depression. No lagged effects of sexual functioning predicting next-day anhedonia were found. However, baseline sexual distress was associated with greater anhedonia (β=.10, z=3.11, p<.01 without a sexual function covariate). Finally, we examined sexual problems and sexual distress predicting anxious arousal and found that worse sexual arousal (β=-.17, z=-3.08, p<.01) and vaginal pain (β=.09, z=2.03, p<.05) were related to increases in somatic symptoms of anxiety. Notably, sexual distress was related to greater anxiety (β=.02, z=1.72, p=.09 in the arousal model; β=.03, z=2.59, p<.05 in the pain model; β=.05, z=3.28, p<.01 without a sexual function covariate).

Normative affective states and sexual functioning.

Regressing sexual function onto same-day affect. In examining the relations between normative affective states and sexual health, we first regressed each measured
index of sexual function onto same-day levels of happiness, self-assurance, serenity, hostility, sadness, and fear. Indices of positive affect showed markedly consistent relations with greater desire, pleasure, and sexual self-image. There was also some evidence suggestive of positive affect being related to less sexual avoidance. Specifically, analyses revealed happiness to be related to greater same-day sexual desire ($\beta=.74$, $z=13.12$, $p<.001$), pleasure ($\beta=.56$, $z=5.24$, $p<.001$), and sexual self-image ($\beta=.34$, $z=17.74$, $p<.001$), as well as less sexual avoidance ($\beta=-.08$, $z=-2.73$, $p<.001$). Next, results showed self-assurance to be associated with higher levels of sexual desire ($\beta=.56$, $z=10.56$, $p<.001$), pleasure ($\beta=.49$, $z=5.40$, $p<.001$), and self-image ($\beta=.34$, $z=18.52$, $p<.001$). Additionally, the relation between self-assurance and avoidance approached significance ($\beta=-.04$, $z=-1.70$, $p=.09$). Serenity was positively associated with greater desire ($\beta=.93$, $z=8.27$, $p<.001$), pleasure ($\beta=.72$, $z=3.62$, $p<.001$), and sexual self-image ($\beta=.47$, $z=11.94$, $p<.001$).

Of the three measured indices of negative daily affect, fear and sadness were most consistently associated with sexual problems. Fear was related to all measured aspects of sexual health: desire ($\beta=-.27$, $z=-3.62$, $p<.01$), arousal ($\beta=-.22$, $z=-6.44$, $p<.001$), orgasmic function ($\beta=-.25$, $z=-3.95$, $p<.001$), avoidance ($\beta=.18$, $z=3.97$, $p<.001$), pleasure ($\beta=-.46$, $z=-2.76$, $p<.01$), self-image ($\beta=-.13$, $z=-4.51$, $p<.001$), lubrication difficulties ($\beta=-.15$, $z=3.18$, $p<.01$), and vaginal pain ($\beta=.13$, $z=2.68$, $p<.01$). Regarding sadness, significant relations were found with lower levels of desire ($\beta=-.36$, $z=-3.86$, $p<.001$), arousal ($\beta=-.13$, $z=-3.66$, $p<.001$), pleasure ($\beta=-.53$, $z=-2.84$, $p<.001$), and self-image ($\beta=-.23$, $z=-7.12$, $p<.001$), as well as greater orgasm difficulties ($\beta=-.16$, $z=-2.34$, $p<.05$).
and avoidance ($\beta=.10$, $z=2.09$, $p<.05$). Associations between sadness and lubrication difficulties ($\beta=-.10$, $z=-1.92$, $p=.06$) and pain ($\beta=.09$, $z=1.80$, $p=.07$) approached significance. Finally, analyses revealed hostility to be associated with lower levels of sexual desire ($\beta=-.55$, $z=-4.98$, $p<.001$), worse sexual self-image ($\beta=-.31$, $z=-8.12$, $p<.001$), and greater avoidance ($\beta=.31$, $z=5.81$, $p<.001$). A relation between hostility and arousal was a trend ($\beta=-.08$, $z=-1.84$, $p=.07$).

