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# EMOTIONAL AND SOCIAL REACTIVITY AS MECHANISMS OF STRESS GENERATION: A MOMENTARY ASSESSMENT STUDY

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Depressed individuals report higher rates of stressful daily interpersonal events. The stress generation hypothesis suggests that traits and behaviors associated with depression may actually cause these stressors to occur. The exact day-to-day emotional and behavioral processes that drive stress generation, however, are less well understood. The present study uses experience sampling methods in a sample of 110 female undergraduate students to examine hour-by-hour emotional and social reactivity and avoidance coping as possible contributors to stress generation. Participants reported on overall symptoms of depression and then completed four daily diaries per day over a five-day period on emotional state, stressful interpersonal experiences, and avoidance behaviors. Multilevel models revealed that emotional distress both generated and was generated by interpersonal stressors such as conflict, rejection, or criticism. Avoidant behavioral responses to stressors—such as social withdrawal, substance use, or ignoring a problem—also significantly contributed to negative mood: Emotional reactivity was thus amplified by problem avoidance. Individuals who reported more depressive symptoms

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were especially likely to respond to negative moods with avoidance behavior. Ramifications for clinical interventions that focus on reducing emotional reactivity and avoidance coping are discussed.

*Keywords*: stress generation; interpersonal stress; avoidance; daily diaries; depression

Decades of research have established strong ties between stress and mental health. The diathesis-stress model, which states that stressful events serve as triggers for the onset of mental illness, is the most widely applied theory that explains the high rates of life stressors seen in individuals diagnosed with psychiatric disorders. Other theories, however, point to a more complex interrelationship between stress and mental illness. Hammen (1991) observed that individuals with a history of depression experience more than the average number of dependent stressors (stressors to which their own actions contribute, most often negative interpersonal events; Liu & Alloy, 2010), whereas they seem to experience no more than an average number of independent stressors (stressors unlikely have been determined by the individual's acts; e.g., death of a loved one, natural disaster). Studies on this topic indicate that some quality of depression or depressed individuals seems to actually generate stressful events (Hammen, 1991; Liu & Alloy, 2010). Accordingly, this phenomenon is known as stress generation.

Stress generation has been thoroughly documented in a series of daily diary studies in which measures of depression prospectively predict stressful daily life events documented over the course of several days or weeks (see Liu & Alloy, 2010 for a review). It remains unclear, however, *how* depressive symptoms impact the stressful events an individual encounters on a day-to-day basis.

Cross-sectional research has identified many individual-level traits associated with stress generation. These include high negative affectivity combined with stress reactivity (Hankin, 2010); avoidant coping styles (Holahan, Moos, Holahan, Brennan, & Schutte, 2005); poorer ability to manage conflict, provide emotional support to others, and initiate new interactions or relationships (Cummings et al., 2013; Cummings, Hayes, Laurenceau, & Cohen, 2010); and negative cognitive styles (e.g., self-

criticism and rumination; Liu & Alloy, 2010), among others. The accumulation of specific day-to-day behavioral and emotional experiences fuels the broad patterns observed in cross-sectional research: Identifying these daily processes is critical to the development of clinical interventions that target behavioral skill sets, such as social skills or distress coping strategies.

Bolger and Zuckerman (1995) proposed several daily processes that link the frequency with which daily stressors occur with personality traits: Higher raw exposure to stressors, higher emotional reactivity (i.e., distress responses) to stressors when they occur, poor coping strategy selection, and less effective use of the coping strategies chosen. These daily processes parallel the broader cognitive behavioral patterns described in the stress generation literature. Consistent with the well-documented correspondence between neuroticism and depression (e.g., Kendler, Kessler, Neale, Heath, & Eaves, 1993), they tested and found evidence that depressed mood contributed to the association between stressor occurrence and the personality trait of neuroticism. We propose that similar emotional and behavioral processes may contribute to the frequency with which depressed individuals experience dependent stressors.

Indeed, there is good evidence to implicate Bolger and Zuckerman's processes in depressive disorders. As already described, the extant stress generation literature offers clear evidence to support the first proposal: depression does prospectively increase rates of stressful interpersonal events, above and beyond the continuation of pre-depressive episode stressors (Uliaszek et al., 2012). The specific roles of daily emotional reactivity and coping strategy selection in predicting stressor occurrence are discussed below.

## EMOTIONAL REACTIVITY

Negative affective reactivity to stressors correlates with a range of mental health concerns. In momentary assessment studies like this one, individuals with major depression have been shown to exhibit larger increases in negative emotion on days when they report increases in daily life stress compared to control samples (Myin-Germeys et al., 2003; Wichers et al., 2007). Negative affec-

tive reactivity to daily stressors has also been shown to prospectively predict depressive symptoms, as opposed to depression predicting reactivity (Brose, Wichers, & Kuppens, 2017; O'Neill, Cohen, Tolpin, & Gunthert, 2004; Parrish, Cohen, & Laurenceau, 2011). These studies provide further evidence that day-to-day affective reactions play a role in generating symptoms of depression.

Reduction in emotional reactivity to stressful daily life events may be one active component in effective treatment of psychiatric disorders. One study found that imipramine, a tricyclic antidepressant, reduced emotional stress sensitivity in a sample of depressed patients (Wichers et al., 2008). Dialectical Behavior Therapy (DBT; Linehan, 1993) includes a significant focus on improving coping skills to regulate emotions and improve patients' tolerance of distressing events. Increased use of these behavioral skills resulting from DBT treatment has been shown to mediate improvements in depressed mood (Neacsiu, Rizvi, & Linehan, 2010). This study aims to first replicate past research that indicates that emotional reactivity to stressors—in this study, interpersonal stressors—is associated with depressive symptoms, and second, test a potential link between depression and daily emotional states in the form of avoidance coping. Further, this study investigates the role of negative affect in prospectively predicting the occurrence of interpersonal stressors (termed here Social Reactivity, or the tendency to translate negative mood states into an increased likelihood of experiencing stressful interpersonal events).

