Positive Emotion in Daily Life: Emotion Regulation and Depression

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R code can be made available for the anonymous reviewers and will be made publicly available via the Open Science Framework upon acceptance of this manuscript.

Abstract

Depression is associated with the infrequent use of emotion regulation strategies that increase positive emotion and the frequent use of strategies that decrease positive emotion. However, prior research mostly relies on global, retrospective assessments that fail to capture dynamic relations between positive emotion and emotion regulation in ecologically-valid settings. This study used an ecological momentary assessment (EMA) design to test whether depression is related to positive emotion regulation in daily life. We recruited 108 individuals to complete a 14-day EMA study, tracking strategy use and positive emotion over time. Higher momentary positive emotion was associated with greater subsequent use of positive rumination and less use of dampening. Elevated depressive symptoms, however, were associated with lower average use of positive rumination and higher average use of dampening. Depressive symptom levels did not modulate relations between positive emotion and emotion regulation strategy use. Less use of positive rumination and more use of dampening were related to lower levels of momentary positive emotion. Taken together, depression was associated with a pattern of strategy use that is associated with low positive emotion. Emotion regulation may help to explain positive emotion deficits in depression.

Keywords: depression; emotion regulation; dampening; positive rumination; ecological momentary assessment

Positive Emotion in Daily Life: Emotion Regulation and Depression

Depression is a disorder of emotion. Emotion dysregulation in depression is clearly evident in the hallmark symptoms of the disorder (American Psychiatric Association, 2013), and decades of empirical work show that depression is associated with elevated levels of negative emotion and low levels of positive emotion (Watson et al., 1988; Bylsma, Taylor-Clift, & Rottenberg, 2011; Khazanov & Ruscio, 2016). Difficulties in the regulation of emotion are proposed to contribute to emotion dysfunction in depression (Aldao & Nolen-Hoeksema, 2010; Joormann & Stanton, 2016; Liu & Thompson, 2017). Emotion regulation (ER) refers to the ability to modulate the intensity, frequency, and duration of emotional responses, and the ways in which people regulate their emotions are known as ER strategies (Gross, 1998; Gross, 2014). Most research on depression narrowly focuses on the regulation of negative emotion (Liu & Thompson, 2017; Visted et al., 2018), but individual differences in ER may also help in our understanding of low levels of positive emotion. Of note, there is a paucity of research on the regulation of positive emotion and its relation to depression. This empirical gap is critical given prior working showing that diminished levels of positive emotion and hypoactivation in brain regions that underlie positive emotion distinguish depression from other forms of psychopathology (Watson, Clark, & Carey, 1988), relate to a worse course of depression (Vrieze et al., 2013), and predict poor treatment response (Forbes et al., 2010; McMakin et al., 2012; Spijker et al., 2001). It is therefore particularly important to investigate whether problems with ER explain low levels of positive emotion as they relate to depressive symptoms.

Depression has been linked to difficulties in using ER strategies that actively serve to increase or maintain positive emotion (Feldman, Joormann, & Johnson, 2008; Werner-Seidler et al., 2013). One of the most commonly studied strategies aimed at increasing or maintaining positive emotion is positive rumination. Positive rumination is defined as a cyclical style of thought in which individuals perseverate on the nature of positive emotion and its consequences (Feldman et al., 2008; Gruber et al., 2009; Gruber et al., 2011). There are two forms of positive rumination – emotion-focused positive rumination and self-focused positive rumination. Whereas emotion-focused positive rumination centers on the experience of emotion (e.g., “Think about how happy you feel”), self-focused positive rumination centers on how the individual contributed to the causes (e.g., “I am getting everything done.”) and consequences (e.g., “I am living up to my potential.”) of positive emotion (Feldman et al., 2008). There is little evidence linking depression to positive rumination; however, one notable exception shows an inverse relation between depressive symptoms and the habitual use of positive rumination (Harding et al., 2014). Further, there is some evidence revealing that the infrequent use of self- and emotion-focused positive rumination are linked to elevated levels of depression-related anhedonia (e.g., Werner-Seidler et al., 2013). Not only does empirical work find that depression is related to difficulties in up-regulating positive emotion, but also, depression is linked to strategies that decrease positive emotion (e.g., Feldman et al., 2008).

One of the most commonly studied ER strategies aimed at reducing positive emotion is dampening. Dampening entails negative appraisals of the nature (e.g., “Remind yourself these feelings won’t last.”) and consequences of positive emotion (e.g., “Think, ‘I don’t deserve this.’”), and it serves to attenuate positive emotion (Feldman et al., 2008). Few studies examine the use of these strategies in depression. Some notable exceptions document that individuals with elevated, compared to low, levels of depressive symptoms exhibit different responses to positive emotion (Feldman et al., 2008; Werner-Seidler et al., 2013). For example, individuals with greater depressive symptoms report greater engagement in dampening following the elicitation of positive emotion (Raes et al., 2012; Werner-Seidler et al., 2013; Nelis et al., 2015). Increased use of dampening is also linked to elevated levels of depression-related anhedonia (Werner-Seidler et al., 2013).

While research has made advances in identifying positive ER difficulties in depression, one critical limitation is that prior research efforts almost exclusively utilize global, retrospective reports of ER strategy use, which measure more trait-like characteristics of implementing these strategies. To date, there is a dearth of research in ecologically valid settings that is aimed at gaining a better understanding of the dynamic features of positive ER related to depression by studying the regulation of positive emotion and positive emotion in real-time. Two notable exceptions have studied the relation between depression and positive ER processes in daily life. Using an Ecological Momentary Assessment (EMA) paradigm, Carl and colleagues (2014) examined people's ER goals (i.e., whether they wanted to increase or decrease positive emotion) and investigated the relation between one's goals and subsequent changes in emotion. They found that depressive symptoms were not associated with positive ER goals. However, people with elevated depressive symptoms exhibited greater declines in positive emotion after endorsing a down-regulatory goal. Although certainly related, ER goals and strategy use are thought to represent distinct constructs (Tamir, 2009). People tend to use strategies that are congruent with their goals (Tamir, 2016), but research has yet to show that goals predict the implementation of specific ER strategies. Importantly, though, prior work highlights that certain ER strategies are more problematic in depression than others (Aldao, Nolen-Hoeksema, & Schweizer, 2010). Thus, there is a need to examine the relation between depressive symptoms and specific positive ER strategies.

Only one study examined the relation between depressive symptoms and specific positive ER strategies in daily life (Li et al., 2017). The authors utilized a daily diary paradigm in which they assessed positive events, positive emotion, strategy use, and depressive symptoms once daily for 14 days. They investigated whether the association between positive events and depressive symptoms was moderated by the extent to which individuals engaged in dampening and positive rumination (Li et al., 2017). Positive events were associated with less depressive symptoms and with more positive emotion when participants endorsed relatively lower levels of dampening. Counter to the author's predictions, positive events were associated with less depressive symptoms and more positive emotion when participants endorsed relatively lower levels of positive rumination. Despite these exciting findings, the assessment paradigm included only one survey per day. Given the dynamic nature of emotion and ER, establishing relations between such constructs repeatedly over time is essential to more clearly demonstrate that problems with positive ER are associated with the low levels of positive emotion putatively associated with depression. Therefore, the current study used an EMA task that included six surveys per day for 14 days to examine the relation between strategy use and positive emotion over time and the degree to which depressive symptoms moderated this relation.

To our knowledge, the current study is the first to leverage the strengths of an EMA paradigm to advance the understanding of the relation between depressive symptoms, the use of positive ER strategies (i.e., dampening, emotion-focused positive rumination, self-focused positive rumination), and momentary positive emotion in people's daily lives. Adopting a dimensional approach to study these psychological processes along the continuum of depressive symptom severity, we sought to address two overarching aims.

The first aim was to examine the relation between ER strategy use and momentary positive emotion and to test the degree to which depressive symptoms moderated this relation. Consistent with cross-sectional findings on the relation between strategy use and emotion (Li et al., 2017), we predicted that engagement in both forms of positive rumination would be associated with greater levels of momentary positive emotion. In contrast, use of dampening was expected to be related to lower levels of positive emotion. To determine the role of depressive symptom severity, we explored whether depression severity potentiates or inhibits the relation between ER strategy (i.e., positive rumination, dampening) and momentary positive emotion. Given the exploratory nature of this question, specific predictions regarding the degree to which depression may enhance or hinder the emotional effects of a given ER strategy were not made.

The second aim was to investigate whether positive emotion predicted subsequent strategy use and to again test the moderating role of depressive symptoms. In line with prior work showing that adults typically seek to maintain or increase positive emotions (Riediger, Schmiedek, Wanger, & Lindenberger, 2009), it was hypothesized that positive emotion would be related to greater subsequent engagement in self- and emotion-focused positive rumination and less engagement in dampening. Investigating the role of depression severity, we tested whether depressive symptoms were related to the average use of positive ER strategies in daily life and whether symptom severity modulated the relation between positive emotion and subsequent ER strategy use. Based on findings from cross-sectional studies (Feldman et al., 2008; Werner-Seidler et al., 2013), we hypothesized that depressive symptoms would be linked to greater overall use of dampening and to less overall use of both self- and emotion-focused positive rumination. Further, we explored whether depressive symptom severity moderated the relation between positive emotion and subsequent strategy use. Although exploratory, the relation between positive emotion and subsequent dampening was predicted to be stronger among individuals with elevated depressive symptoms; higher levels of positive emotion were expected to be followed by greater engagement in dampening among individuals with relatively more depressive symptoms but not among individuals with less depressive symptoms. Conversely, the relation between positive emotion and subsequent emotion- and self-focused positive rumination was predicted to be weaker among individuals with greater depressive symptoms; here, greater positive emotion was expected to be associated with more engagement in emotion- and self-focused positive rumination among participants endorsing relatively fewer depressive symptoms but not among those reporting elevated symptoms.

Method

Participants

Participants were recruited using online advertisements and flyers within the New Haven community. To qualify for the current study, individuals had to be between the ages of 18 and 65, proficient in the English language, and possess a cellular device with internet capabilities. Exclusion criteria included self-reported history of a neurological disorder, learning disability, and colorblindness. Additional exclusion criteria included a history of hypomania or mania, a history of psychotic symptoms, and elevated risk for a substance use disorder as determined by scores on a self-report questionnaire. These psychological exclusion criteria were chosen given that prior research has documented unique disruptions in positive emotion associated with substance use (Berridge & Robinson, 2016), bipolar disorder (Johnson, Edge, Holmes, & Carver, 2012), and psychotic symptoms (Gard et al., 2007).

Of those deemed eligible for participation, 116 people initially enrolled in the study. However, eight people did not complete at least 25% of the EMA surveys and, consistent with prior research (cf. Gruber, Kogan, Mennin, & Murray, 2013), were not considered in the analyses. This resulted in a final sample of 108 individuals, which was consistent with prior EMA studies on ER (e.g., Pe et al., 2013). Of note, imposing higher compliance thresholds (e.g., 50%) did not alter the results reported in this article (see the sensitivity analyses reported below). The sample included 73 women and 35 men. Ages ranged from 18 to 64 years old (M = 32.19, SD = 10.99). Across participants, 48.1% identified as White or Caucasian, 24.1% identified as Black or African American, 10.2% identified as Asian or Asian American, 11.1% identified as Hispanic or

Latino, and 6.5% identified as "Other" or mixed race. Regarding educational attainment, 2.8% of participants did not complete high school, 20.4% earned a high school diploma, 27.8% completed some college or vocational training or earned an Associate's degree, 32.3% earned a Bachelor's degree, and 16.7% earned a master's, professional, or doctoral degree. Regarding depression, participants exhibited considerable variability in self-reported depressive symptoms (measurement of symptoms described in greater detail below). Indeed, scores on the Beck Depression Inventory-II (Beck et al., 1996) ranged from 0 to 41 (M = 9.82, SD = 8.65). Using established cutoff scores to determine depression severity (Beck et al., 1996), 71.6% of participants fell in the range indicating minimal depressive symptoms, 13.7% fell in the mild depression range, 10.8% fell in the moderate depression range, and 3.9% fell in the severe depression range. Further, 14 participants within the current sample met criteria for a current Major Depressive Disorder based on the Structured Clinical Interview for DSM-5 that was administered to screen participant eligibility (described in greater detail below). All study procedures were approved by the Institutional Review Board at Yale University, and all participants provided informed consent prior to participating in the current study. Participants were compensated $10 per hour for the laboratory session, which lasted approximately 1.5 hours, and they were paid $0.50 for each EMA survey they completed. Consistent with the recommendations of Conner and Lehman (2012) and similar to prior emotion research using EMA paradigms (e.g., Thompson et al., 2011; Wu et al., 2018), participants with high survey completion rates earned a bonus payment. In the current study, participants received an $8 bonus if they completed at least 80% of the EMA surveys.