**Regressing sexual function onto previous-day affect.** As expected, we found fewer lagged effects between positive emotions and later sexual functioning than concurrent relations. Specifically, results showed happiness to predict next-day increases in desire ($\beta=.20$, $z=3.20$, $p<.01$) and sexual self-image ($\beta=.09$, $z=3.85$, $p<.001$). A trend was observed between happiness and next-day sexual pleasure ($\beta=.21$, $z=1.67$, $p=.09$). Self-assurance predicted increases in sexual self-image ($\beta=.07$, $z=3.11$, $p<.01$). Next, we found that serenity was similarly related to next-day reports of sexual self-image ($\beta=.09$, $z=2.12$, $p<.05$).

We also found markedly fewer lagged relations between negative affect and sexual function than concurrent. Analyses revealed no lagged effects of fear on next-day sexual function, though a relation with pleasure trended toward significance ($\beta=.36$, $z=-1.91$, $p=.06$), such that fear predicted increases in next-day pleasure. An association between sadness and decreases in desire trended toward significance ($\beta=-.17$, $z=-1.74$, $p=.08$). Finally, results showed hostility to predict changes in sexual self-image ($\beta=-.12$, $z=-3.02$, $p<.01$).
Regressing affect onto previous-day sexual function while controlling for trait levels of sexual distress. Analyses of sexual function predicting changes in normative affect showed desire, pleasure, sexual self-image, avoidance and sexual distress to be related to positive emotional states. Regarding sexual health predicting next-day happiness, we found that self-image (β=.05, z=2.27, p<.05) predicted next-day levels of happiness while controlling for sexual distress (β=-.04, z=-2.21, p<.05). Self-assurance was predicted by previous-day levels of sexual self-image (β=.15, z=5.91, p<.001) while controlling for sexual distress (β=-.05, z=-2.37, p<.05). Counterintuitively, sexual avoidance predicted increases in self-assurance (β=.15, z=2.43, p<.05) while controlling for sexual distress (β=-.07, z=-3.05, p<.01). Analyses for serenity predicted by previous-day sexual function revealed desire (β=.01, z=2.21, p<.05) and sexual self-image (β=.03, z=2.32, p<.05) to be significant while controlling for sexual distress (β=.03, z=3.49, p<.001 in the desire model; β=.03, z=3.23, p<.01 in the self-image model).

Comparatively, daily sexual function had an even less consistent impact on next-day negative affect. In fact, none of the daily measured indices of sexual function predicted next-day levels of fear. However, baseline sexual distress was related to greater fear (β=.05, z=3.47, p<.01). When predicting next-day sadness, orgasmic function (β=-.06, z=-2.07, p<.05) was a significant predictor while controlling for sexual distress (β=.02, z=1.17, p=.24). Though sexual distress was nonsignificant in the orgasm model, it was a significant predictor in the desire (β=.03, z=3.40, p<.01), arousal (β=.03, z=1.97, p<.05), avoidance (β=.03, z=2.34, p<.05), and pleasure (β=.03, z=3.29, p<.001) models. Finally, regarding hostility, sexual arousal predicting decreases in hostility (β=-.07, z=-
1.67, p=.09) approached significance while controlling for sexual distress (β=.03, z=2.78, p<.01), which was related to increases in anger.
DISCUSSION

The present study sought to examine the concurrent and temporal relations of depression, anxiety, and normative affective states as they relate to various indices of sexual health. In support of our hypotheses, our data showed both pathological mood and normal, everyday emotions to be related to daily changes in aspects of sexual functioning, and that these relations were more consistent and robust when they were more proximal. Further, this daily repeated measures study demonstrated a number of temporal relations between mood and sexual function. Finally, our findings support de-pathologizing how we conceptualize these relations between the two constructs. That is, sexual health is not only a determinant and consequence of symptoms of depression and anxiety, but also of changes in normal, everyday moods, such as happiness, confidence, and hostility.