## CHOICE OF COPING BEHAVIOR

Poor coping strategy selection is the second daily process by which stress generation is hypothesized to occur. Coping behaviors and cognitive appraisals are critical mediators between stressful experiences and an individual's response. Emotional and social reactivity are presumably less likely to occur if individuals select highly effective coping strategies that minimize their affective and behavioral responses to unwanted experiences. Coping should impact stress generation in one of two ways: it should either minimize the negative mood response (by

moderating the link between the initial stressor and the resultant emotion), or prevent the negative mood from adversely affecting behavior (by moderating the link between the negative mood and later stressful events, or social reactivity).

Coping behaviors have sometimes been categorized in terms of problem-approach strategies, which include actions designed to affect the stressful situation, and avoidance strategies, in which individuals do not engage with a problem. Cross-sectional studies of coping have shown that problem-solving is associated with overall higher positive affect and lower negative affect, whereas avoidance is associated with lower positive and higher negative affect (Ben-Zur, 2009). Along these lines, individuals who reported using more distraction or relaxation-oriented coping techniques reported higher negative affect at the end of the day (Gunthert, Cohen, & Armeli, 1999). Avoidance also has implications for stress generation: one study found that students who reported having avoidance goals as opposed to approach goals were more likely to experience negative events throughout their semester (Elliot, Thrash, & Murayama, 2011).

Depression is broadly associated with the tendency to use avoidance coping (Holahan et al., 2005), and chronic patterns of avoidance have been linked to more negative long-term mental and physical health outcomes than approach coping (Elliot et al., 2011; O'Brien & DeLongis, 1996). Benefits of avoidance, however, have been identified, such as when resources are overwhelmed and capacity for problem-solving or emotional processing is exceeded (e.g., in the context of intense emotional charge; Elliot et al., 2011; Suls & Fletcher, 1985). Brief social withdrawal may impede social reactivity by allowing distressed individuals time to recover from negative emotional arousal and by reducing the likelihood of conflict-inducing approach-coping behaviors like reassurance-seeking or acts of anger (Eberhart & Hammen, 2009; Larson & Gillman, 1999; Story & Repetti, 2006; Wang, Repetti, & Campos, 2011). This study addresses whether or not depressed individuals are more likely to engage in avoidance behavior in response to feeling upset (whether or not the individual is aware of using the behavior as a coping strategy), and the extent to which avoidance may contribute to social reactivity processes

that cause some individuals to experience unusually high rates of interpersonal stress.

## THE INTERPERSONAL NATURE OF DEPRESSION

Often, dependent stressors are of an interpersonal nature—not surprising given a strong literature suggesting that mood disorders are deeply intertwined with interpersonal functioning and relationship quality (Hammen, 1991, 2006; Joiner & Coyne, 1999). In fact, social skills deficits and attachment styles have been hypothesized as important contributors to stress generation (Hammen, 2003; Segrin, 2001). A preponderance of evidence suggests that women are, on the whole, especially vulnerable to negative interpersonal events—and they are also far more likely to experience clinical depression than male counterparts (Cyranowski, Frank, Young, & Shear, 2000; Ferrari et al., 2013). In fact, women particularly appear to experience a number of psychiatric disorders as fundamentally interpersonal, both in origin and in consequence (Hammen, 2003). For these reasons, an all-female sample is used in the present study.

## MEASURING STRESS AND COPING

Momentary assessment techniques are critical to addressing the day-to-day stress generation and coping processes described above. One reason is that these techniques decrease participant cognitive burden. Retrospective reports of stressors and coping behaviors require that participants recall past events, aggregate them into average behavior, and often even compare their own behavior against the hypothetical average person—all of which increase vulnerability to bias (Porter et al., 2000). Evidence shows that cross-sectional questionnaires do not compare well to momentary assessments of coping behaviors (Schwartz, Neale, Marco, Shiffman, & Stone, 1999; Slatcher, Robles, Repetti, & Fellows, 2010). One study found that participants' recall of coping behaviors used even within as short a period as the last two days showed significant divergence from reports made every 20 to 60 minutes throughout those same two days (Stone et al., 1998). The hour-to-hour associations among affect, daily stressors, and be-

havior that are hypothesized in the present study can thus be addressed more readily and more accurately using momentary assessment strategies.

A second strategy used in this study to limit perceptual biases was to employ uniquely behaviorally-specific language in the daily coping assessments. Individuals do not necessarily consciously practice specific behaviors to manage stress responses; for example, someone may attribute eating a cookie to a chance craving rather than as an attempt to reduce stress. Thus, in this study, avoidance behavior consists of behaviors commonly associated with avoidance coping without necessarily being assigned to specific stressors or identified as coping by the participant.

Unlike individual daily stress and coping behaviors, models of psychopathology are defined by aggregations of emotional, cognitive and behavioral patterns across time. Using multilevel modeling techniques, this study examines day-to-day associations between changes in the environment and in the participant's mood and behavior (referred to as level 1 or within-subject associations). It also examines how these processes are associated with overall symptoms of depression (referred to as a level 2 or between-subject variable). By examining level 1 moderators of associations among stressful experiences, affect and behavior, we can watch stress generation processes unfold at a micro- rather than macro-level. By examining level 2 moderators of within-subject associations, we are able to determine how depressive symptoms interact with daily experiences to predict behavior, over and above the influence of proximal events.

## STUDY HYPOTHESES

To elucidate the association between depression and stressor occurrence, the present study aims to examine in particular the roles of emotional reactivity to interpersonal stressors and coping strategy selection to explain why some individuals experience higher exposure to stressful daily events. Specifically, we examine the interplay among emotional reactivity, avoidance coping, and social reactivity, and their associations with symptoms of depression using hourly experience sampling methods.

## EMOTIONAL REACTIVITY

Emotional reactivity will be evidenced by increases in negative mood relative to each individual's baseline several hours after interpersonal stressors are reported.

## SOCIAL REACTIVITY

Social reactivity will be evidenced by an increased likelihood of interpersonal stressors reported in the time period immediately following elevations in negative mood.

## AVOIDANCE

*Hypothesis 1a.* Avoidance behavior will impact the degree to which emotional reactivity occurs (i.e., strengthen or weaken the effect of stressors on negative mood).

*Hypothesis 1b.* Avoidance behavior will impact the degree to which social reactivity occurs (i.e., strengthen or weaken the effect of negative emotion on interpersonal stressor occurrence).