Materials

Questionnaires used for assessing study eligibility.

A prescreening questionnaire was used to collect patient demographic information, including age, race, educational attainment, and self-reported history of a neurological disorder, learning disability, and colorblindness. Moreover, the Psychosis Screening Questionnaire (PSQ; Bebbington & Nayani, 1995) was used to assess for psychotic symptoms. The PSQ was scored using the algorithm described by Bebbington and Nayani (1995), and individuals who were deemed at risk for psychosis based on their responses were also deemed ineligible. Furthermore, the Alcohol Use Disorders Identification Test (AUDIT; Babor et al., 1992) and the Drug Use Disorders Identification Test (DUDIT; Berman et al., 2005) were used to screen for risk for Alcohol and Substance Use Disorders, respectively. Individuals who scored a 20 or higher on the AUDIT or a 25 or higher on the DUDIT were deemed ineligible for the current study given their increased risk for a Substance Use Disorder (Conigrave, Hall, & Saunders, 1995; Berman et al., 2005; Berman et al., 2008). The cut-off score for the AUDIT was higher than the traditional cut-off score of 8. A higher cut-off score was selected based on previous work documenting that such scores are associated with increased specificity for detecting significant alcohol problems (Conigrave et al., 1995). The PSQ, AUDIT, and DUDIT were administered as part of the pre-screening questionnaire battery.

Structured Clinical Interview for DSM-5 (SCID-5).

The mood module from the Structured Clinical Interview for DSM-5 (SCID; First et al., 2015) was used to assess for a history of mania or hypomania. Trained, doctoral-level, graduate students administered the SCID during the in-person laboratory session, and diagnostic inter-rater reliability was strong (K = .91). As noted, participants who met full diagnostic criteria for either a current or past episode of mania or hypomania were excluded. Two individuals were deemed ineligible for enrollment in the current study based on the SCID interview.

Beck Depression Inventory-II (BDI-II; Beck et al., 1996).

The BDI-II is a 21-item measure of depression symptom severity in the past two weeks. Items map on to the core features of Major Depressive Disorder (MDD) and are rated on a 4-point Likert scale ranging from 0-3. The BDI-II is one of the most commonly used measures of depression severity and it has strong psychometric properties (Beck et al., 1996). Internal consistency in the current study was excellent ($\alpha = .93$).

Ecological momentary assessment (EMA) measures.

Measures of ER strategy use and state emotion were included within the EMA paradigm. The current study was part of a larger EMA study. The research questions addressed within the present study were a prior. See Supplement 1 for a full list of EMA questionnaire items, including those that were not included within the present manuscript.

Emotion regulation. Items from the Responses to Positive Affect (RPA; Feldman et al., 2008) scale were used to assess dampening as well as self- and emotion-focused positive rumination. Prior research has documented that the RPA (Feldman et al., 2008) possesses good psychometric properties, including high internal consistency and test-retest reliability (Feldman et al., 2008; Raes et al., 2009; Dempsey, Gooding, & Jones, 2011; Olofsson, Boersma, Engh, & Wurm, 2014). To minimize participant burden at each EMA questionnaire, the three items with the highest loadings onto the dampening subscale of the RPA were used to index use of dampening since the prior EMA assessment. Specifically, participants responded to the items "How much were you thinking, 'My streak of luck is going to end soon'?", "How much were you thinking, 'I don't deserve to feel good'?", and "How much were you thinking about things that could go wrong?" *since the last survey* they completed. As for emotion-focused and self-focused positive rumination, the two items with the highest loadings onto each positive rumination subscale of the RPA were used to assess these ER behaviors since the last EMA assessment. Emotion-focused positive rumination was assessed by "How much were you thinking about or noticing how good you felt?" and "How much were you thinking about or noticing how strong you felt?". Self-focused positive rumination was measured by "How much were you thinking, 'I am achieving everything'?" and "How much were you thinking, 'I am living up to my potential'?". Within- and between-subject reliability coefficients were calculated following Bolger and Laurenceau (2013). For dampening, the within-subject reliability was .52, and the between-subject reliability was .69. For emotion-focused positive rumination, the within-subject reliability was .62, and the between-subject reliability was .80. For self-focused positive rumination, the within-subject reliability was .71, and the between-subject reliability was .88.

Participants were given the following instructions: "People think and do many different things when they feel or want to feel positive emotions (e.g., love, joy, hope, contentment). The next questions ask you about "how much you were doing certain things *since the last survey* you completed". A five-point scale, where 1 indicated "Not at all" and 5 indicated "Extremely", was used to quantify the extent to which participants engaged in each RPA item. Higher scores indicated greater use of the given ER strategy. A sum score was calculated for each of the ER strategies.

State emotion. Participants rated state levels of four discrete positive emotions (joy, love, hope, contentment) using a five-point scale, where 1 indicated "Not at all" and 5 indicated "Extremely". Specifically, they were asked to indicate the extent which they were experiencing each emotional state "*right now*". These emotions were chosen because they have been shown to comprise the most frequently experienced positive emotions among community participants (Trampe, Quoidbach, & Taquet, 2015), and prior research on the relation between emotion and clinical symptoms has assessed these positive emotional states given their high frequency (Gruber et al., 2013). Consistent with prior EMA research (Li et al., 2017), responses to the four emotion items were summed, yielding a total score of current positive emotion. Greater values reflected higher levels of positive emotion. The within-subject reliability was .79, and the between-subject reliability was .88.

Procedure

Participants were invited to complete a laboratory session if deemed eligible based on their responses to the prescreening questionnaire. During the initial laboratory session, participants received instructions regarding the EMA procedure. The delivery of the EMA paradigm was modeled after prior EMA research (Pe et al., 2013; Kuppens, Allen, & Sheeber, 2010). Consistent with other EMA studies (Kuppens et al., 2010; Li et al., 2017), participants were sent six EMA questionnaires per day for 14 days. EMA questionnaires were sent via SurveySignal (Hofmann & Patel, 2015) between the hours of 9 am and 9 pm. Questionnaires were pseudo-randomly distributed within six two-hour time segments over the 12-hour daily assessment window. There was a minimum of 45 minutes between any two questionnaires. EMA questionnaires were administered via Qualtrics (Qualtrics, Provo, UT). At the time of each assessment, Survey Signal sent a text message to participants instructing them that the next EMA questionnaire was ready, providing a link to the Qualtrics questionnaire. Item order was randomized at each survey. Participants had 45 minutes to complete the questionnaire before the link expired. On average, participants responded to 75.82% (*SD*=17.39) of the EMA surveys, demonstrating good compliance comparable to prior research (Gruber et al., 2013).

An experimenter reviewed an information booklet regarding the EMA paradigm with participants during the laboratory session. In addition to reviewing the above-mentioned structure of the EMA paradigm, the booklet provided definitions of the four discrete positive emotions and instructions on how to complete the dampening and positive rumination questionnaire items. Participants were also sent home with a copy of the booklet to refer to throughout the EMA phase of the study. Next, participants registered their cellular phone with Survey Signal, which culminated in a practice EMA questionnaire that participants completed on their cellular device. Then, they completed a separate cognitive task (i.e., an emotion-modified Implicit Associations Task; Markovitch, Netzer, & Tamir, 2017), which was included as part of a separate research study. Afterwards, participants completed a set of questionnaires, including a demographics questionnaire and the BDI-II, which marked the end of the laboratory session. Participants were then compensated for their participation in the initial laboratory session and sent home. The EMA paradigm began the day after the laboratory session and lasted for the following 14 days. Participants received an e-mail from the principal investigator after the third day of the EMA paradigm providing them with an update regarding their completion rate across the first three days of the paradigm and assessing whether they had any questions or were experiencing any technical difficulties related to Survey Signal or Qualtrics. After completion of the EMA paradigm, participants were invited back to the laboratory to receive their compensation pertaining to the EMA paradigm. Finally, participants were debriefed regarding the overall study aims.

Data Analysis

Multilevel modeling was used to address the study aims. This technique accounts for the nested structure of the data: Measurement occasions (*t*: 1-84 EMA surveys) nested within persons (*j*: 1-108 participants). The statistical analyses were performed using R version 3.6.3 (R Core Team, 2018) and the *nlme* package (Bates, Mächler, Bolker, & Walker, 2015).

To address the first aim of this study, we constructed a series of multilevel models (separately for each ER strategy) examining whether Emotion Regulation Strategy Use was associated with concurrent momentary positive emotion. At Level-1, we constructed a model in which Emotion Regulation Strategy Use at occasion *t* (i.e., self-focused positive rumination, emotion-focused positive rumination, or dampening, which were assessed "*since the last survey*") was associated with momentary Positive Emotion at occasion *t*.[1] The Level-1 predictors were person-mean centered.[2] At Level-2, we modeled the random intercepts and slopes (of ER strategy use) as a function of individual differences in Depression Severity. Depression Severity was grand-mean centered. The Level-1 and Level-2 models were as follows:

$$Positive\ Emotion_{\mathrm{tj}} = \pi_{0\mathrm{j}} + \pi_{1\mathrm{j}}\ (ER\ Strategy\ \mathrm{Use}_{\mathrm{tj}}) + \mathrm{e}_{\mathrm{tj}}$$

$$\pi_{0\mathrm{j}} = \beta_{00} + \beta_{01}\ (Depression\ Severity_j) + \mathrm{r}_{0\mathrm{j}}$$

$$\pi_{1\mathrm{j}} = \beta_{20} + \beta_{21}\ (Depression\ Severity_j) + \mathrm{r}_{2\mathrm{j}}$$

To address the second aim of this study, we constructed a series of multilevel models examining whether momentary positive emotion is related to subsequent use of an ER strategies (i.e., self-focused positive rumination, emotion-focused positive rumination, or dampening). At Level-1, we modeled how Positive Emotion at occasion *t-1* is related to Emotion Regulation Strategy Use reported at occasion *t*. Note that the outcome was assessed since the last measurement occasion, reflecting the use of a strategy between measurement occasions *t-1* and *t*. The Level-1 predictor was person-mean centered. At Level-2, we allowed the parameters $\pi_{0\mathrm{j}}$ and $\pi_{1\mathrm{j}}$ to vary across persons and examined whether the Level-1 intercept and slope vary as a function of individual differences in depression severity. The Level-2 predictor, Depression Severity, was grand-mean centered. The Level-1 and Level-2 models were as follows:

$$ER\ Strategy\ \mathrm{Use}_{\mathrm{tj}} = \pi_{0\mathrm{j}} + \pi_{1\mathrm{j}}\left(Positive\ Emotion_{t-1,j}\right) + \mathrm{e}_{\mathrm{tj}}$$

$$\pi_{0\mathrm{j}} = \beta_{00} + \beta_{01}\ (Depression\ Severity_j) + \mathrm{r}_{0\mathrm{j}}$$

$$\pi_{1\mathrm{j}} = \beta_{10} + \beta_{11}\ (Depression\ Severity_j) + \mathrm{r}_{1\mathrm{j}}$$

Sensitivity analyses were conducted to determine the robustness of the results. The results of the sensitivity analyses demonstrated that the time between two consecutive measurement occasions, the compliance threshold, individual differences in anxiety levels, and gender differences did not alter the pattern of findings reported below. The output of these analyses is provided in Supplement 3.