Trait depression, anxiety, and sexual distress.

An important strength of the present study regards our ability to test both inter-individual differences and intra-individual change. Regarding syndromal mood, women who reported greater severity of depressive symptoms over the prior month to participating did not differ in daily levels of sexual functioning than did women with low levels of depression, with one exception: women with greater severity of depression at baseline went on to report worse sexual self-image. However, it is important to note that this finding may be driven by the negative correlation between depression and self-
esteem in general (Roberts, 2006), and may not be specific to sexual self-image. Similarly, women who indicated greater severity of anxiety at baseline did not differ from women with low anxiety on most indices of daily sexual function. The one exception, however, was that women with higher baseline levels of anxiety later experienced greater vaginal pain. Overall, these findings did not support our hypotheses, as we had posited that women with greater severity depression and anxiety at baseline would more consistently predict later sexual difficulties. One possible explanation may regard regression to the mean. That is, women with greater severity of depression or anxiety in the month prior to participating in our study may have experienced marked reductions in symptoms; that our sample was non-clinical makes this a particularly plausible explanation. Another non-mutually exclusive explanation may be that between-person differences in depression and anxiety lack robust predictive power of later normative changes in sexual functioning in a non-clinical sample.

In contrast, women with greater severity of sexual distress at baseline indicated higher levels of depression and anxiety later on. Additionally, sexual distress was also deleteriously related to normal, everyday emotions. That is, women with greater sexual distress reported overall worse affect later on, such as being less happy, less confident, less calm, more fearful, more sad, and more angry. In fact, baseline sexual distress was more consistently and robustly related to affect than most daily indices of sexual function. Considering the strength of the associations between sexual distress and syndromal and normative affect, future investigations would benefit from elucidating
sexual distress’ role in the relation between mood and sexual health. However, it may serve future investigations well to tend to the possibility that participant reports of sexual distress may be contaminated by more general feelings of distress or demoralization, as it is possible that these relations are driven by an affect-stress relation, rather than distress specific to sexual difficulties.

**State changes in sexual function and pathological mood: concurrent relations.**

In our prior study (Kalmbach et al., 2012), we found that weekly changes in mood were accompanied by weekly changes in sexual functioning. However, the assessment window of a week was identified as a potential concern. If various aspects of mood and sexual health significantly vacillate considerably within a week (e.g., on a daily basis), then, by asking participants to consolidate these fluctuations into a weekly report of experiences, our study was not sensitive to these normative fluctuations. The present study was designed be more sensitive of these changes by prospectively assessing mood and sexual health on a daily basis, which is consistent with the FDA’s (2000) recommendations.

Regarding syndromal symptoms, we found depression and anxiety to be related to different aspects of female sexual health (see Figure 1). Specifically, we found anhedonic depression to be related to more psychological aspects of sexual health, such as diminished desire and pleasure, as well as worse sexual self-image. That is, as a woman’s depression increased, her desire for sex, her pleasure in sexual activity, and her sexual
self-image all decreased. These findings are consistent with many features of depression, including diminished appetitive drive, buffered positive affect, and low self-esteem.

Fig. 1, Model of same-day relations between depression, anxiety, and sexual function.

Key: Blue arrows represent unique same-day relations between Anhedonia and indices of sexual functioning. Black arrows represent unique same-day relations with sexual functioning. Red arrows represent unique same-day relations between anxious arousal and sexual functioning. Absence of an arrow indicates an absence of a same-day relation.

In contrast, anxious arousal was related to more peripherally-based sexual problems, including lubrication difficulties and vaginal pain, suggesting potentially shared biological underpinnings, such as dysregulation of the autonomic nervous system, which plays a significant role in sexual functioning (Meston, 2000). Indeed, it may be that anxious arousal and peripherally-based sexual problems are manifestations of the
same process. For example, a stressor may lead to activation of the autonomic nervous system (e.g., fight or flight response, physiological hyperarousal), which then leads to subjective feelings of anxiety, lubrication difficulties, and vaginal pain. However, it is possible that a negative mood state leads to increased hyperarousal, which in turn increases lubrication and vaginal pain problems. A number of non-mutually exclusive potential pathways may exist. Additionally, anxiety was associated with worse subjective arousal and sexual avoidance, suggesting that anxiety is related to both psychological and physiological aspects of arousal, as well as overtly avoidant behaviors of engaging in sexual activity.