## DEPRESSIVE SYMPTOMS

*Hypothesis 2a.* Emotional reactivity will be more likely to occur in individuals with elevated depressive symptoms.

*Hypothesis 2b.* Social reactivity will be more likely to occur in individuals with elevated depressive symptoms.

## AVOIDANCE AND DEPRESSIVE SYMPTOMS

*Hypothesis 3.* More avoidant behavioral responses to recent elevations in negative mood will be more likely to occur in individuals with elevated depressive symptoms.

## METHOD

### PARTICIPANTS

One hundred and ten female undergraduate students participated in the study. Participants had an average age of 20.5 (*SD* = 2.81) and were evenly dispersed across the first four years of college (30% in their first year, 24.6% second, 23.6% third, 20% fourth, and 1.8% in their fifth year or higher). In terms of ethnic background, 50% described themselves as of Asian descent, 30% Caucasian, 14% Latino, 1% African-American, and 5% mixed or other. When asked about romantic relationships, 52.7% were single and not dating anyone, 13.6% were single but dating, 31.8% had a boyfriend or girlfriend, and 1.8% were married.

### PROCEDURE

Students were recruited through psychology classes and were awarded course credit for participation. All students over the age of 18 were eligible to participate. Students viewed a brief synopsis of the study and signed up for a baseline session on an online portal through the Psychology department website. During the baseline session, a research assistant obtained informed consent, practiced the study procedures to troubleshoot any technical problems, and scheduled the daily surveys to ensure there were no significant conflicts with participants' schedules. During this meeting participants also completed a series of questionnaires (see Materials for a description of the questionnaires). On the Tuesday following the baseline session, participants received their first daily surveys. Participants completed four daily surveys per day for five days at the time points scheduled during their baseline sessions.

The span of five days (Tuesday through Saturday) was chosen for the daily surveys to capture three consecutive days during which most students attend class (Tuesday through Thursday) and at least one weekend day (Saturday) so as to contrast a day

of recovery with weekdays. Survey time points were scheduled according to the participant's needs, aiming for 3 to 4 hour gaps between time points. On average, participants scheduled their surveys for 10:40am, 2:00pm, 6:00pm, and 9:50pm. Participants received e-mail and text message reminders reading "Survey time!" with a link to the appropriate daily survey at their individually-scheduled times. Email and text message reminders were pre-scheduled using a secure online program called Lettermelater, and surveys were administered using the secure online program Surveymonkey.com.

The surveys were, on average, taken within 15 minutes of their scheduled time. The number of course credits each participant received was dependent on the number of surveys completed on time (i.e., taken within an hour of receiving their reminder): participants received all 5 credits if 18 out of 20 of the surveys were completed on time, 4 credits if they completed 16–17 surveys on time, and so on. Response rates were excellent: 93% of all surveys were completed within one hour of the scheduled survey time, with no substantive differences in response rate associated with time of day or day of the week. On average, each participant completed 18.6 ($SD$ = 1.6) out of the maximum 20 observations, resulting in a total of 2,049 observations.

## MEASURES

### DAILY DIARIES

*Negative Mood.* Eight of the original 14-item daily diary mood items (adapted from Cohen, Doyle, Turner, Alper, & Skoner, 2003) assessed negative mood; the six additional items assessed positive mood and were not included in the present study. Participants rated their own negative mood on a 1 (not at all) to 7 (extreme) scale based on the prompt, "Please rate how well each of the following adjectives describes how you have felt since you woke up this morning," or, in the case of afternoon surveys, ". . . since you took your last survey." Scores on the eight items associated with negative mood (sad, angry, unhappy, on edge, tense, hostile, stressed, overwhelmed) were averaged at a daily level for an overall negative mood score (mean = 2.16, $SD$ = 1.08;

range 1 to 7 across data points, range 1.03 to 4.70 across participants' averages). The occasion-level reliability estimate (an alternative to Cronbach's alpha developed for within-person scales such as this one) in this sample was .90 (Nezlek, 2017). Prior studies have also found this scale to have good internal reliability (Cronbach's alphas ranging from .87 to .93 across subscales; Cohen et al., 2003). As would be expected in a normal sample of college students, the scale was positively skewed with more frequent responses occurring at lower values; however, participants responded across the full range of the scale and the majority of participants did endorse instances of negative mood, leading to good variability in responses despite the overall skew.

*Interpersonal Stressors.* Five of the 10 original items on the stressful events checklist assessed recent stressful interpersonal events. The other five non-interpersonal stressors (e.g., financial, school-related) were not used in the present study. The items were either written for the purposes of this study or were adapted from the Live Events and Coping Inventory (Dise-Lewis, 1988). Items included the following: "Had a fight, conflict, or argument with someone," "Something happened that left me feeling ignored, left out, or rejected," "Something happened that left me feeling criticized or put down," "Was teased or laughed at," and "Tried to share something important with someone, but they didn't seem to understand." All items were rated as either N/A (Has not occurred since last survey) or, if the event did occur, on a 1 (Not at all distressing) to 5 (Extremely distressing) scale, and participants were specifically asked to refer to events that had occurred within the hours since waking or since the last survey was taken, whichever occurred most recently. To separate the experience of distress from the occurrence of a stressor, the present study's interpersonal stressor scale score is a sum of the number of stressful interpersonal events reported at that survey time. Events were rated as present (yes/no) if the participant had rated that item at a distress level of 2 (slightly distressing) or higher; because 5 items were included, scale scores could (and did) range from 0 to 5. Participants reported an average of .64 stressful interpersonal events per survey ($SD$ = 1.13). With respect to variability, as with negative mood, the scale was positively skewed such that lower scores were more frequent, however,

90% of the participants did report some instances of relationship stress (range 0 to 3.30 events across participants' averages) and the overall sample's scores ran the full range of the scale.