Results

Preliminary analyses

Means, *SD*s, and intraclass correlation coefficients (ICCs) were estimated for positive emotion, self-focused positive rumination, emotion-focused positive rumination, and dampening using intercept-only models. For *positive emotion*, the mean level was 2.84 (95% CI:[2.69, 2.98]), with *SD*s of 0.61 and 0.74 at the within- and between-subject levels, respectively. The ICC for positive emotion was .59, indicating that 59% of the total variability in positive emotion was between persons and 41% was within-subject variance. For *self-focused positive rumination*, the mean level was 2.17 (95% CI:[2.00, 2.35]), with *SD*s of 0.64 and 0.91 at the within- and between-subject level, respectively. The ICC was .67. Thus, 67% of the total variance was between persons and 33% was within persons. For *emotion-focused positive rumination*, the mean level was 2.19 (95% CI:[2.04, 2.35]), with *SD*s of 0.67 and 0.82 at the within- and between-subject levels, respectively. The ICC was .60, suggesting that 60% of the total variance in emotion-focused positive rumination was between persons and 40% was within persons. For *dampening*, the mean was 1.45 (95% CI:[1.37, 1.54]), with standard deviations of 0.43 and 0.45 at the within- and between-subject levels, respectively. The ICC for dampening was .51, indicating that 51% of the variability was between persons and 49% was within persons.

Furthermore, the pattern of within- and between-subject correlations between the ER strategies was inspected. The within-subject average correlations (i.e., within-subject relations between the variables across the EMA period) indicate that self-focused positive rumination was moderately correlated to emotion-focused positive rumination (r = .56, 95% CI:[.55, .58]) but not related to dampening (r = .08, 95% CI:[.06, .11]). Dampening was not related to emotion-focused positive rumination (r = .06, 95% CI:[.04, .09]). The pattern of between-subject correlations (i.e., correlations the mean-levels of the variables across all measurement occasions) was similar. A strong correlation emerged between self-focused and emotion-focused positive rumination (r = .89, 95% CI:[.85, .93]). Dampening was not related to self-focused (r = .14, 95% CI:[-0.05, .32]) or emotion-focused (r = .19, 95% CI:[.00, .37]) positive rumination.

Research aim 1

Table 1 presents the results of the tested multilevel models to address the first study aim. With respect to *self-focused positive rumination*, a significant positive relationship was found between self-focused positive rumination and positive emotion at occasion *t* (β_{20}=0.305, *p*<.001). This suggests that the use of self-focused positive rumination is associated with concurrent positive emotion in daily life. However, there was no significant association between depression severity and the positive emotion – self-focused positive rumination slope (β_{21}=0.001, *p*=.723). This indicates that depressive symptoms do not moderate the relation between self-focused positive rumination use and momentary positive emotion.

The analyses on *emotion-focused positive rumination* revealed a significant positive relation between the use of this ER strategy and positive emotion at occasion *t* (β_{20}=0.350, *p*<.001). This indicates that emotion-focused positive rumination use is associated with concurrent positive emotion in daily life. Again, depression severity did not moderate the relation between the use emotion-focused positive rumination and positive emotion (β_{21}=0.001, *p*=.833).

Finally, *dampening* was significantly related to positive emotion at occasion *t* (β_{20}=-0.300, *p*<.001). Higher levels of dampening use were associated with lower levels of momentary positive emotion. As in the previous analyses, depression severity did not moderate the relation between dampening use and positive emotion (β_{21}=0.002, *p*=.625).

Research aim 2

Table 2 presents the results from the multilevel analyses addressing the second study aim. With respect to *self-focused positive rumination,* a significant positive relationship (β_{10}=0.169, *p*<.001) was found between positive emotion at occasion *t-1* and the use of this ER strategy between occasion *t-1* to *t*. On average, higher levels of positive emotion were associated with greater subsequent use of self-focused positive rumination. Furthermore, depression severity was related to a person's average level of self-focused positive rumination (β_{01}=-0.027, *p*=.008). Higher levels of depression severity were related to lower use of self-focused positive rumination. Finally, depression severity did not modulate the positive emotion (at occasion t-1) – self-focused positive rumination slope (β_{11}=0.001, p=.818). This indicates that depression severity did not moderate the relation between a person's reported positive emotion at occasion t-1 and use of self-focused positive rumination between occasion *t-1* and *t*.

The analyses on *emotion-focused positive rumination* revealed a significant relation between the use of this ER strategy between occasion *t-1* to *t* and positive emotion at occasion *t-1* (β_{10}=0.211, *p*<.001). Higher levels of positive emotion were associated with subsequent use of emotion-focused positive rumination. In addition, there was a trending relationship between depression severity and a person's average level of positive emotion (β_{01}=-0.017, *p*=.062), suggesting that higher levels of depressive symptoms may be related to lower average levels of emotion-focused positive rumination. Finally, depression severity did not moderate the relation between positive emotion and emotion-focused positive rumination (β_{11}=0.001, *p*=.730).

Finally, with respect to the use of *dampening*, positive emotion at occasion *t-1* was associated with the use of dampening between occasion *t* to *t+1* (β_{10}=-0.045, *p*=.002). On average, higher levels of positive emotion were related to greater subsequent use of dampening. Furthermore, there was a significant relationship between depression severity and the average use of dampening (β_{01}=0.017, *p*<.001). Higher levels of depressive symptom severity were related to greater use of dampening in daily life. Finally, there was no significant association between depression severity and the dampening – positive emotion slopes (β_{11}=-0.001, *p*=.774). This indicates that individual differences in depressive symptoms did not moderate the relation between positive emotion at *t-1* and the use of dampening between *t-1* and *t*.

Discussion

The current study used an EMA design to investigate the dynamic relation between positive ER strategies and positive emotion as well as how depressive symptom severity moderates this relation in daily life. The main findings were: (a) greater use of self- and emotion-focused positive rumination was associated with greater levels of momentary positive emotion, whereas greater use of dampening was linked to lower levels of momentary positive emotion; (b) positive emotion was associated with greater subsequent use of self- and emotion-focused positive rumination and less use of dampening; and (c) depressive symptom severity was related to less use of self-focused positive rumination and greater use of dampening, but did not moderate the relation between ER strategy use and momentary positive emotion or the relation between positive emotion and subsequent ER. Together, these results suggest that individuals with greater depressive symptom severity engaged in a profile of ER strategy use that was linked to lower levels of positive emotion. These results are discussed in turn.

Extending prior research based on global retrospective questionnaires, this study showed that depressive symptom severity was linked to greater average use of dampening and lower average use of self-focused positive rumination in daily life. Previous work on trait strategy use shows that participants with elevated depressive symptoms report greater use of dampening (Feldman et al., 2008; Werner-Seidler et al., 2013; Nelis et al., 2015), and there is some work revealing that depression is related to the infrequent use of positive rumination (e.g., Harding et al., 2014). However, the overwhelming majority of this work relies on laboratory-based studies that use global, retrospective measures of strategy use. Here, though, we document that similar patterns are observed in real-world settings. Further, the utilization of a 14-day EMA framework decreases the likelihood that the observed pattern of ER strategy use is confounded by reporting biases that commonly characterize global, retrospective reports (Tversky & Kahneman, 1973; Shiffman, Stone, & Hufford, 2008). The finding that depression was inversely associated with self-focused rumination but not emotion-focused positive rumination is consistent with prior research that separates the two subtypes of positive rumination. Indeed, in the development of the RPA, the authors found that depressive symptoms were associated with dampening and self-focused positive rumination but not emotion-focused positive rumination (Feldman et al., 2008).

Interestingly, the results suggest that the relation between positive emotion and subsequent ER strategy use did not vary as a function of depressive symptoms. One could expect differential ER responses to positive emotion depending on depression levels. We hypothesized that higher levels of positive emotion would be associated with greater subsequent dampening among individuals with relatively elevated levels of depressive symptoms but not among individuals with low levels of depressive symptoms. Instead, the results indicate the depressive symptom levels did not account for variation in how individuals respond to positive emotion with ER. The present data show that individuals with elevated depressive symptoms report greater overall use of dampening and less use of self-focused positive rumination regardless of the level of prior positive emotion. Stated another way, individuals with greater depressive symptoms were more likely to engage in dampening and less likely to engage in self-focused positive rumination than individuals with less depressive symptoms following low, medium, and high levels of positive emotion. Thus, depression-related ER differences do not depend on the extent to which one is experiencing positive emotion, but rather, individuals with greater levels of depression are more likely to engage in maladaptive strategy use in response to any level of positive emotion.

Moreover, results from the study compliment and extend prior research on the relation between strategy use and positive emotion. As anticipated, greater use of dampening was associated with lower levels of momentary positive emotion. This finding is consistent with previous work showing that a dampening induction results in decreases in positive emotion (Burr et al., 2017) as well as a study showing that trait dampening was associated with lower levels of positive emotion in daily life (Li et al., 2017). Prior research on the relation between positive rumination and positive emotion is mixed. Positive rumination inductions do not yield increases in positive emotion above and beyond that generated by authors' control condition (i.e., a 15-minute walk); however, Li and colleagues (2017) found that trait positive rumination was associated with greater levels of positive emotion in daily life. Within the current study, greater engagement in both forms of positive rumination are associated with higher levels of momentary positive emotion. In fact, a notable strength of the current study is the comprehensive assessment of depression, strategy use, and positive emotion within the same sample and the implementation of multilevel models to examine dynamic relations between strategy use and positive emotion. Most studies on the link between depressive symptoms and ER strategy use do not also assess the relation between strategy use and positive emotion (e.g., Feldman et al., 2008; Beblo et al., 2012; Werner-Seidler et al., 2013; Nelis et al., 2015). Across two sets of models, we show that depression is associated with maladaptive strategy use (i.e., increased use of dampening and decreased use of self- and emotion-focused positive rumination) and that such strategy use is related to lower levels of momentary positive emotion. The integration of these findings provides support for the notion that depression-related differences in positive ER strategy use contribute to low levels of positive emotion putatively associated with depression.

Within the current sample, depression did not moderate the relation between positive ER strategy use and momentary positive emotion. This finding suggests that dampening and both forms of positive rumination relate to positive emotion similarly across all levels of depressive symptoms. Therefore, depression-related problems with positive ER may be specifically characterized by difficulties with habitual strategy use and not by deficits in the ability to effectively utilize these strategies. That is, individuals with elevated depressive symptoms may be as able to use self- and emotion-focused positive rumination to increase positive emotion; however, they use these strategies infrequently, and, instead, they habitually engage in dampening responses to positive emotion. This pattern of results is consistent with difficulties in the regulation of negative emotion as they relate to depression. Indeed, in a recent review paper, Liu and Thompson (2017) highlight that depression is more robustly associated with difficulties regarding the habitual use of ER strategies than with problems implementing a given strategy to down-regulate negative emotion.