Finally, general distress was related to same-day levels of orgasm difficulties and worse sexual self-image, suggesting that women experience greater difficulty reaching orgasm and worse sexual self-image when they feel emotionally stressed. As general distress is conceptualized as negative affect commonly experienced in depression and anxiety, this suggests that orgasm difficulties and sexual self-image are common in both mood syndromes. That depression is consistently related to psychological aspects of sexual functioning, whereas anxiety is related to a greater number of physiological sexual complaints is consistent with our prior studies (Kalmbach et al., 2012; Kalmbach et al., under review), and provides a more nuanced conceptualization of the interplay between mood and sexual health.
State changes in sexual function and normative affective states: concurrent relations.

One strength of the current investigation regards the examination of normative affect states—both positive and negative—and their relations to sexual function (see Figure 2). Regarding positive emotions, we found that women experienced greater sexual desire, pleasure, and self-image, as well as less engagement in sexual avoidance behaviors, when they are happier. Additionally, we found that women indicated higher levels of sexual desire, pleasure, and self-image when they were feeling more self-assured and confident. Similarly, a greater sense of serenity or calmness was accompanied by higher levels of desire, pleasure, and self-image. Broadly, positive emotions appear to be consistently related to the desire, pleasure, and self-image aspects of female sexual health, which is consistent with the observed relations between anhedonia (i.e., absence of positive emotion and motivation) and daily sexual function. Negative daily affect was also consistently related to concurrent sexual difficulties. For instance, women experiencing greater fear also indicated higher levels of same-day problems for each of the measured indices of sexual health. Similarly, when women were sad, they experienced greater difficulties with each index of sexual problems, with the exception of lubrication difficulties and vaginal pain, which were statistical trends. When women experienced greater anger, they desired less sex, had worse sexual self-image, and were more avoidant of sexual activity. These findings, taken together, establish the importance of daily normative affect in the experience of sexual function. The relation
between mood and sexual function is not purely at clinical levels of impairment or of clinical presentation and that these concurrent changes in mood and sex are normal even among psychologically and sexually healthy individuals.

Fig. 2. Model of same-day relations between normative affective states and sexual function.

Key: Blue arrows represent unique same-day relations between Anhedonia and indices of sexual functioning. Black arrows represent unique same-day relations with sexual functioning. Red arrows represent unique same-day relations between anxious arousal and sexual functioning. Absence of an arrow indicates an absence of a same-day relation.

State changes in sexual function, pathological mood, and normative affective states: temporal relations.
Consistent with our predictions, relations between mood and sexual health were more proximal than distal. That is, a greater number of concurrent relations between affect and sexual functioning was observed. However, a number of day-to-day associations were observed. Regarding sexual desire, women’s happiness predicted next-day increases in desire. Conversely, women’s anhedonia was related to later decreases in desire. A trend was observed regarding sadness predicting next-day decreases in desire. Finally, women’s levels of sexual desire predicted increases in next-day serenity or calmness.

Concerning sexual arousal, women who predicted greater sexual arousal experienced decreases in next-day levels of anxiety and distress. These findings suggest that greater sexual arousal during sexual activity may have a soothing effect on mood. Regarding sexual pleasure, anhedonia was predictive of a decrease in women’s sexual pleasure. Additionally, our data showed that women’s experiences with anxiety predicted next-day difficulties with orgasmic function. Further, orgasmic function was predictive of later increases in sadness. Women’s experience with vaginal pain was predictive of increases in anxiety. One unintuitive finding, however, regarded sexual avoidance’s relation to decreases in self-assurance or confidence, which we attribute to a Type I error.