*Avoidance Behavior.* Seven of the original 12 items on the coping strategies checklist measured avoidance behavior: the other five items were not used in the present study. The items were either written for the purposes of this study or were adapted from the Ways of Coping checklist (Folkman & Lazarus, 1980). Participants were prompted to rate how well each item described their activities since their last survey response using the following scale: either N/A (Not applicable, doing this would have been impossible), or, if the behavior was possible, 0 (Not at all well) to 4 (Extremely well). Items included the following: "Spent some alone time," "Avoided someone I was upset with," "Procrastinated or avoided doing something I needed to do," "Took a break or postponed a difficult task by doing something soothing or relaxing," "Drank alcohol or used other drugs," "Pushed away or ignored thoughts about a problem I'm having," and "Put off making a difficult decision (e.g., about a relationship or school)." In an effort to capture strategies that the participant would not necessarily describe as purposeful coping, but that are known within the coping literature to be associated with stress and negative emotion (e.g., drinking alcohol), none of the items required the participant to have an active intention to cope using these strategies, and behaviors were not linked to specific stressors. Ratings of "N/A" were coded as missing data; ratings of 0–4 were averaged across the seven avoidance items for each survey to create an avoidance scale score (mean = 1.36, *SD* = .92; range 0 to 4 across data points, range .11 to 3.72 across participants' averages). Scores were relatively normally distributed around the mean with a modest positive skew such that higher scores were relatively less frequent than lower scores.

## QUESTIONNAIRE

*Depressive Symptoms.* The Center for Epidemiological Studies—Depression Measure (CESD; Radloff, 1977) is a widely-used 20-item self-report scale of depressive symptoms occurring in the

past week. The CESD has been shown to discriminate depressive symptom severity in an undergraduate population more effectively than the frequently-used Beck Depression Inventory (Santor, Zuroff, Ramsay, Cervantes, & Palacios, 1995). Items include, "I felt depressed" and "My sleep was restless," and are rated on a 0 (rarely or none of the time, less than one day) to 4 (most or all of the time, 5–7 days) scale such that higher scores indicate more severe symptoms of depression. The mean summary score in the current study was 13.26 ($SD$ = 7.83, range 0 to 43, $\alpha$ = .87). Previous studies of non-clinical samples (including undergraduate samples) report comparable means from 7.94 ($SD$ = 7.53) to 18.0 ($SD$ = 12.3) and similar inter-item reliability estimates ($\alpha$ = .84–.90; Radloff, 1977; Santor et al., 1995). The CESD was Winsorized (Guttman, 1973) to correct for outliers; the single individual whose score fell above 3 SDs from the sample's mean was reduced to the next highest value below the 3 SD cutoff.

## RESULTS

First, individual-level associations among depressive symptoms and daily survey responses were examined. As expected based on the symptom criteria for depression and past stress generation findings, participants' CESD scores were correlated with their average negative mood ($r$ = .42, $p < .001$) and the average number of interpersonal stressors they reported over the 20 time points ($r$ = .20, $p$ = .040). Participants' average endorsement of avoidance behavior was not correlated with depressive symptoms ($r$ = .15, $p$ = .117).

Due to the nesting of up to 20 consecutive daily survey responses within individual respondents, multilevel models were assessed using maximum likelihood procedures in Stata 12 (StataCorp, 2011). Daily survey observations (level 1, $t$) were nested within individuals (level 2, $i$). There were four observation times per day. The following models largely examine predicted effects from one observation time to the next; however, effects are expected to occur on a short-term basis and thus are not expected to cross from one day to the next. In addition, if effects from the final evening to the first morning measurements had been examined, the length of time between measurements (and the oppor-

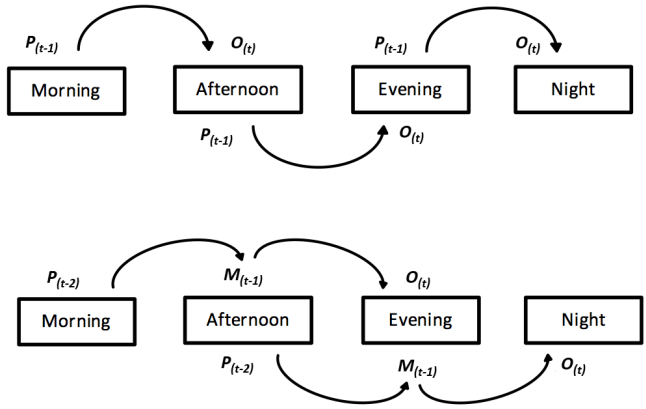


FIGURE 1. Schematic of Time-Lapsed Multilevel Models.
*P* = Predictor, *M* = Moderator, *O* = Outcome

tunities for interpersonal interaction) would not be comparable to the within-day measurements. For these reasons, effects are examined from one survey to the next survey only within the same day. The time at which the outcome is measured is labeled *t*, and the time at which the predictor is measured is *t*–1. To address moderation effects, moderators measured between the outcome and predictor were included in models. In these cases, the predictor was measured at *t*–2, the moderator at *t*–1, and the outcome at *t*. A schematic is presented in Figure 1 to clarify the time-lagged nature of the effects.

## EMOTIONAL REACTIVITY

The following multilevel model equation assessed emotional reactivity. The number of interpersonal stressors reported on survey *t-1* were tested as predictors of negative mood ratings on survey *t*:

$$\text{Negative mood}_{ti} = B_{00} + B_{10}(\text{Interpersonal Stress}_{(t\text{-}1)i}) + u_{0i} + u_{1di}(\text{Interpersonal Stress}_{(t\text{-}1)i}) + r_{ti} \quad (1)$$

In this equation, the negative mood rating reported on survey *t* for individual *i* (Negative mood$_{ti}$) is a function of the intercept, the total number of interpersonal stressors reported on the survey completed immediately prior to survey *t* (*t*–1), and between- and within-subjects error. Negative mood ratings were centered around each individual's mean (i.e., group mean centered). In this and all models described below, robust standard errors were applied to address violations of assumptions of normality in daily data, given the negative mood ratings' skew towards lower scores, and a first-order autoregressive variance-covariance matrix was applied to allow residuals to covary across time due to nonindependence of ratings made closer together in time. In this equation, $B_{10}$ (the main effect of the interpersonal stressor score reported on survey *t*–1) serves as a test of the hypothesis.

Higher interpersonal stress scores were indeed predictive of the negative mood rated on the next survey completed that day, such that with each increase in the number of interpersonal stressors reported, negative mood ratings were elevated relative to the individual's average negative mood ($B$ = .06, $SE$ = .02), $z$ = 2.62, $p$ = .009; see Table 1 for further detail.