The current study is not without limitations. First, the measurement of habitual ER relied on self-report measures of strategy use. Although the utilization of an EMA paradigm addresses many of the limitations of global, retrospective reports, the EMA model is still subject to limitations of self-report methods in general. In particular, it is important to note that self-reports of dampening and positive rumination require insight into one's cognitive responses to emotion, and there is evidence showing that people's estimates of their habitual use of cognitive ERs strategies is not always associated spontaneous strategy use (e.g., Egloff et al., 2006). Thus, an important direction for future work is the development and refinement of tools for assessing habitual ER, such as spontaneous ER sampling (Ehring et al., 2010). Second, the EMA questionnaire did not assess the events of one's day, which may have important ramifications for emotional functioning. Daily life events were not assessed in the current study to limit the length of EMA questionnaires in the service of preventing participant burnout. Nevertheless, future work integrating reports of daily events, ER strategy use, and positive emotion would allow for researchers to examine the complex interactions between these constructs as they relate to depression. Third, the current study focused on depressive symptoms even though anhedonia has been shown to cut across multiple forms of psychopathology (Corral-Frías et al., 2015; Husain & Roiser, 2018). The focus on depression was driven by the central role that anhedonia plays within the disorder, comprising one of its two hallmark symptoms. That said, greater understanding of the relation between ER and positive emotion across psychological difficulties holds promise for refining unified treatments for emotional difficulty in general. Finally, it is important to note that the within-subjects reliability coefficients of the RPA subscales were lower compared to the between-subjects reliability coefficients, and this was especially the case with regard to the dampening subscale. Although the three dampening items all entail negative cognitions in response to positive emotion, such cognitions may stem from related but distinct underlying processes such as worry (thinking about things that could go wrong), pessimism (thinking, "my streak of luck is going to end soon"), and negative self-esteem (thinking, "I don't deserve to feel good"). Greater variability in these underlying processes may explain the relatively low within-subjects reliability.[3] To between understand the psychometric properties of this subscale and to elucidate differences between within- and between-subject coefficients, we recommend that prior research assessing strategy use over time to publish these statistics.

Better understanding of ER difficulties as they relate to depression has important implications for its treatment. The current gold standard psychotherapy for depression is individual cognitive behavioral therapy (CBT), with an emphasis on behavioral activation (Cuijpers, van Straten, & Warmerdam, 2007). Behavioral activation focuses on increasing one's engagement in activities that elicit positive emotion. However, the current data imply that it is also important to directly address how individuals respond to positive emotion once it has been evoked. In fact, recent research shows that engagement in dampening and positive rumination has important implications for emotional responding to positive activity scheduling, a core premise of behavioral activation. Indeed, Burr and colleagues (2017) find that greater engagement in dampening during scheduled positive events is associated with higher levels of negative emotion and lower levels of positive emotion. Similar findings are seen in studies on the moderating role that dampening and positive rumination play in the relation between positive events and depressive symptoms over time. For example, Li, Starr, and Hershenberg (2017) report that greater dampening mitigates the lessening of depressive symptoms following positive events among individuals with elevated depressive symptoms. Thus, the current results, in conjunction with recent research, highlight the risk for ER difficulties undermining existing aspects of gold-standard treatments for depression. As such, these findings suggest that treatments would benefit from directly targeting difficulties with the regulation of positive emotion.

Finally, the present findings reveal important directions for future research. The current study shows that dysfunction in the habitual use of positive ER strategies contributes to low levels of positive emotion. It remains unclear, however, as to *why* individuals with elevated depressive symptoms use certain strategies over others. Thus, a vital next step is to identify factors that guide the habitual use of positive ER strategies. Instrumental models of ER (Tamir, 2009; Tamir, 2016) highlight one important factor (i.e., emotion preferences) that may guide strategy use. These models posit that people use strategies that are congruent with their emotion preferences (i.e., desired emotion states). Importantly, instrumental models account for the notion that people may not always strive to increase positive emotion and, instead, may down-regulate positive emotion if it is not preferred. As such, these models may provide a promising structure for future research aimed at investigating the relation between emotion preferences and habitual strategy use as they relate to depression given that depressive symptoms are associated with a propensity to down-regulate positive emotion. Identifying factors associated with maladaptive strategy use would highlight additional targets for treatments aimed at improving the regulation of positive emotion.

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Footnotes

[1] Additional models that included the autoregressive term of positive emotion were tested to investigate how emotion regulation strategy use is associated with changes in positive emotion from *t-1* to *t*. The results of these analyses and a caveat to its interpretation are presented in Supplement 2.

[2] As suggested during the review process, we also specified multilevel models that included between-subjects terms for all level-1 variables as predictors of the random intercepts and slopes. However, no convergence was obtained for the new models. Simplified models (without random slopes) suggested no substantial changes in the parameter estimates of the within-subject parameters. Because simplified models with fixed slopes are less likely to reflect the complexity of relations between positive emotion and emotion regulation strategy use, and do not allow us to test all our hypotheses regarding depression severity, we decided to report the results from models that included level-1 variables that were person-centered and level-2 variables that were between-person centered. These models are similar to various other studies in this field of research and increase comparability of the results across studies (Pe et al., 2013; Haines et al., 2016; Kircanski et al., 2018).

[3] Supplement 4 details results of the analyses examine potential differential relations between the dampening items and momentary positive affect. All three dampening items were related to concurrent positive emotions and positive emotions predicted subsequent dampening behaviors (in particular item 1 and item 2).

Table 1. The estimated parameters from the models examining research question 1.

Model	Fixed effects					Random effects			
	Effect	Estimate.	*SE*	*t*	*p*	Effect	Estimate	CI_{95}(*SD*) lower	upper
1	Intercept (β_{00})	2.813	0.066	42.547	<.001	Intercept	0.681	0.600	0.779
	Self-focused positive rumination at t (β_{20})	0.305	0.027	11.119	<.001	Self-focused positive rumination at t	0.240	0.200	0.288
	Depression Severity (β_{01})	-0.035	0.008	-4.593	<.001	Correlation Intercept - Self-focused positive rumination at t	-0.073	-0.268	0.130
	Depression Severity * Self-focused positive rumination (β_{21})	0.002	0.003	0.607	.544	Residual	0.558	0.549	0.568
2	Intercept (β_{00})	2.813	0.066	42.557	<.001	Intercept	0.681	0.595	0.780
	Emotion-focused positive rumination at t (β_{20})	0.350	0.027	13.102	<.001	Emotion -focused positive rumination at t	0.236	0.198	0.282
	Depression Severity (β_{01})	-0.035	0.008	-4.595	<.001	Correlation Intercept - Emotion-focused positive rumination at t	-0.099	-0.360	0.176
	Depression Severity * Emotion-focused positive rumination (β_{21})	0.001	0.003	0.0211	.833	Residual	0.541	0.532	0.549
3	Intercept (β_{00})	2.813	0.066	42.561	<.001	Intercept	0.681	0.594	0.780
	Dampening at t (β_{20})	-0.300	0.045	-6.677	<.001	Dampening at t	0.384	0.319	0.462
	Depression Severity (β_{01})	-0.035	0.008	-4.496	<.001	Correlation Intercept - Dampening at t	-0.180	-0.412	0.074
	Depression Severity * Dampening (β_{21})	0.002	0.005	0.337	.736	Residual	0.580	0.570	0.590

Note. Positive Affect at time t is the outcome variable for each of these model

Table 2. The estimated parameters from the models examining research question 2.

Outcome	Fixed effects					Random effects			
	Effect	Estimate.	*SE*	*t*	*p*	Effect	Estimate	$CI_{95}(SD)$ lower	$CI_{95}(SD)$ upper
Self-focused positive rumination	Intercept (β_{00})	2.145	0.086	24.980	<.001	Intercept	0.885	0.775	1.012
	Positive Affect at t-1 (β_{10})	0.169	0.019	8.783	<.001	Positive Affect at t-1	0.125	0.089	0.176
	Depression Severity (β_{01})	-0.027	0.010	-2.708	.008	Correlation Intercept - Positive Affect at t-1	0.581	0.274	0.780
	Depression Severity * Positive Affect at t-1 (β_{11})	0.001	0.002	0.230	.818	Residual	0.619	0.607	0.630
Emotion-focused positive rumination	Intercept (β_{00})	2.166	0.078	27.619	<.001	Intercept	0.807	0.706	0.923
	Positive Affect at t-1 (β_{10})	0.211	0.024	8.727	<.001	Positive Affect at t-1	0.182	0.142	0.233
	Depression Severity (β_{01})	-0.017	0.009	-1.885	.062	Correlation Intercept - Positive Affect at t-1	0.233	-0.048	0.480
	Depression Severity * Positive Affect at t-1 (β_{11})	0.001	0.003	0.346	.730	Residual	0.635	0.624	0.647
Dampening	Intercept (β_{00})	1.458	0.041	35.899	<.001	Intercept	0.417	0.363	0.478
	Positive Affect at t-1 (β_{10})	-0.045	0.016	-3.072	.002	Positive Affect at t-1	0.123	0.099	0.153
	Depression Severity (β_{01})	0.017	0.005	3.732	<.001	Correlation Intercept - Positive Affect at t-1	0.053	-0.095	0.199
	Depression Severity * Positive Affect at t-1 (β_{11})	-0.001	0.002	-0.287	.774	Residual	0.419	0.412	0.427

Supplement 1: EMA questionnaire items

The EMA questionnaire included a total of 29 items. The first eight items assessed state positive and negative emotion, the second eight items assessed emotion regulation goals, and the final 13 items assessed engagement in emotion regulation strategies.

State Emotion. Individuals rated state levels of four discrete positive emotions (joy, love, hope, contentment) and four discrete negative emotions (sad, irritated, guilty, anxious) using a slider scale with two anchors ("not at all" and "extremely"). They were instructed to rate the degree to which they were experiencing each emotional state "right now". These emotions were chosen because they have been shown to comprise the most frequently experienced positive and negative emotions among community participants (Trampe, Quoidbach, & Taquet, 2015), and prior research on the relation between emotion and clinical symptoms has assessed these emotional states given their high frequency (Gruber et al., 2013).

Emotion Regulation Goals. Participants also rated their regulation goals for each emotional state. Specifically, they were asked to indicate what they wanted to do with each emotional state among four options: decrease it (i.e., feel less of the emotion), maintain it (i.e., continue feeling the same amount of the emotion), or increase it (i.e., feel more of the emotion). The fourth option indicated that they did not want to change the emotion. Participants were told to select this option if they did not want to actively modulate a given emotion. Participants rated their preference for each of the positive (joy, love, hope, contentment) and negative (sad, irritated, guilty, anxious) emotion states.

Emotion Regulation. The final part of the EMA questionnaire battery was the assessment of engagement in emotion regulation strategies. The study assessed three positive emotion regulation strategies (dampening, self-focused positive rumination, and emotion-focused positive rumination). It also assessed two negative emotion regulation strategies.

Negative rumination was selected to examine the engagement in a cognitive strategy known to increase negative emotion (Nolen-Hoeksema et al., 2008), and reappraisal was selected to examine the use of a cognitive strategy that serves to decrease negative emotion (Gross & John, 2003).

The Responses to Positive Emotion (RPA; Feldman et al., 2008) scale was used to assess dampening and self- and emotion-focused positive rumination. To minimize participant burden at each EMA questionnaire, the three items with the highest loadings onto the dampening subscale of the RPA were used to index use of dampening since the prior EMA assessment. These items included: 1) "How much were you thinking, 'My streak of luck is going to end soon'?", 2), "How much were you thinking, 'I don't deserve to feel good'?" and 3) "How much were you thinking about things that could go wrong?". The two items with the highest loadings onto each positive rumination subscale were collected to assess emotion-focused and self-focused positive rumination, respectively. For self-focused positive rumination, the items included 1) "How much were you thinking, 'I am achieving everything'?" and 2) "How much were you thinking, 'I am living up to my potential'?". For emotion-focused positive rumination, the items included 1) "How much were you thinking about or noticing how good you felt?" and 2) "How much were you thinking about or noticing how strong you felt?".

The Ruminative Responses Scale (RRS; Treynor, Gonzalez, & Nolen-Hoeksema, 2003) was used to assess negative rumination. Similar to the RPA subscales, the three items with the highest loadings onto the RRS were used to minimize participant burden. These items included: 1) "How much were you thinking, 'What am I doing to deserve feeling bad'?", 2) "How much were you thinking about how negative you felt?", and 3) "How much were you thinking about all your shortcomings, failings, faults, mistakes?". The reappraisal subscale from the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) was used to assess reappraisal. Again, the three items with the highest loading onto the reappraisal subscale were used. These items included: 1) “How much were you thinking about how you’re becoming a strong person as a result of how you’re feeling?”, 2) “How much were you looking for the positive aspects of how you’re feeling?”, and 3) “How much were you thinking about what you can learn from how you’re feeling?”.