Sexual self-image, which does not receive as much research interest as other aspects of sexual health, such as desire or arousal, was established as a very important feature of sexual health in its relation to mood. Bidirectional effects between sexual self-
image and happiness, self-assurance, and serenity were found such that healthier sexual self-image is related to increases in positive affect, just as positive affect impacts increases in sexual self-image. Regarding negative affect, anhedonia, general distress, and hostility predicted decreases in sexual self-image.

**Future directions and limitations.**

Our findings must be interpreted in the context of certain methodological considerations. One such consideration regards generalizability. Our sample largely consisted of young, non-clinical female adults. Therefore, these relations may not accurately reflect what we might find in older or more dysfunctional populations. Further, we cannot extend these findings to that of male sexual function. Secondly, similar to our prior investigation, the daily intervals in the present study may not be the optimal duration between assessments to capture the impact of mood on normal fluctuations in sexual function, or vice versa. In our prior study, we determined that a week between assessments was likely too long to capture normative fluctuations, thus we decided to look at daily changes. Our decision to shorten the duration between assessments was supported by more consistent and robust concurrent and lagged relations between mental and sexual health in the current study. However, we found, once again, that the influence of mood on sexual function (and the other direction) is more proximal than distal, which suggests the possibility that changes in one construct more immediately impact the other than what we can perhaps capture using daily assessments. Two approaches should be considered: 1) randomized control trials that allow for examining affective changes.
following non-pharmaceutical treatment of sexual dysfunction, and vice versa, or 2) repeated and randomized ecological momentary assessments with several measurements during the day. Finally, the present study conducted a large number of analyses, which may have increased the risk of type I error. However, we elected not to employ alpha modification out of concern for increasing type II error (O’Keefe, 2003; Nakagawa, 2004), given that the present sample was young and relatively healthy. Additionally, we believe that type I errors are relevant to the interpretation of findings. That is, if our study results were inconsistent with prior research, we would be more inclined to interpret those finding as type I errors. In contrast, as our findings were largely consistent with past research, we are less inclined to interpret our significant findings as the result of chance. However, in attempt to not overemphasize questionably erroneous findings, we did not interpret any of the statistical trends in the manuscript.

Despite these limitations, we believe, however, that the present study adds to the literature of psychological consequences and determinants of female sexual health, and we suggest a number of future directions. First, we found that female sexual distress and sexual difficulties consistently predicted both pathological and normative affect. However, the mechanisms by which sexual difficulties exert their influence on mood are not clearly understood. One future consideration is to examine if female sexual distress mediates the relation between sexual problems and later mood. To illustrate, a woman’s experience with low levels of sexual desire may not impact her mood, unless she finds her diminished libido to cause her sexual distress. Additionally, it may behoove
investigators to examine this potential mediation effect in men. For instance, if a man experiences erection difficulties during sexual activity, his mood may not be impacted if his difficulties do not lead to increased sexual distress, which may, in turn, increase negative affect.

Additionally, our findings revealed consistent relations between sexual desire and positive affect (or lack thereof, in regard to anhedonia). In searching for potential mechanisms by which these constructs are related, we can borrow from the neuroscience literature on reward and appetitive drive, which has largely focused on the neurotransmitter dopamine (Ashby, Isen, & Turken, 1999). A number of studies have shown dopamine activity to be related to motivational anhedonia (i.e., lack of appetitive drive), consummatory anhedonia (i.e., lack of pleasure), and major depression (see Treadway & Zald, 2011, for review). Similarly, dopaminergic activity has been identified as an important factor in the neurobiology of sexual desire and arousal (Clayton, 2010; Giuliano & Allard, 2001; Pfau, 2009). Taken together, as positive affect and sexual desire have shown to be consistently and robustly related, it is possible that they share a similar pathophysiology.