## SOCIAL REACTIVITY

A model identical to Equation 1 (but reversed) was used to assess social reactivity to emotional distress, or the effect of negative mood on the likelihood of experiencing interpersonal stressors in the immediate future. In this model, the occurrence of interpersonal stressors on survey *t* was predicted by the negative mood rating reported on survey *t*–1. Elevated negative mood on survey *t*–1 predicted a significant increase in the number of interpersonal stressors subsequently reported on survey *t* ($B$ = .09, $SE$ = .03), $z$ = 2.74, $p$ = .006; see Table 2 for further detail.

## AVOIDANCE

*Hypothesis 1a.* Avoidance behavior reported at *t-1* was then tested as a moderator of emotional reactivity (the association between the number of interpersonal stressors reported on survey

**TABLE 1. Emotional Reactivity: Predictors of Negative Mood With and Without Moderators**

| Fixed Effects | Emotional Reactivity | *B* | *SE* | Hypothesis 1a | *B* | *SE* |
|---|---|---|---|---|---|---|
| | Intercept ($B_{00}$) | −0.041** | −0.02 | Intercept ($B_{00}$) | −0.029 | −0.05 |
| | Interpersonal Stress$_{(t-1)i}$ ($B_{10}$) | 0.06** | −0.02 | Interpersonal Stress$_{(t-2)i}$ ($B_{10}$) | −0.081 | −0.07 |
| | | | | Avoidance$_{(t-1)i}$ ($B_{20}$) | 0.006 | −0.03 |
| | | | | Interpersonal Stress$_{(t-2)i}$ × Avoidance$_{(t-1)i}$ ($B_{30}$) | 0.092* | −0.04 |
| **Random Effects** | | **Estimate** | ***SE*** | | **Estimate** | ***SE*** |
| **Level 2 Variance** | Var(Intercept) ($u_{0i}$) | 0 | 0 | Var(Intercept) ($u_{0i}$) | 0.004 | −0 |
| | Var(Interpersonal Stress$_{(t-1)}$) ($u_{1i}$) | 0.004 | −0 | Var(Interpersonal Stress$_{(t-2)}$) ($u_{1i}$) | 0.03 | −0.02 |
| | | | | Cov(Interpersonal Stress$_{(t-2)}$, Intercept) | −0.01 | −0.01 |
| **Level 1 Variance** | Rho | 0.297 | −0.05 | Rho | 0.298 | −0.06 |
| | Var($r_{ti}$) | 0.592 | −0.05 | Var($r_{ti}$) | 0.585 | −0.06 |
| **Fixed Effects** | **Hypothesis 2a** | ***B*** | ***SE*** | **Hypothesis 2a (posthoc)** | ***B*** | ***SE*** |
| | Intercept ($B_{00}$) | 1.642*** | −0.11 | Intercept ($B_{00}$) | 1.551*** | −0.11 |
| | Interpersonal Stress$_{(t-1)i}$ ($B_{10}$) | 0.015 | −0.06 | Interpersonal Stress$_{(t)i}$ ($B_{10}$) | 0.212*** | −0.05 |
| | Depression$_i$ ($B_{01}$) | 0.035*** | −0.01 | Depression$_i$ ($B_{01}$) | 0.033*** | −0.01 |
| | Interpersonal Stress$_{(t-1)i}$ × Depression$_i$ ($B_{11}$) | 0.004 | −0 | Interpersonal Stress$_{(t)i}$ × Depression$_i$ ($B_{11}$) | 0.006† | −0 |
| **Random Effects** | | **Estimate** | ***SE*** | | **Estimate** | ***SE*** |
| **Level 2 Variance** | Var(Intercept) ($u_{0i}$) | 0.329 | −0.07 | Var(Intercept) ($u_{0i}$) | 0.273 | −0.05 |
| | Var(Interpersonal Stress$_{(t-1)}$) ($u_{1i}$) | 0.016 | −0.01 | | | |
| **Level 1 Variance** | Rho | 0.383 | −0.05 | Rho | 0.372 | −0.04 |
| | Var($r_{ti}$) | 0.658 | −0.06 | Var($r_{ti}$) | 0.59 | −0.04 |

*Notes.* *$p < .05$; **$p < .01$; ***$p < .001$; †$p < .10$.

**TABLE 2. Social Reactivity: Predictors of Interpersonal Stressor Occurrence With and Without Moderators**

| **Fixed Effects** | **Social Reactivity** | ***B*** | ***SE*** | **Hypothesis 1b** | ***B*** | **SE** |
|---|---|---|---|---|---|---|
| | Intercept ($B_{00}$) | 0.458*** | –0.093 | Intercept ($B_{00}$) | 0.396* | –0.162 |
| | Negative Mood$_{(t-1)i}$ ($B_{10}$) | 0.09** | –0.033 | Negative Mood$_{(t-2)i}$ ($B_{10}$) | 0.1 | –0.067 |
| | | | | Avoidance$_{(t-1)i}$ ($B_{20}$) | –0.013 | –0.086 |
| | | | | Negative Mood$_{(t-2)i}$ × Avoidance$_{(t-1)i}$ ($B_{30}$) | 0.033 | –0.037 |
| **Random Effects** | | **Estimate** | ***SE*** | | **Estimate** | ***SE*** |
| **Level 2 Variance** | Var(Intercept) ($u_{0i}$) | 0.328 | –0.103 | Var(Intercept) ($u_{0i}$) | 0.234 | –0.13 |
| | Var(Negative Mood$_{(t-1)}$) ($u_{1i}$) | 0.007 | –0.008 | Var(Negative Mood$_{(t-2)}$) ($u_{1i}$) | 0.034 | –0.017 |
| **Level 1 Variance** | Rho | 0.142 | –0.063 | Rho | 0.154 | –0.068 |
| | Var($r_{ti}$) | 0.868 | –0.094 | Var($r_{ti}$) | 0.907 | –0.103 |
| **Fixed Effects** | **Hypothesis 2b** | ***B*** | ***SE*** | | | |
| | Intercept ($B_{00}$) | 0.386* | –0.166 | | | |
| | Negative Mood$_{(t-1)i}$ ($B_{10}$) | 0.046 | –0.069 | | | |
| | Depression$_i$ ($B_{01}$) | 0.007 | –0.01 | | | |
| | Negative Mood$_{(t-1)i}$ × Depression$_i$ ($B_{11}$) | 0.003 | –0.004 | | | |
| **Random Effects** | | **Estimate** | ***SE*** | | | |
| **Level 2 Variance** | Var(Intercept) ($u_{0i}$) | 0.327 | –0.111 | | | |
| | Var(Negative Mood$_{(t-1)}$) ($u_{1i}$) | 0.006 | –0.008 | | | |
| **Level 1 Variance** | Rho | 0.144 | –0.063 | | | |
| | Var($r_{ti}$) | 0.868 | –0.094 | | | |

*Notes.* *$p < .05$; **$p < .01$; ***$p < .001$.