Participants were asked to rate the extent to which they engaged in each RPA/RRS/ERQ item since the prior EMA assessment. Engagement in each strategy was measured using a five-point scale, where 1 indicated “Not at all” and 5 indicated “Extremely”. Higher scores indicated greater use of the given emotion regulation strategy.

Supplement 2: Additional models for research question 1

The models testing Research Question 1 below include the autoregressive path of positive emotion to investigate how emotion regulation strategy use is associated with changes in positive emotion from *t-1* to *t*. Though commonly-used in research using Ecological Momentary Assessment methods, including a lagged value of the dependent variable as a predictor may introduce severe bias. As pointed out by Allison (see https://statisticalhorizons.com/lagged-dependent-variables), this practice may violate the assumption that u_i is statistically independent of $y_{i(t-1)}$ and result in biased parameter estimates (with too large coefficients of the lagged dependent variable and too small coefficients for other variables). Therefore, the results in the Table S1 should be interpreted with caution. With that in mind, the results reveal that greater engagement in emotion- and self-focused positive rumination is associated with increases in positive emotion and that greater use of dampening is associated with decreases in positive emotion.

Table S1.

Model	Fixed effects					Random effects			
	Effect	Estimate.	*SE*	*t*	*p*	Effect	Estimate	CI_{95}(*SD*) lower	upper
1	Intercept (β_{00})	2.812	0.067	42.282	<.001	Intercept	0.685	0.597	0.786
	Positive Affect at t-1 (β_{10})	0.289	0.011	25.201	<.001	Self-focused positive rumination at t	0.208	0.171	0.251
	Self-focused positive rumination at t (β_{20})	0.269	0.025	10.717	<.001	Correlation Intercept - Self-focused positive rumination at t	-0.080	-0.523	0.399
	Depression Severity (β_{01})	-0.036	0.008	-4.696	<.001	Residual	0.526	0.517	0.536
	Depression Severity * Self-focused positive rumination (β_{21})	0.001	0.003	0.355	.723				
2	Intercept (β_{00})	2.815	0.067	42.315	<.001	Intercept	0.685	0.599	0.784
	Positive Affect at t-1 (β_{10})	0.264	0.011	23.266	<.001	Emotion -focused positive rumination at t	0.191	0.157	0.232
	Emotion-focused positive rumination at t (β_{20})	0.301	0.023	13.140	<.001	Correlation Intercept - Emotion-focused positive rumination at t	-0.048	-0.255	0.163
	Depression Severity (β_{01})	-0.036	0.008	-4.654	<.001	Residual	0.516	0.507	0.526
	Depression Severity * Emotion-focused positive rumination (β_{21})	-0.000	0.003	-0.047	.963				
3	Intercept (β_{00})	2.808	0.067	42.106	<.001	Intercept	0.686	0.600	0.785
	Positive Affect at t-1 (β_{10})	0.310	0.012	26.166	<.001	Dampening at t	0.303	0.248	0.369
	Dampening at t (β_{20})	-0.275	0.038	-7.213	<.001	Correlation Intercept - Dampening at t	-0.155	-0.394	0.104
	Depression Severity (β_{01})	-0.036	0.008	-4.689	<.001	Residual	0.545	0.535	0.555
	Depression Severity * Dampening (β_{21})	0.002	0.004	0.489	.625				

Supplement 3: Sensitivity analyses

1. Modeling the time between two consecutive measurement occasions

A. Research Question 1

```
> PosrumSF.PA <- lme(fixed=Data.PosAff ~ 1 + Data.PosRumSFpm + Data.bdi_baselinegm + D
ata.bdi_baselinegm*Data.PosRumSFpm + Data.MinutesSinceSignalpm,
+                   random= ~ 1 + Data.PosRumSFpm | Data.ID,
+                   data=Data2,
+                   method="ML",
+                   na.action=na.exclude)
> summary(PosrumSF.PA)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
      AIC      BIC   logLik
  11753.84 11815.03 -5867.92

Random effects:
 Formula: ~1 + Data.PosRumSFpm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                StdDev    Corr
(Intercept)     0.6739613 (Intr)
Data.PosRumSFpm 0.2349755 -0.031
Residual        0.5595109

Fixed effects: Data.PosAff ~ 1 + Data.PosRumSFpm + Data.bdi_baselinegm + Data.bdi_base
linegm *      Data.PosRumSFpm + Data.MinutesSinceSignalpm
                                        Value  Std.Error   DF  t-value p-value
(Intercept)                         2.8268389 0.06588457 6515 42.90593  0.0000
Data.PosRumSFpm                     0.3042653 0.02757042 6515 11.03593  0.0000
Data.bdi_baselinegm                -0.0352761 0.00758772  105 -4.64910  0.0000
Data.MinutesSinceSignalpm          -0.0000390 0.00002219 6515 -1.75934  0.0786
Data.PosRumSFpm:Data.bdi_baselinegm  0.0024406 0.00324713 6515  0.75163  0.4523
 Correlation:
                                    (Intr) Dt.PRSF Dt.bd_ Dt.MSS
Data.PosRumSFpm                     -0.026
Data.bdi_baselinegm                  0.077 -0.003
Data.MinutesSinceSignalpm            0.000 -0.010   0.000
Data.PosRumSFpm:Data.bdi_baselinegm -0.003  0.113  -0.027 -0.004

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max
-5.51034016 -0.54279860 -0.01504497  0.52642186  5.90654849

Number of Observations: 6625
Number of Groups: 107

> intervals(PosrumSF.PA, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                           lower          est.         upper
(Intercept)                          2.697732e+00  2.826839e+00  2.955946e+00
Data.PosRumSFpm                      2.502386e-01  3.042653e-01  3.582920e-01
Data.bdi_baselinegm                 -5.031547e-02 -3.527610e-02 -2.023673e-02
Data.MinutesSinceSignalpm           -8.251547e-05 -3.903617e-05  4.443139e-06
Data.PosRumSFpm:Data.bdi_baselinegm -3.922398e-03  2.440644e-03  8.803687e-03
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                    lower        est.     upper
sd((Intercept))                 0.5882703  0.67396126 0.7721345
sd(Data.PosRumSFpm)             0.1957965  0.23497546 0.2819941
cor((Intercept),Data.PosRumSFpm) -0.1684421 -0.03141719 0.1067989

 Within-group standard error:
```

```
    lower      est.     upper 
0.5499201 0.5595109 0.5692689 


> PosrumEF.PA <- lme(fixed=Data.PosAff ~ 1 + Data.PosRumEFpm + Data.bdi_baselinegm + D
ata.bdi_baselinegm*Data.PosRumEFpm + Data.MinutesSinceSignalpm,
+                     random= ~ 1 + Data.PosRumEFpm | Data.ID,
+                     data=Data2,
+                     method="ML",
+                     na.action=na.exclude)
> summary(PosrumEF.PA)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2 
       AIC      BIC    logLik
  11343.37 11404.55 -5662.684

Random effects:
 Formula: ~1 + Data.PosRumEFpm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                StdDev    Corr  
(Intercept)     0.6748381 (Intr)
Data.PosRumEFpm 0.2294354 -0.044
Residual        0.5420584       

Fixed effects: Data.PosAff ~ 1 + Data.PosRumEFpm + Data.bdi_baselinegm + Data.bdi_base
linegm *      Data.PosRumEFpm + Data.MinutesSinceSignalpm 
                                        Value  Std.Error   DF  t-value p-value
(Intercept)                         2.8266732 0.06593907 6509 42.86795  0.0000
Data.PosRumEFpm                     0.3386059 0.02616829 6509 12.93955  0.0000
Data.bdi_baselinegm                -0.0351960 0.00759131  105 -4.63636  0.0000
Data.MinutesSinceSignalpm          -0.0000585 0.00002163 6509 -2.70670  0.0068
Data.PosRumEFpm:Data.bdi_baselinegm  0.0005380 0.00304276 6509  0.17682  0.8597
 Correlation: 
                                    (Intr) Dt.PREF Dt.bd_ Dt.MSS
Data.PosRumEFpm                     -0.037                      
Data.bdi_baselinegm                  0.076 -0.003               
Data.MinutesSinceSignalpm            0.000 -0.032   0.000       
Data.PosRumEFpm:Data.bdi_baselinegm -0.003  0.082  -0.037 -0.012

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max 
-5.36691578 -0.53935500 -0.01021811  0.53463132  6.10818838 

Number of Observations: 6619
Number of Groups: 107 

> intervals(PosrumEF.PA, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                           lower          est.         upper
(Intercept)                         2.6974597374  2.826673e+00  2.955887e+00
Data.PosRumEFpm                     0.2873268375  3.386059e-01  3.898850e-01
Data.bdi_baselinegm                -0.0502424695 -3.519600e-02 -2.014953e-02
Data.MinutesSinceSignalpm          -0.0001009116 -5.853417e-05 -1.615678e-05
Data.PosRumEFpm:Data.bdi_baselinegm -0.0054245264  5.380273e-04  6.500581e-03
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID 
                                    lower        est.     upper
sd((Intercept))                 0.5880454  0.67483813 0.7744411
sd(Data.PosRumEFpm)             0.1917794  0.22943542 0.2744852
cor((Intercept),Data.PosRumEFpm) -0.3110174 -0.04394026 0.2295688

 Within-group standard error:
    lower      est.     upper 
0.5327568 0.5420584 0.5515224 
```

```
> Damp.PA <- lme(fixed=Data.PosAff ~ 1 + Data.Damppm + Data.bdi_baselinegm + Data.bdi_
baselinegm*Data.Damppm + Data.MinutesSinceSignalpm,
+                random= ~ 1 + Data.Damppm | Data.ID,
+                data=Data2,
+                method="ML",
+                na.action=na.exclude)
> summary(Damp.PA)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
       AIC      BIC   logLik
  12220.78 12281.96 -6101.39

Random effects:
 Formula: ~1 + Data.Damppm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
            StdDev    Corr
(Intercept) 0.6748215 (Intr)
Data.Damppm 0.3776432 -0.127
Residual    0.5802474

Fixed effects: Data.PosAff ~ 1 + Data.Damppm + Data.bdi_baselinegm + Data.bdi_baseline
gm *      Data.Damppm + Data.MinutesSinceSignalpm
                                     Value  Std.Error   DF  t-value p-value
(Intercept)                      2.8250300 0.06600695 6513 42.79898  0.0000
Data.Damppm                     -0.3150417 0.04476958 6513 -7.03696  0.0000
Data.bdi_baselinegm             -0.0351608 0.00760566  105 -4.62297  0.0000
Data.MinutesSinceSignalpm       -0.0000044 0.00002304 6513 -0.19313  0.8469
Data.Damppm:Data.bdi_baselinegm  0.0021382 0.00491177 6513  0.43533  0.6633
 Correlation:
                                (Intr) Dt.Dmp Dt.bd_ Dt.MSS
Data.Damppm                     -0.104
Data.bdi_baselinegm              0.077 -0.009
Data.MinutesSinceSignalpm        0.000 -0.014  0.000
Data.Damppm:Data.bdi_baselinegm -0.010  0.001 -0.111 -0.004

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max
-5.58458435 -0.53350792 -0.02513277  0.51418810  4.82268975

Number of Observations: 6623
Number of Groups: 107

> intervals(Damp.PA, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                        lower          est.         upper
(Intercept)                      2.695684e+00  2.825030e+00  2.954376e+00
Data.Damppm                     -4.027716e-01 -3.150417e-01 -2.273117e-01
Data.bdi_baselinegm             -5.023573e-02 -3.516079e-02 -2.008586e-02
Data.MinutesSinceSignalpm       -4.959801e-05 -4.449668e-06  4.069867e-05
Data.Damppm:Data.bdi_baselinegm -7.486792e-03  2.138246e-03  1.176328e-02
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                  lower       est.     upper
sd((Intercept))               0.5885835  0.6748215 0.7736949
sd(Data.Damppm)               0.3140237  0.3776432 0.4541516
cor((Intercept),Data.Damppm) -0.3637480 -0.1272587 0.1246422

 Within-group standard error:
    lower      est.     upper
0.5703015 0.5802474 0.5903667
```