Furthermore, we found anxious arousal to be consistently related to subjective sexual arousal, as well as lubrication difficulties and vaginal pain. Indeed, activation of the autonomic nervous system plays an important role in anxiety (Hoehn-Saric & McLeod, 1988; Thayer, Friedman, & Borkovec, 1996) and sexual arousal and genital blood flow (Meston, 2000; Pfau, 2009). Given the importance of somatic arousal to
these aspects of health, dysregulation of these systems may constitute a shared risk factor or mediating factor between anxiety and sexual arousal, lubrication difficulties, and vaginal pain. Investigating shared biological underpinnings of mood and sexual function may elucidate the mechanisms by which these constructs impact one another.
REFERENCES


APPENDICES

Appendix A. Baseline measures.

ID ______________________

Below are some questions about yourself, including questions about health behaviors and your sexual history. Please take your time to answer these questions honestly. Some of these questions are personal. If you do not want to answer a certain question, please feel free to skip the question. If you have any questions or concerns, please alert the researcher at any time.

What is your age? ________
What is your height? __________
What is your weight? __________
With which ethnicity do you most closely identify?
   A. Caucasian
   B. African-American
   C. Eastern Asian or Pacific Islander
   D. Western Asian or Middle Eastern
   E. Native American
   F. Hispanic or Latino
   G. Other, please specify: __________

What is your sexual orientation?
   A. Completely heterosexual, Only sexually attracted to men
   B. Mostly heterosexual, More so sexually attracted to men, but also to women
   C. Bisexual, Equally sexually attracted to both men and women
   D. Mostly homosexual, More so sexually attracted to women, but also to men
   E. Completely homosexual, Only sexually attracted to women

Do you currently have a romantic partner (e.g., boyfriend, girlfriend, fiancé, husband, wife, etc.)?
   A. Yes, I have a romantic partner
      If Yes, then how long have you two been in a relationship?
      If Yes, are you sexually active with your romantic partner? Yes or No
   B. No, I do not have a romantic partner

Do you currently have a sexual partner? This person may or may not be a romantic partner. A sexual partner can be a romantic partner, a friend, or anybody else with whom you are having a sexual relationship with.
   A. Yes, I have a sexual partner or partners
      If Yes, then how many sexual partners are you currently involved with?
      If Yes, then how long have you been in a sexual relationship with your partner(s)? ______________________
   B. No, I do not have a current sexual partner

At what age did you first engage in sexual activity with another person? __________
How many sexual partners have you had during your life? __________
How many sexual partners have you had in the past month? __________
Have you ever self-stimulated (i.e., masturbated)?
   A. Yes
   B. No
Have you ever performed hand sex on another person (“fingered” a woman or “jacked off” a man)?
   A. Yes
   B. No
Have you ever engaged in vaginal sex (penis penetrating your vagina) with another person?
   A. Yes
   B. No
Have you ever performed oral sex on another person?
   A. Yes
   B. No
Has another person ever performed oral sex on you?
   A. Yes
   B. No
Have you ever engaged in anal sex?
   A. Yes
   B. No
Have you ever engaged in group sex (i.e., sexual activity with a total of three or more people)?
   A. Yes
   B. No
Center for Epidemiologic Studies Depression Scale (CESD)

Using the scale below, indicate the number which best describes how often you felt or behaved this way – DURING THE PAST MONTH.

1 = Rarely or none of the time (less than 1 day)
2 = Some or a little of the time (1-2 days)
3 = Occasionally or a moderate amount of time (3-4 days)
4 = Most or all of the time (5-7 days)

DURING THE PAST MONTH:

___ 1. I was bothered by things that don’t usually bother me.
___ 2. I did not feel like eating; my appetite was poor.
___ 3. I felt that I could not shake off the blues even with help from my family or friends.
___ 4. I felt that I was just as good as other people.
___ 5. I had trouble keeping my mind on what I was doing.
___ 6. I felt depressed.
___ 7. I felt that everything I did was an effort.
___ 8. I felt hopeful about the future.
___ 9. I thought my life had been a failure.
___ 10. I felt fearful.
___ 11. My sleep was restless.
___ 12. I was happy.
___ 13. I talked less than usual.
___ 15. People were unfriendly.
___ 16. I enjoyed life.
___ 17. I had crying spells.
___ 18. I felt sad.
___ 19. I felt that people disliked me.
___ 20. I could not get “going.”
State Trait Anxiety Inventory – Revised, State Scale (STAIXS)

A number of statements which people used to describe themselves are given below. Read each statement and then indicate how you have felt over the past month. There are no right or wrong answers. Do not spend too much time on anyone one statement, but give the answer which seems to describe your feelings over the past month.