$t$–2 and negative mood reported on survey $t$) using the following equation:

$$\text{Negative mood}_{ti} = B_{00} + B_{10}(\text{Interpersonal Stress}_{(t-2)i}) + B_{20}(\text{Avoidance}_{(t-1)i}) + B_{30}(\text{Interpersonal Stress}_{(t-2)i} * \text{Avoidance}_{(t-1)i}) + u_{0i} + u_{1i}(\text{Interpersonal Stress}_{(t-2)i}) + r_{ti}, \quad (1a)$$

where the negative mood rating on survey $t$ by individual $i$ (Negative mood$_{ti}$) is a function of the intercept, the interpersonal stress score reported on survey $t$–2, the level of avoidance behavior reported on survey $t$–1, the interaction between interpersonal stress on survey $t$–2 and avoidance on survey $t$–1, and within- and between-subjects error. A random slope for interpersonal stress was included, but not for avoidance due to model nonconvergence. Here, the interaction between interpersonal stress and avoidance ($B_{30}$) serves as a test of Hypothesis 1a.

Avoidance was a significant moderator of emotional reactivity: the interaction between the interpersonal stress score on survey $t$–2 and avoidance on survey $t$–1 significantly predicted the negative mood rating on survey $t$ (B = .09, $SE$ = .04), $z$ = 2.29, $p$ = .022; see Table 1. Figure 2 shows graphically that the combination of a higher interpersonal stress score on survey $t$–2 and a higher avoidance rating (one standard deviation above the mean) on survey $t$–1 predicted elevated distress on survey $t$ relative to the individual's mean negative mood (simple slope = .12, $p$ = .007)—whereas interpersonal stress failed to predict negative mood when avoidance was one standard deviation below the mean (simple slope = –.04, $p$ = .427).

*Hypothesis 1b.* In an interaction model identical to that described in Equation 1a, avoidance ratings reported at $t$–1 were tested as moderators of social reactivity (the association between negative mood reported on survey $t$–2 and the number of interpersonal stressors reported on survey $t$). Avoidance was not a significant moderator of social reactivity ($B$ = .03, $SE$ = .04), $z$ = 0.88, $p$ = .377; see Table 2.

## DEPRESSIVE SYMPTOMS

*Hypothesis 2a.* Depression scores were examined as moderators of emotional reactivity by testing whether the interaction be-

tween depressive symptoms and interpersonal stress predicted subsequent negative emotion:

$$\text{Negative mood}_{ti} = B_{00} + B_{10}(\text{Interpersonal Stress}_{(t-1)i}) + B_{01}(\text{CESD}_i) + B_{11}(\text{Interpersonal Stress}_{(t-1)i} * \text{CESD}_i) + u_{0i} + u_{1i}(\text{Interpersonal Stress}_{(t-1)i}) + r_{ti}, \quad (2a)$$

where the negative mood rating on survey $t$ by individual $i$ (Negative mood$_{ti}$) is a function of the intercept, the level 1 interpersonal stress score reported at $t-1$, the level 2 depressive symptom score, the interaction between interpersonal stress on survey $t-1$ and the depression score, and within- and between-subjects error. Here, the interaction between interpersonal stress and depression scores ($B_{11}$) serves as a test of Hypothesis 2a. More depressed participants were not more likely to report elevated negative mood in the hours following interpersonal stress ($B = .004$, $SE = .004$), $z = 1.03$, $p = .303$; see Table 1.

To allow for the possibility that sensitized negative emotional responses to stressors may occur more immediately than lagged analyses (which examine emotional responses to stressors at a several hours delay) can accommodate, a post-hoc analysis was conducted to test depression as a moderator of the association between concurrent interpersonal stress and negative emotion (i.e., stress and mood both rated at time $t$). While inference about which came first (negative emotion or stressor) cannot be made, individuals with higher depression scores were marginally more likely to report elevated negative emotions in the immediate context of concurrent interpersonal stress ($B = .01$, $SE = .003$), $z = 1.67$, $p = .095$; see Table 1. Simple slopes indicate that interpersonal stress is related to negative mood at both one standard deviation below the average depression score (simple slope = .24, $p = <.001$) and one standard deviation above (simple slope = .33, $p <.001$).

*Hypothesis 2b.* Depression scores were examined as moderators of social reactivity by testing the interaction between depressive symptoms and negative mood at time $t-1$ as a predictor of interpersonal stressors at time $t$. More depressed participants were not more likely to report the occurrence of an interpersonal stressor in the hours following an elevation in negative mood ($B = .003$, $SE = .004$), $z = 0.61$, $p = .543$; see Table 2. Because the post-hoc analysis described above (examining depression as a

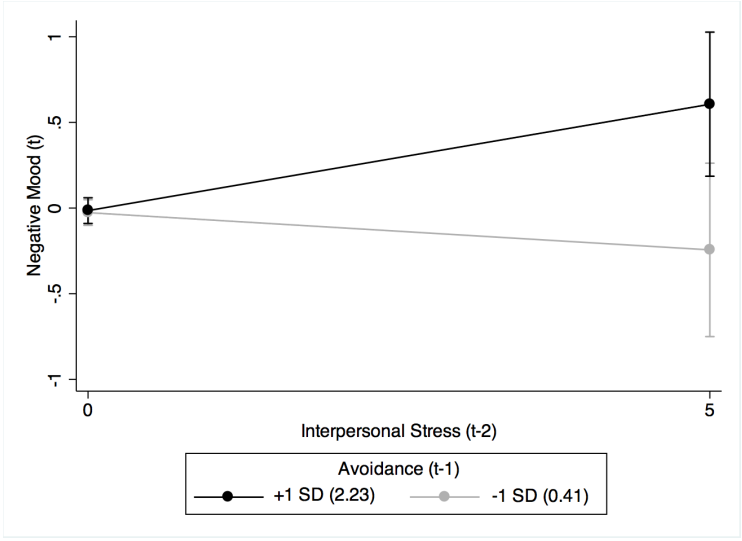


FIGURE 2. Interaction between Interpersonal Stressors and Avoidance in Predicting Negative Mood

moderator of concurrent elevated negative emotion and interpersonal stress) does not support causal inference differentiating between emotional and social reactivity on the basis of a time lag between the level 1 predictor and outcome, a similar post-hoc analysis was not conducted to follow up on the results of the test of Hypothesis 2b.