B. Research Question 2

```
> PosrumSF <- lme(fixed=Data.PosRumSF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_ba
selinegm*Data.PosAfflag1pm + Data.MinutesSinceSignalpm,
```

```
+               random= ~ 1 + Data.PosAfflag1pm | Data.ID,
+               data=Data2,
+               method="ML",
+               na.action=na.exclude)

> summary(PosrumSF)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
    AIC     BIC    logLik
  11684 11744.1 -5833.001

Random effects:
 Formula: ~1 + Data.PosAfflag1pm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                 StdDev    Corr
(Intercept)      0.8819475 (Intr)
Data.PosAfflag1pm 0.1264631 0.578
Residual         0.6244091

Fixed effects: Data.PosRumSF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm +      Data.bdi_baseli
negm * Data.PosAfflag1pm + Data.MinutesSinceSignalpm
                                          Value  Std.Error   DF   t-value p-value
(Intercept)                           2.1638072 0.08620794 5760 25.099860  0.0000
Data.PosAfflag1pm                     0.1692932 0.01954800 5760  8.660384  0.0000
Data.bdi_baselinegm                  -0.0268025 0.00991512  105 -2.703197  0.0080
Data.MinutesSinceSignalpm             0.0000436 0.00003681 5760  1.185250  0.2360
Data.PosAfflag1pm:Data.bdi_baselinegm  0.0005746 0.00219505 5760  0.261770  0.7935
 Correlation:
                                      (Intr) Dt.PA1 Dt.bd_ Dt.MSS
Data.PosAfflag1pm                      0.363
Data.bdi_baselinegm                    0.076  0.031
Data.MinutesSinceSignalpm              0.040 -0.023  0.000
Data.PosAfflag1pm:Data.bdi_baselinegm  0.031  0.040  0.378 -0.006

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max
-5.69256911 -0.52853995 -0.05287086  0.42076668  5.40709483

> intervals(PosrumSF, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                             lower          est.         upper
(Intercept)                            1.994879e+00  2.163807e+00  2.3327352043
Data.PosAfflag1pm                      1.309881e-01  1.692932e-01  0.2075983341
Data.bdi_baselinegm                   -4.645400e-02 -2.680252e-02 -0.0071510431
Data.MinutesSinceSignalpm             -2.850019e-05  4.362686e-05  0.0001157539
Data.PosAfflag1pm:Data.bdi_baselinegm -3.726684e-03  5.745970e-04  0.0048758782
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                       lower      est.     upper
sd((Intercept))                   0.77089386 0.8819475 1.0089992
sd(Data.PosAfflag1pm)             0.08948943 0.1264631 0.1787129
cor((Intercept),Data.PosAfflag1pm) 0.26595250 0.5782836 0.7807376

 Within-group standard error:
    lower      est.     upper
0.6130243 0.6244091 0.6360055

> PosrumEF <- lme(fixed=Data.PosRumEF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_ba
selinegm*Data.PosAfflag1pm + Data.MinutesSinceSignalpm,
+                 random= ~ 1 + Data.PosAfflag1pm | Data.ID,
+                 data=Data2,
+                 method="ML",
+                 na.action=na.exclude)

> summary(PosrumEF)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
      AIC      BIC    logLik
  11990.6 12050.69 -5986.302

Random effects:
 Formula: ~1 + Data.PosAfflag1pm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                 StdDev    Corr
(Intercept)      0.8045078 (Intr)
Data.PosAfflag1pm 0.1825483 0.232
```

```
Residual         0.6405068

Fixed effects: Data.PosRumEF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm +      Data.bdi_baseli
negm * Data.PosAfflag1pm + Data.MinutesSinceSignalpm
                                        Value  Std.Error   DF   t-value p-value
(Intercept)                         2.1820586 0.07879161 5754 27.694048  0.0000
Data.PosAfflag1pm                   0.2096136 0.02454274 5754  8.540757  0.0000
Data.bdi_baselinegm                -0.0173969 0.00907099  105 -1.917865  0.0578
Data.MinutesSinceSignalpm           0.0000510 0.00003784 5754  1.347579  0.1778
Data.PosAfflag1pm:Data.bdi_baselinegm  0.0006576 0.00278645 5754  0.235990  0.8134
 Correlation:
                                    (Intr) Dt.PA1 Dt.bd_ Dt.MSS
Data.PosAfflag1pm                    0.169
Data.bdi_baselinegm                  0.077  0.017
Data.MinutesSinceSignalpm            0.045 -0.019  0.000
Data.PosAfflag1pm:Data.bdi_baselinegm  0.017  0.058  0.179 -0.005

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max
-5.71167847 -0.56576023 -0.05485222  0.48750242  4.74845614

> intervals(PosrumEF, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                          lower          est.        upper
(Intercept)                          2.027663e+00  2.182059e+00 2.3364539065
Data.PosAfflag1pm                    1.615211e-01  2.096136e-01 0.2577060955
Data.bdi_baselinegm                 -3.537537e-02 -1.739694e-02 0.0005814974
Data.MinutesSinceSignalpm           -2.315735e-05  5.099401e-05 0.0001251454
Data.PosAfflag1pm:Data.bdi_baselinegm -4.802587e-03  6.575748e-04 0.0061177366
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                          lower      est.     upper
sd((Intercept))                      0.70299526 0.8045078 0.9206789
sd(Data.PosAfflag1pm)                0.14198924 0.1825483 0.2346929
cor((Intercept),Data.PosAfflag1pm) -0.03984704 0.2323152 0.4723872

 Within-group standard error:
    lower      est.     upper
0.6288113 0.6405068 0.6524198

> Damp <- lme(fixed=Data.Damp ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_baselinegm
*Data.PosAfflag1pm + Data.MinutesSinceSignalpm,
+                 random= ~ 1 + Data.PosAfflag1pm | Data.ID,
+                 data=Data2,
+                 method="ML",
+                 na.action=na.exclude)

> summary(Damp)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
       AIC      BIC    logLik
  7087.666 7147.761 -3534.833

Random effects:
 Formula: ~1 + Data.PosAfflag1pm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                  StdDev    Corr
(Intercept)       0.4176939 (Intr)
Data.PosAfflag1pm 0.1234154 0.066
Residual          0.4231199

Fixed effects: Data.Damp ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_baselinegm *
Data.PosAfflag1pm + Data.MinutesSinceSignalpm
                                        Value  Std.Error   DF  t-value p-value
(Intercept)                         1.4716315 0.04112573 5758 35.78372  0.0000
Data.PosAfflag1pm                  -0.0515390 0.01647185 5758 -3.12892  0.0018
Data.bdi_baselinegm                 0.0176519 0.00474414  105  3.72077  0.0003
Data.MinutesSinceSignalpm           0.0000824 0.00002498 5758  3.29634  0.0010
Data.PosAfflag1pm:Data.bdi_baselinegm -0.0004805 0.00187009 5758 -0.25692  0.7972
 Correlation:
                                    (Intr) Dt.PA1 Dt.bd_ Dt.MSS
Data.PosAfflag1pm                    0.049
Data.bdi_baselinegm                  0.079  0.009
Data.MinutesSinceSignalpm            0.057 -0.019  0.000
Data.PosAfflag1pm:Data.bdi_baselinegm  0.008  0.059  0.060 -0.004
```

```
Standardized Within-Group Residuals:
       Min         Q1        Med         Q3        Max
-5.2681905 -0.4563301 -0.1186505  0.3491976  8.1287249

> intervals(Damp, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                             lower          est.         upper
(Intercept)                           1.391044e+00  1.471631e+00  1.5522190361
Data.PosAfflag1pm                    -8.381630e-02 -5.153904e-02 -0.0192617750
Data.bdi_baselinegm                   8.249121e-03  1.765187e-02  0.0270546140
Data.MinutesSinceSignalpm             3.339836e-05  8.235525e-05  0.0001313121
Data.PosAfflag1pm:Data.bdi_baselinegm -4.144989e-03 -4.804639e-04  0.0031840613
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                        lower       est.     upper
sd((Intercept))                    0.36393493 0.41769391 0.4793940
sd(Data.PosAfflag1pm)              0.09871272 0.12341537 0.1542998
cor((Intercept),Data.PosAfflag1pm) -0.17161371 0.06594986 0.2962651

 Within-group standard error:
    lower      est.     upper
0.4154082 0.4231199 0.4309748
```

2. Determining the role of compliance thresholds

In line with prior research (Gruber, Kogan, Mennin, & Murray, 2013), this study excluded participants (n=8) who did not complete at least 25% of the EMA surveys. The analyses below explored whether applying more restrictive compliance thresholds altered the study findings. Excluding participants (n=20) who did not complete at least 50% of the EMA surveys did not alter the pattern of findings. Furthermore, the findings remained unaltered when applying an even more restrictive compliance threshold of 70% (n=40 excluded participants). These observations increase confidence in the robustness of the reported results. The output of the analyses with the 50% compliance threshold is detailed below.