1 = Not at all  
2 = Somewhat  
3 = Moderately  
4 = Very much so

1. I feel calm.  
2. I feel secure.  
3. I am tense.  
4. I am regretful  
5. I feel at ease  
6. I feel upset  
7. I am presently worrying over possible misfortunes.  
8. I feel rested  
9. I feel anxious  
10. I feel comfortable  
11. I feel self-confident  
12. I feel nervous  
13. I am jittery  
14. I feel “high strung”  
15. I am relaxed  
16. I feel content  
17. I am worried  
18. I feel over-excited and “rattled”  
19. I feel joyful  
20. I feel pleasant.
Female Sexual Distress Scale – Revised (FSDS-R)

Over the past four weeks, how often did you feel…

0 = Never
1 = Rarely
2 = Occasionally
3 = Frequently
4 = Always

1. Distressed about your sex life.
2. Unhappy about your sexual relationship (please leave blank, if not in a sexual relationship).
3. Guilty about your sexual difficulties.
4. Frustrated by your sexual problems.
5. Stressed about sex.
6. Inferior because of sexual problems.
7. Worried about sex.
8. Sexually inadequate.
9. Regrets about your sexuality.
10. Embarrassed about your sexual problems.
11. Dissatisfied with your sex life.
12. Angry about your sex life.
Appendix B. Daily measures.

Were you menstruating today?

A. Yes, I was menstruating today.

B. No, I was not menstruating today.
Mini-Mood and Anxiety Symptom Questionnaire (MASQ)

Below is a list of feelings, sensations, problems, and experiences that people sometimes have. Please indicate how you have felt today.

Use this scale when answering:

1 = Not at all
2 = A little bit
3 = Moderately
4 = Quite a bit
5 = Extremely

1. Felt really happy
2. Felt tense or “high strung”
3. Felt depressed
4. Was short of breath
5. Felt withdrawn from other people
6. Felt dizzy or lightheaded
7. Felt hopeless
8. Hands were cold or sweaty
9. Felt like I had a lot to look forward to
10. Hands were shaky
11. Felt like nothing was very enjoyable
12. Felt keyed up, “on edge”
13. Felt worthless
14. Had trouble swallowing
15. Felt like I had a lot of interesting things to do
16. Had hot or cold spells
17. Felt like a failure
18. Felt like I was choking
19. Felt really lively, “up”
20. Felt uneasy
21. Felt discouraged
22. Muscles twitched or trembled
23. Felt like I had a lot of energy
24. Was trembling or shaking
25. Felt like I was having a lot of fun
26. Had a very dry mouth
Positive and Negative Affect Schedule – Revised (PANAS-X)

You will now be presented with some emotions. Please indicate the extent to which you felt these emotions over the past 24 hours.

Use this scale:
- 1 = Very slightly or Not at all
- 2 = A little bit
- 3 = Moderately
- 4 = Quite a bit
- 5 = Extremely

| ____ 1. Afraid       | ____ 17. Energetic
| ____ 2. Nervous      | ____ 18. Optimistic
| ____ 4. Jittery      | ____ 20. Proud
| ____ 5. Frightened   | ____ 21. Strong
| ____ 6. Shaky        | ____ 22. Confident
| ____ 7. Angry        | ____ 23. Fearless
| ____ 8. Hostile      | ____ 24. Upset
| ____ 9. Irritable    | ____ 25. Calm
| ____ 10. Sad         | ____ 26. Relaxed
| ____ 11. Alone       | ____ 24. Upset
| ____ 12. Stressed out| ____ 25. Calm
| ____ 14. Happy       | ____ 27. Sleepy
| ____ 15. Cheerful    | ____ 28. Tired
| ____ 16. Excited     |
Profile of Female Sexual Function (PFSF)

*Please answer the following questions about your sexuality that you experienced today. These questions are about any sexual activity, including masturbation or sex with another person.*

Use this scale:

1 = Never  
2 = Seldom  
3 = Sometimes  
4 = Often  
5 = Very often  
6 = Always  
N/A = Not applicable.