## AVOIDANCE AND DEPRESSIVE SYMPTOMS

*Hypothesis 3.* Lastly, depression scores were tested as moderators of the association between between negative mood and subsequent avoidance behavior (see Figure 3): An interaction between the negative mood score reported on survey $t$–1 and the individual-level depressive symptom score predicted avoidance behavior ratings on survey $t$ ($B$ = .01, $SE$ = .003), $z$ = 2.15, $p$ = .031; see Table 3. Simple slopes were not significantly different from zero. The slope directions indicate, however, that individuals with higher depression scores were more likely (simple slope = .05, $p$ = .083), and those with lower depression scores less likely

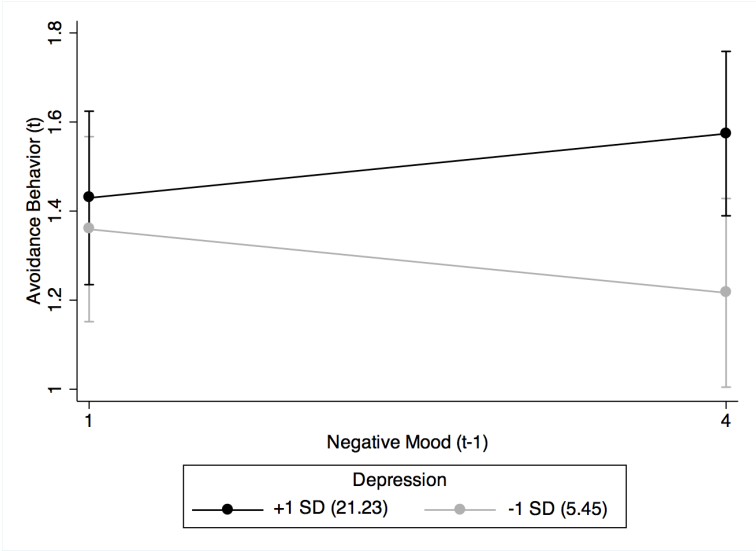


FIGURE 3. Interaction between Depressive Symptoms and Negative Mood in Predicting Avoidance Behavior

(simple slope = −.05, $p$ = .197), to report avoidance behavior following elevated negative mood.

## DISCUSSION

This study used experience sampling methods to study within-day mood, coping and stressor patterns proposed to play a role in the association between depression and stress generation. Three processes were addressed: emotional reactivity, social reactivity, and avoidance coping.

The college-age women represented in this study endorsed emotional reactivity to stressors in that they reported elevated negative mood shortly after reporting that they had experienced interpersonal problems. They also experienced social reactivity, in that they were more likely to experience stressful events shortly after reporting increases in emotional distress. Both emotional and social reactivity occurred regardless of depression symptom profile. In short, disruptions in relationships—conflict, invalidation, rejection, criticism, or teasing—both seemed to precede and follow anger, sadness, or other forms of emotional distress.

**TABLE 3. Hypothesis 3: Depressive Symptoms Moderate the Association Between Negative Mood (*t*–1) And Avoidance Behavior (*t*)**

| **Fixed Effects** | ***B*** | ***SE*** |
|---|---|---|
| Intercept ($B_{00}$) | 1.416*** | –0.175 |
| Negative Mood$_{(t-1)i}$ ($B_{10}$) | –0.081 | –0.05 |
| Depression$_i$ ($B_{01}$) | –0.002 | –0.011 |
| Negative Mood$_{(t-1)i}$ * Depression$_i$ ($B_{11}$) | 0.006* | –0.003 |
| **Random Effects** | **Estimate** | ***SE*** |
| **Level 2 Variance** | | |
| Var(Intercept) ($u_{0i}$) | 0.537 | –0.113 |
| Var(Negative Mood$_{(t-1)}$) ($u_{1i}$) | 0.002 | –0.002 |
| Cov(Negative Mood$_{(t-1)i}$, Intercept) | –0.036 | –0.019 |
| **Level 1 Variance** | | |
| Rho | 0.193 | –0.052 |
| Var($r_{ti}$) | 0.468 | –0.038 |

*Notes.* *$p < .05$; **$p < .01$; ***$p < .001$.

## AVOIDANCE COPING

More striking perhaps is the interplay between avoidance behavior and emotion. This study found that continued emotional upset several hours after an interpersonal disruption primarily occurred when participants responded to a stressor with behaviors such as spending time alone, ignoring thoughts about a problem, or drinking alcohol or using drugs. In other words, avoidant responses to interpersonal stressors resulted in a worse emotional state than nonavoidant responses. Avoiding did not appear to contribute to the social reactivity that was hypothesized as a day-to-day mechanism of stress generation.

Despite occasional past findings that short-term avoidance may actually be helpful in reducing distress or stressors, this study's findings are more consistent with the majority of the coping literature: avoidance appears to exacerbate problems of daily living. Most individuals who engage in avoidance behavior in the context of a stressful event, however, are likely attempting to manage or reduce distress. Our findings suggest that such attempts are misguided: the very effort to avoid negative emotion generates it. A more precise accounting of individual behaviors

and their effects in different stressful circumstances, however, is an important next step.