A. Research Question 1

```
> PosrumSF.PA <- lme(fixed=Data.PosAff ~ 1 + Data.PosRumSFpm + Data.bdi_baselinegm + Data.bdi_bas
elinegm*Data.PosRumSFpm,
+                    random= ~ 1 + Data.PosRumSFpm | Data.ID,
+                    data=DataCT,
+                    method="ML",
+                    na.action=na.exclude)
> summary(PosrumSF.PA)
Linear mixed-effects model fit by maximum likelihood
 Data: DataCT
       AIC      BIC    logLik
  11624.23 11678.5 -5804.114

Random effects:
 Formula: ~1 + Data.PosRumSFpm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                StdDev    Corr
(Intercept)     0.6925102 (Intr)
Data.PosRumSFpm 0.2438251 -0.095
Residual        0.5621609

Fixed effects: Data.PosAff ~ 1 + Data.PosRumSFpm + Data.bdi_baselinegm + Data.bdi_baselinegm *
Data.PosRumSFpm
                                         Value  Std.Error   DF  t-value p-value
(Intercept)                          2.8025402 0.07077919 6432 39.59554  0.0000
Data.PosRumSFpm                      0.3153887 0.02922210 6432 10.79281  0.0000
Data.bdi_baselinegm                 -0.0328039 0.00813728   95 -4.03131  0.0001
Data.PosRumSFpm:Data.bdi_baselinegm  0.0001821 0.00338755 6432  0.05376  0.9571
 Correlation:
                                    (Intr) Dt.PRSF Dt.bd_
Data.PosRumSFpm                     -0.080
Data.bdi_baselinegm                  0.051 -0.004
Data.PosRumSFpm:Data.bdi_baselinegm -0.004  0.059  -0.079

Standardized Within-Group Residuals:
```

```
        Min          Q1         Med          Q3         Max 
-5.52569028 -0.54960182 -0.01365427  0.53163694  5.89029625 

Number of Observations: 6531
Number of Groups: 97 

> intervals(PosrumSF.PA, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                         lower          est.        upper
(Intercept)                        2.663831967  2.8025402416  2.941248516
Data.PosRumSFpm                    0.258121206  0.3153887107  0.372656215
Data.bdi_baselinegm               -0.048953546 -0.0328039442 -0.016654342
Data.PosRumSFpm:Data.bdi_baselinegm -0.006456583  0.0001821114  0.006820806
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID 
                                    lower        est.     upper
sd((Intercept))                 0.6008278  0.69251024 0.7981829
sd(Data.PosRumSFpm)             0.2013479  0.24382513 0.2952636
cor((Intercept),Data.PosRumSFpm) -0.3461382 -0.09499276 0.1688566

 Within-group standard error:
    lower      est.     upper 
0.5524609 0.5621609 0.5720312 

> PosrumEF.PA <- lme(fixed=Data.PosAff ~ 1 + Data.PosRumEFpm + Data.bdi_baselinegm + Data.bdi_bas
elinegm*Data.PosRumEFpm,
+                    random= ~ 1 + Data.PosRumEFpm | Data.ID,
+                    data=DataCT,
+                    method="ML",
+                    na.action=na.exclude)
> summary(PosrumEF.PA)
Linear mixed-effects model fit by maximum likelihood
 Data: DataCT 
       AIC     BIC    logLik
  11211.43 11265.7 -5597.715

Random effects:
 Formula: ~1 + Data.PosRumEFpm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                StdDev    Corr  
(Intercept)     0.6927135 (Intr)
Data.PosRumEFpm 0.2348828 -0.109
Residual        0.5442439       

Fixed effects: Data.PosAff ~ 1 + Data.PosRumEFpm + Data.bdi_baselinegm + Data.bdi_baselinegm * 
Data.PosRumEFpm 
                                        Value  Std.Error   DF  t-value p-value
(Intercept)                         2.8024350 0.07077783 6428 39.59482  0.0000
Data.PosRumEFpm                     0.3611024 0.02748745 6428 13.13699  0.0000
Data.bdi_baselinegm                -0.0328222 0.00813694   95 -4.03373  0.0001
Data.PosRumEFpm:Data.bdi_baselinegm -0.0009516 0.00317045 6428 -0.30013  0.7641
 Correlation: 
                                    (Intr) Dt.PREF Dt.bd_
Data.PosRumEFpm                     -0.094               
Data.bdi_baselinegm                  0.051 -0.005        
Data.PosRumEFpm:Data.bdi_baselinegm -0.005  0.050  -0.093

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max 
-5.37801850 -0.54465128 -0.01592209  0.54639449  6.09804510 

Number of Observations: 6527
Number of Groups: 97 

> intervals(PosrumEF.PA, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                         lower          est.        upper
(Intercept)                        2.663729439  2.8024350324  2.941140626
Data.PosRumEFpm                    0.307234326  0.3611023759  0.414970426
Data.bdi_baselinegm               -0.048971144 -0.0328222340 -0.016673324
Data.PosRumEFpm:Data.bdi_baselinegm -0.007164786 -0.0009515597  0.005261666
attr(,"label")
[1] "Fixed effects:"
```

```
 Random Effects:
  Level: Data.ID
                                     lower       est.     upper
sd((Intercept))                  0.6011198  0.6927135 0.7982635
sd(Data.PosRumEFpm)              0.1947339  0.2348828 0.2833094
cor((Intercept),Data.PosRumEFpm) -0.3354904 -0.1085281 0.1303420

 Within-group standard error:
    lower      est.     upper
0.5348466 0.5442439 0.5538062
>
> Damp.PA <- lme(fixed=Data.PosAff ~ 1 + Data.Damppm + Data.bdi_baselinegm + Data.bdi_baselinegm*
Data.Damppm,
+               random= ~ 1 + Data.Damppm | Data.ID,
+               data=DataCT,
+               method="ML",
+               na.action=na.exclude)

> summary(Damp.PA)
Linear mixed-effects model fit by maximum likelihood
 Data: DataCT
       AIC      BIC    logLik
  12107.29 12161.56 -6045.645

Random effects:
 Formula: ~1 + Data.Damppm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
            StdDev    Corr
(Intercept) 0.6919617 (Intr)
Data.Damppm 0.3957910 -0.183
Residual    0.5839983

Fixed effects: Data.PosAff ~ 1 + Data.Damppm + Data.bdi_baselinegm + Data.bdi_baselinegm *      D
ata.Damppm
                                    Value  Std.Error   DF  t-value p-value
(Intercept)                      2.8024470 0.07075177 6430 39.60957  0.0000
Data.Damppm                     -0.3159551 0.04800754 6430 -6.58136  0.0000
Data.bdi_baselinegm             -0.0328153 0.00813436   95 -4.03415  0.0001
Data.Damppm:Data.bdi_baselinegm  0.0009667 0.00523434 6430  0.18469  0.8535
 Correlation:
                                (Intr) Dt.Dmp Dt.bd_
Data.Damppm                     -0.152
Data.bdi_baselinegm              0.051 -0.008
Data.Damppm:Data.bdi_baselinegm -0.008 -0.022 -0.160

Standardized Within-Group Residuals:
       Min         Q1        Med         Q3        Max
-5.5559615 -0.5359084 -0.0263109  0.5157714  4.7934101

Number of Observations: 6529
Number of Groups: 97

> intervals(Damp.PA, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                       lower          est.       upper
(Intercept)                      2.663792434  2.8024469674  2.94110150
Data.Damppm                     -0.410037066 -0.3159551311 -0.22187320
Data.bdi_baselinegm             -0.048959051 -0.0328152567 -0.01667146
Data.Damppm:Data.bdi_baselinegm -0.009291176  0.0009667376  0.01122465
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                 lower       est.      upper
sd((Intercept))              0.5995225  0.6919617 0.79865394
sd(Data.Damppm)              0.3269096  0.3957910 0.47918599
cor((Intercept),Data.Damppm) -0.4299140 -0.1826719 0.09005569

 Within-group standard error:
    lower      est.     upper
0.5739252 0.5839983 0.5942483
```

B. Research Question 2

```
> PosrumSF <- lme(fixed=Data.PosRumSF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_ba
selinegm*Data.PosAfflag1pm,
+                random= ~ 1 + Data.PosAfflag1pm | Data.ID,
```

```
+                 data=DataCT,
+                 method="ML",
+                 na.action=na.exclude)

> summary(PosrumSF)
Linear mixed-effects model fit by maximum likelihood
 Data: DataCT
       AIC      BIC    logLik
  11301.75 11355.02 -5642.874

Random effects:
 Formula: ~1 + Data.PosAfflag1pm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                  StdDev    Corr
(Intercept)       0.8950318 (Intr)
Data.PosAfflag1pm 0.1226447 0.543
Residual          0.6162373

Fixed effects: Data.PosRumSF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm +      Data.bdi_baseli
negm * Data.PosAfflag1pm
                                          Value  Std.Error   DF   t-value p-value
(Intercept)                           2.1417264 0.09141129 5665 23.429560  0.0000
Data.PosAfflag1pm                     0.1638961 0.01943830 5665  8.431608  0.0000
Data.bdi_baselinegm                  -0.0259433 0.01051158   95 -2.468068  0.0154
Data.PosAfflag1pm:Data.bdi_baselinegm  0.0006538 0.00217612 5665  0.300459  0.7638
 Correlation:
                                      (Intr) Dt.PA1 Dt.bd_
Data.PosAfflag1pm                     0.348
Data.bdi_baselinegm                   0.051  0.018
Data.PosAfflag1pm:Data.bdi_baselinegm 0.018  0.021  0.357

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max
-5.75701586 -0.52006885 -0.05354123  0.41124402  5.47456822

> intervals(PosrumSF, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                            lower          est.        upper
(Intercept)                            1.96258743  2.1417263654  2.320865302
Data.PosAfflag1pm                      0.12580283  0.1638961155  0.201989399
Data.bdi_baselinegm                   -0.04680416 -0.0259432865 -0.005082413
Data.PosAfflag1pm:Data.bdi_baselinegm -0.00361072  0.0006538368  0.004918394
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                        lower      est.     upper
sd((Intercept))                    0.77209144 0.8950318 1.0375480
sd(Data.PosAfflag1pm)              0.08643914 0.1226447 0.1740150
cor((Intercept),Data.PosAfflag1pm) 0.21131179 0.5431974 0.7627744

 Within-group standard error:
    lower      est.     upper
0.6049081 0.6162373 0.6277788

> PosrumEF <- lme(fixed=Data.PosRumEF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_ba
selinegm*Data.PosAfflag1pm,
+                 random= ~ 1 + Data.PosAfflag1pm | Data.ID,
+                 data=DataCT,
+                 method="ML",
+                 na.action=na.exclude)

> summary(PosrumEF)
Linear mixed-effects model fit by maximum likelihood
 Data: DataCT
      AIC      BIC    logLik
  11661.9 11715.17 -5822.949

Random effects:
 Formula: ~1 + Data.PosAfflag1pm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                  StdDev    Corr
(Intercept)       0.8076875 (Intr)
Data.PosAfflag1pm 0.1799050 0.237
Residual          0.6353380
```

```
Fixed effects: Data.PosRumEF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm +      Data.bdi_baseli
negm * Data.PosAfflag1pm
                                           Value  Std.Error   DF   t-value p-value
(Intercept)                            2.1804119 0.08259786 5661 26.397921  0.0000
Data.PosAfflag1pm                      0.2112678 0.02462797 5661  8.578369  0.0000
Data.bdi_baselinegm                   -0.0174258 0.00949972   95 -1.834343  0.0697
Data.PosAfflag1pm:Data.bdi_baselinegm  0.0002875 0.00278766 5661  0.103134  0.9179
 Correlation:
                                      (Intr) Dt.PA1 Dt.bd_
Data.PosAfflag1pm                     0.176
Data.bdi_baselinegm                   0.051  0.009
Data.PosAfflag1pm:Data.bdi_baselinegm 0.009  0.036  0.178

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max
-5.76025534 -0.55977736 -0.05343193  0.48162915  4.77995515


> intervals(PosrumEF, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                             lower          est.       upper
(Intercept)                            2.018544653  2.1804118760 2.342279099
Data.PosAfflag1pm                      0.163004333  0.2112678261 0.259531320
Data.bdi_baselinegm                   -0.036278536 -0.0174257532 0.001427030
Data.PosAfflag1pm:Data.bdi_baselinegm -0.005175477  0.0002875029 0.005750483
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                         lower      est.     upper
sd((Intercept))                     0.70156119 0.8076875 0.9298678
sd(Data.PosAfflag1pm)               0.13978871 0.1799050 0.2315337
cor((Intercept),Data.PosAfflag1pm) -0.04924689 0.2371004 0.4874315

 Within-group standard error:
    lower      est.     upper
0.6236461 0.6353380 0.6472490

> Damp <- lme(fixed=Data.Damp ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_baselinegm
*Data.PosAfflag1pm,
+             random= ~ 1 + Data.PosAfflag1pm | Data.ID,
+             data=DataCT,
+             method="ML",
+             na.action=na.exclude)

> summary(Damp)
Linear mixed-effects model fit by maximum likelihood
 Data: DataCT
       AIC      BIC    logLik
  6823.411 6876.683 -3403.706

Random effects:
 Formula: ~1 + Data.PosAfflag1pm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                  StdDev    Corr
(Intercept)       0.3773216 (Intr)
Data.PosAfflag1pm 0.1195380 0.253
Residual          0.4197597

Fixed effects: Data.Damp ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_baselinegm *
Data.PosAfflag1pm
                                           Value  Std.Error   DF  t-value p-value
(Intercept)                            1.4455622 0.03879805 5663 37.25863  0.0000
Data.PosAfflag1pm                     -0.0500614 0.01632408 5663 -3.06672  0.0022
Data.bdi_baselinegm                    0.0179781 0.00446543   95  4.02605  0.0001
Data.PosAfflag1pm:Data.bdi_baselinegm -0.0007806 0.00184797 5663 -0.42242  0.6727
 Correlation:
                                      (Intr) Dt.PA1 Dt.bd_
Data.PosAfflag1pm                     0.187
Data.bdi_baselinegm                   0.051  0.010
Data.PosAfflag1pm:Data.bdi_baselinegm 0.010  0.036  0.190

Standardized Within-Group Residuals:
       Min         Q1        Med         Q3        Max
-5.3451932 -0.4585570 -0.1075931  0.3438641  8.3048843

> intervals(Damp, 0.95)
Approximate 95% confidence intervals
```

```
 Fixed effects:
                                            lower          est.        upper
(Intercept)                           1.369529533  1.4455621698  1.521594807
Data.PosAfflag1pm                    -0.082051787 -0.0500614445 -0.018071102
Data.bdi_baselinegm                   0.009116140  0.0179780707  0.026840002
Data.PosAfflag1pm:Data.bdi_baselinegm -0.004402097 -0.0007806251  0.002840847
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                         lower      est.     upper
sd((Intercept))                    0.326737834 0.3773216 0.4357365
sd(Data.PosAfflag1pm)              0.095797224 0.1195380 0.1491622
cor((Intercept),Data.PosAfflag1pm) -0.008304886 0.2530984 0.4821226

 Within-group standard error:
    lower      est.     upper
0.4120501 0.4197597 0.4276136
```

3. Modeling anxiety scores

The anxiety scale of the 21-item Depression, Anxiety and Stress Scales (Henry & Crawford, 2005) was used to measure individual differences in anxiety levels. Participants rated the extent to which the statements applied to them over the past week using a 4-point severity scale. The questionnaire's scales have adequate psychometric properties (Henry & Crawford, 2005).