1. I felt like having sex.  
2. My sexual desire was high.  
3. I really wanted sex.  
4. I felt sexual desire.  
5. I lacked sexual desire.  
6. I had strong sexual feelings.  
7. I was uninterested in sex.  
8. I got warm all over just thinking about sex.  
9. I felt really sexually excited.

1. It was very difficult for me to become aroused.  
2. I really had to focus to get sexually aroused.  
3. Getting aroused took forever.

1. I reached orgasm easily  
2. It took a lot of work for me to reach orgasm.  
3. Having orgasms was difficult.  
4. Reaching orgasm was impossible.

1. I got a lot of pleasure from sex.  
2. Sex felt good.  
3. I felt warm all over during sex.  
4. Sex was wonderful.  
5. I felt tingly all over during sex.  
6. Sex was exciting.  
7. Sex was satisfying.
1. I made up excuses to avoid having sex.
2. I avoided doing anything that would get my partner sexually excited.
3. I avoided having sex.
4. I dreaded having sex.
5. Having sex was a chore.

1. How often did you feel good about yourself sexually?
2. How often did you feel sexually desirable?
3. How often did you feel like a sensuous woman?
4. How often did you feel unhappy about yourself sexually?
Female Sexual Function Index

Please answer the following questions about your sexuality that you experienced today. These questions are about any sexual activity, including masturbation or sex with another person (unless otherwise specified).

Today, how often did you become lubricated (“wet”) during sexual activity or intercourse?
  ___ I did not have sexual activity either by myself or with another person.
  ___ Almost always or always
  ___ Most times (more than half the time)
  ___ Sometimes (about half the time)
  ___ A few times (less than half the time)
  ___ Almost never or never.

Today, how difficult was it to become lubricated (“wet”) during sexual activity or intercourse?
  ___ I did not have sexual activity either by myself or with another person.
  ___ Extremely difficult or impossible
  ___ Very difficult
  ___ Difficult
  ___ Slightly difficult
  ___ Not difficult

Today, how often did you maintain lubrication (“wetness”) until completion of sexual activity or intercourse?
  ___ I did not have sexual activity either by myself or with another person.
  ___ Almost always or always
  ___ Most times (more than half the time)
  ___ Sometimes (about half the time)
  ___ A few times (less than half the time)
  ___ Almost never or never.

Today, how difficult was it to maintain lubrication (“wetness”) until completion of sexual activity or intercourse?
  ___ I did not have sexual activity either by myself or with another person.
  ___ Extremely difficult or impossible
  ___ Very difficult
  ___ Difficult
  ___ Slightly difficult
  ___ Not difficult

Today, how often did you experience discomfort or pain during vaginal penetration?
  ___ I did not attempt sexual activity either by myself or with another person.
  ___ Almost always or always
  ___ Most times (more than half the time)
  ___ Sometimes (about half the time)
  ___ A few times (less than half the time)
  ___ Almost never or never.

Today, how often did you experience discomfort or pain after vaginal penetration?
  ___ I did not attempt sexual activity either by myself or with another person.
  ___ Almost always or always
  ___ Most times (more than half the time)
  ___ Sometimes (about half the time)
  ___ A few times (less than half the time)
  ___ Almost never or never.
Today, how would you rate your level (degree) of discomfort or pain during or after vaginal penetration?

___ I did not attempt sexual activity either by myself or with another person.
___ Very high
___ High
___ Moderate
___ Low
___ Very low or none at all