This study improves clarity in the assessment of coping by eliciting participants' reports of their actions without requiring that the behavior be interpreted by its user as coping with a specific stressful incident or negative mood. To label one's own behavior as avoidance coping requires clinical levels of psychological self-awareness. In contrast, the present type of assessment places the burden of behavioral labeling on the researcher, who can provide more consistency in interpretation across participants. Repeated hour-by-hour assessment procedures like those used in this study allow researchers to establish whether or not specific behaviors occur shortly after stressors or elevations in distress, thus establishing those behaviors as attempts to cope with difficult or unwanted circumstances.

## REACTIVITY AND DEPRESSION

Building on the stress generation literature (e.g., Hankin, 2010) and Bolger and Zuckerman's (1995) proposed framework linking daily stress processes with broad personality traits, we hypothesized that depressive symptoms might be related to the likelihood that an individual would react with more intense negative emotion to interpersonal stressors (emotional reactivity), and would be more likely to generate interpersonal problems when experiencing negative moods (social reactivity). This study did not support increased social reactivity or sustained emotional reactions to stress among more depressed individuals. Short-term intensifications in distress in the immediate context of interpersonal ruptures were, however, marginally more likely to occur in individuals who endorsed more symptoms of depression. In other words, the fire of anger, sadness, or feeling overwhelmed may be more easily ignited (or burn hotter) when more depressed women experience relationship problems, but those feelings may not necessarily continue to burn longer than they do among less depressed women.

When more depressed individuals experienced negative emotions, they were more likely to engage in avoidance behavior than those who were less depressed. Paired with the findings

that depressive symptoms were broadly associated with higher average negative mood and frequency of relationship stressors, this study points to cyclical negative mood and avoidance reactions to interpersonal stressors that is entirely consistent with the symptom profile of depression: chronic social withdrawal and negative mood, often occurring in the context of repeated interpersonal stressors.

## LIMITATIONS

Data generated by a college student sample has limited generalizability to the wider population, particularly in a study describing predictors and correlates of psychiatric conditions. While the depression scores were wide-ranging in this sample, average psychological functioning would necessarily be lower in a clinical sample. It is possible that individuals struggling with more severe psychiatric distress are more emotionally reactive, experience different types of stressors, or engage in coping behavior differently than individuals drawn from a normal population. Thus, a clinical sample may show different associations between affect, interpersonal stressors, avoidance coping, and depression. A longer period of study would also allow for inferences about the causal relationships among these factors, which were not possible in this five-day assessment period. In addition, the restriction of the sample to female participants limits both generalization and comparison to males. Future research on these interpersonal stress and emotional processes in a larger, mixed gender sample would greatly impact this literature.

Because all data was provided by self-report, it is also possible that level of depression may have introduced biases in reporting stressors. In a study in which spouses both reported on daily conflicts, however, high-neuroticism spouses were not more likely to report marital conflicts than their low-neuroticism spouses (i.e., they agreed; Bolger & Schilling, 1991). Thus there is reason to believe that high average levels of negative affect do not systematically bias reports of stressor occurrence.

Ideal strategies for conceptualizing and measuring daily stress and coping continue to evolve, and this study is no exception to the ongoing discussion in the research literature about how

best to categorize and measure these variables. Researchers have increasingly advocated for disaggregated models of coping because behaviors and outcomes vary widely within large categories like avoidance or emotion-focused coping (Skinner, Edge, Altman, & Sherwood, 2003). Because in this study several behaviors and experiences were combined into the categories of avoidance and interpersonal stressors, the study's findings may be more heavily influenced by certain items than others, or might differ across items. In particular, the interpersonal stressors measured in this study were not unilaterally dependent on the individual's own actions: a conversation partner may not understand a sensitive disclosure despite excellent delivery; one may be teased for something entirely out of one's control. Thus, the sample of interpersonal stressors available in this study may be muddied by external events not impacted by the participant's own affect or coping strategies.

## IMPLICATIONS AND FUTURE DIRECTIONS

We all experience daily stressors: friction in relationships, poor performances at work or in school, unexpected bad news or disappointments. Clinical populations, particularly those with mood disorders, experience more than the average person's share of difficult, stressful interactions with others. Understandably, a higher number of life stressors might impact mood. This study, however, indicates that the magnitude of one's emotional reaction to interpersonal stressors and the behavioral choices one makes in response to distress may differentiate between those who are and are not depressed. Thus, this study provides support for clinical interventions for depression that focus on reducing emotional reactivity to stressful life events, and on addressing the avoidance behaviors that arise in the context of emotional distress.

While cognitive behavioral interventions for depression clearly discourage avoidance behavior—consider practices of thought monitoring, behavioral activation, and exposure—there are circumstances in clinical practice when avoidance is advocated. For example, DBT teaches distraction and self-soothing techniques as crisis survival skills designed to help decrease the likelihood

that individuals will engage in problem behaviors when distressed (Linehan, 1993). These skills were originally designed for individuals who engage in patterns of severe and high-risk behaviors such as non-suicidal self-injury or suicide when in crisis; further, they are explicitly not designed to decrease negative mood.

DBT skills are, however, increasingly being introduced to a wide range of less dysregulated, less high-risk populations, including depressed individuals and college students. This study's findings indicate that these short-term avoidance strategies should be used, and taught, with care, and with explicit acknowledgment that they may not decrease (and may actually increase!) emotional distress in the short-term. Further research is needed on the differential effects of individual avoidance behaviors. It remains possible that specific distraction or self-soothing techniques may avert disastrous behaviors, even if they don't serve to decrease negative mood. Even in this study, while avoidance behavior did not decrease the likelihood of social reactivity to distress, it did not increase it, either. Future research should continue to examine the active interventional components (e.g., specific coping strategies) that reduce emotional reactivity and inhibit problematic social behavioral responses to distress.

Given what we know about the role of stress generation in the instigation and maintenance of depression, clinical interventions designed to reduce negative emotions and emotional reactivity to stressors only address half of the story. The primary behavioral moderator tested in this study—avoidance—did not appear to play a significant role in social reactivity, at least in this nonclinical sample. Continued research is greatly needed to identify the processes by which negative emotions increase the likelihood of social stressors, particularly in clinical populations. Understanding how a depressed individual's behavioral responses to frequent spikes in negative emotion increase the likelihood of interpersonal problems will bring us much closer to finding ways to reduce stress generation and, ultimately, depression.

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