A. Research Question 1

```
> PosrumSF.PA <- lme(fixed=Data.PosAff ~ 1 + Data.PosRumSFpm + Data.bdi_baselinegm + Data.bdi_bas
elinegm*Data.PosRumSFpm
+                    +  Data.dass21_anxietygm +Data.dass21_anxietygm*Data.PosRumSFpm,
+                    random= ~ 1 + Data.PosRumSFpm | Data.ID,
+                    data=Data2,
+                    method="ML",
+                    na.action=na.exclude)
> summary(PosrumSF.PA)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
       AIC      BIC    logLik
  12194.43 12262.81 -6087.213

Random effects:
 Formula: ~1 + Data.PosRumSFpm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                StdDev    Corr
(Intercept)     0.6806421 (Intr)
Data.PosRumSFpm 0.2367496 -0.081
Residual        0.5581388

Fixed effects: Data.PosAff ~ 1 + Data.PosRumSFpm + Data.bdi_baselinegm + Data.bdi_baselinegm *
Data.PosRumSFpm + Data.dass21_anxietygm + Data.dass21_anxietygm *      Data.PosRumSFpm
                                           Value  Std.Error   DF  t-value p-value
(Intercept)                            2.8131701 0.06606925 6784 42.57912  0.0000
Data.PosRumSFpm                        0.3049002 0.02721368 6784 11.20393  0.0000
Data.bdi_baselinegm                   -0.0325237 0.00914380  105 -3.55691  0.0006
Data.dass21_anxietygm                 -0.0115909 0.02630545  105 -0.44063  0.6604
Data.PosRumSFpm:Data.bdi_baselinegm    0.0035846 0.00369224 6784  0.97085  0.3317
Data.PosRumSFpm:Data.dass21_anxietygm -0.0092929 0.01076670 6784 -0.86311  0.3881
 Correlation:
                                      (Intr) Dt.PRSF Dt.bd_ Dt.21_ D.PRSF:D._
Data.PosRumSFpm                       -0.068
Data.bdi_baselinegm                    0.060 -0.004
Data.dass21_anxietygm                  0.001  0.000  -0.561
Data.PosRumSFpm:Data.bdi_baselinegm   -0.004  0.070  -0.069  0.039
Data.PosRumSFpm:Data.dass21_anxietygm  0.000  0.025   0.038 -0.068 -0.515

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max
-5.56592716 -0.53867100 -0.01840166  0.52068268  5.93679815

Number of Observations: 6895
Number of Groups: 108
```

```
> intervals(PosrumSF.PA, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                            lower         est.       upper
(Intercept)                           2.683710026  2.813170114  2.94263020
Data.PosRumSFpm                       0.251576040  0.304900176  0.35822431
Data.bdi_baselinegm                  -0.050646248 -0.032523667 -0.01440109
Data.dass21_anxietygm                -0.063727031 -0.011590879  0.04054527
Data.PosRumSFpm:Data.bdi_baselinegm  -0.003650202  0.003584593  0.01081939
Data.PosRumSFpm:Data.dass21_anxietygm -0.030389797 -0.009292869  0.01180406
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                   lower        est.      upper
sd((Intercept))                0.5948689  0.68064209 0.77878279
sd(Data.PosRumSFpm)            0.1966223  0.23674958 0.28506623
cor((Intercept),Data.PosRumSFpm) -0.2545022 -0.08112936 0.09729605

 Within-group standard error:
    lower      est.     upper
0.5487557 0.5581388 0.5676823

> PosrumEF.PA <- lme(fixed=Data.PosAff ~ 1 + Data.PosRumEFpm + Data.bdi_baselinegm + Data.bdi_bas
elinegm*Data.PosRumEFpm
+                    +  Data.dass21_anxietygm +Data.dass21_anxietygm*Data.PosRumEFpm,
+                    random= ~ 1 + Data.PosRumEFpm | Data.ID,
+                    data=Data2,
+                    method="ML",
+                    na.action=na.exclude)
> summary(PosrumEF.PA)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
       AIC      BIC   logLik
  11765.88 11834.26 -5872.94

Random effects:
 Formula: ~1 + Data.PosRumEFpm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
               StdDev    Corr
(Intercept)     0.6806810 (Intr)
Data.PosRumEFpm 0.2358423 -0.102
Residual        0.5406043

Fixed effects: Data.PosAff ~ 1 + Data.PosRumEFpm + Data.bdi_baselinegm + Data.bdi_baselinegm *
Data.PosRumEFpm + Data.dass21_anxietygm + Data.dass21_anxietygm *      Data.PosRumEFpm
                                          Value  Std.Error   DF  t-value p-value
(Intercept)                           2.8129596 0.06605071 6778 42.58788  0.0000
Data.PosRumEFpm                       0.3456988 0.02633803 6778 13.12546  0.0000
Data.bdi_baselinegm                  -0.0325393 0.00914132  105 -3.55958  0.0006
Data.dass21_anxietygm                -0.0115023 0.02629837  105 -0.43738  0.6627
Data.PosRumEFpm:Data.bdi_baselinegm    0.0011909 0.00360864 6778  0.33002  0.7414
Data.PosRumEFpm:Data.dass21_anxietygm -0.0028589 0.01024115 6778 -0.27916  0.7801
 Correlation:
                                      (Intr) Dt.PREF Dt.bd_ Dt.21_ D.PREF:D._
Data.PosRumEFpm                       -0.088
Data.bdi_baselinegm                    0.060 -0.005
Data.dass21_anxietygm                  0.001  0.000  -0.561
Data.PosRumEFpm:Data.bdi_baselinegm   -0.005  0.065  -0.089  0.050
Data.PosRumEFpm:Data.dass21_anxietygm  0.000 -0.014   0.050 -0.090 -0.547

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max
-5.41419889 -0.54353964 -0.01501289  0.53844028  6.14375316

Number of Observations: 6889
Number of Groups: 108

> intervals(PosrumEF.PA, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                            lower         est.       upper
(Intercept)                           2.683535899  2.812959640  2.94238338
Data.PosRumEFpm                       0.294090501  0.345698832  0.39730716
Data.bdi_baselinegm                  -0.050656952 -0.032539293 -0.01442164
Data.dass21_anxietygm                -0.063624445 -0.011502339  0.04061977
Data.PosRumEFpm:Data.bdi_baselinegm  -0.005880061  0.001190935  0.00826193
Data.PosRumEFpm:Data.dass21_anxietygm -0.022926062 -0.002858942  0.01720818
```

```
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                     lower       est.     upper
sd((Intercept))                  0.5940072  0.6806810 0.7800016
sd(Data.PosRumEFpm)              0.1971800  0.2358423 0.2820855
cor((Intercept),Data.PosRumEFpm) -0.3323797 -0.1020699 0.1397277

 Within-group standard error:
    lower      est.     upper
0.5315092 0.5406043 0.5498550

> Damp.PA <- lme(fixed=Data.PosAff ~ 1 + Data.Damppm + Data.bdi_baselinegm + Data.bdi_baselinegm*
Data.Damppm
+                + Data.dass21_anxietygm +Data.dass21_anxietygm*Data.Damppm,
+                random= ~ 1 + Data.Damppm | Data.ID,
+                data=Data2,
+                method="ML",
+                na.action=na.exclude)
Error in lme.formula(fixed = Data.PosAff ~ 1 + Data.Damppm + Data.bdi_baselinegm +  :
  nlminb problem, convergence error code = 1
  message = false convergence (8)
> summary(Damp.PA)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
       AIC      BIC    logLik
  12219.97 12281.16 -6100.987

Random effects:
 Formula: ~1 + Data.Damppm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
            StdDev    Corr
(Intercept) 0.6736922 (Intr)
Data.Damppm 0.3782118 -0.16
Residual    0.5802477

Fixed effects: Data.PosAff ~ 1 + Data.Damppm + Data.bdi_followupgm + Data.bdi_followupgm *      D
ata.Damppm + Data.MinutesSinceSignalpm
                                    Value  Std.Error   DF  t-value p-value
(Intercept)                      2.8360391 0.06575773 6513 43.12861  0.0000
Data.Damppm                     -0.3149828 0.04481174 6513 -7.02902  0.0000
Data.bdi_followupgm             -0.0417494 0.00896417  105 -4.65736  0.0000
Data.MinutesSinceSignalpm       -0.0000044 0.00002304 6513 -0.19091  0.8486
Data.Damppm:Data.bdi_followupgm -0.0009874 0.00594341 6513 -0.16614  0.8681
 Correlation:
                                (Intr) Dt.Dmp Dt.bd_ Dt.MSS
Data.Damppm                     -0.130
Data.bdi_followupgm              0.041 -0.007
Data.MinutesSinceSignalpm        0.000 -0.014  0.000
Data.Damppm:Data.bdi_followupgm -0.007 -0.021 -0.138 -0.004

Standardized Within-Group Residuals:
       Min         Q1        Med         Q3        Max
-5.5899157 -0.5341984 -0.0266054  0.5125678  4.8145983

Number of Observations: 6623
Number of Groups: 107

> intervals(Damp.PA, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                        lower          est.         upper
(Intercept)                      2.707181e+00  2.836039e+00  2.964897e+00
Data.Damppm                     -4.027954e-01 -3.149828e-01 -2.271703e-01
Data.bdi_followupgm             -5.951695e-02 -4.174937e-02 -2.398180e-02
Data.MinutesSinceSignalpm       -4.954625e-05 -4.398519e-06  4.074921e-05
Data.Damppm:Data.bdi_followupgm -1.263408e-02 -9.874365e-04  1.065921e-02
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                lower       est.      upper
sd((Intercept))             0.5884363  0.6736922 0.77130048
sd(Data.Damppm)             0.3146139  0.3782118 0.45466573
cor((Intercept),Data.Damppm) -0.3846085 -0.1599647 0.08256759

 Within-group standard error:
```

```
    lower      est.     upper
0.5703023 0.5802477 0.5903665
```

B. Research Question 2

```
PosrumSF <- lme(fixed=Data.PosRumSF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_base
linegm*Data.PosAfflag1pm
+                 + Data.dass21_anxietygm +Data.dass21_anxietygm*Data.PosAfflag1pm,
+                 random= ~ 1 + Data.PosAfflag1pm | Data.ID,
+                 data=Data2,
+                 method="ML",
+                 na.action=na.exclude)

> summary(PosrumSF)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
       AIC      BIC    logLik
  11853.03 11920.04 -5916.515

Random effects:
 Formula: ~1 + Data.PosAfflag1pm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                  StdDev    Corr
(Intercept)       0.8853361 (Intr)
Data.PosAfflag1pm 0.1248491 0.581
Residual          0.6185922

Fixed effects: Data.PosRumSF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm +      Data.bdi_baseli
negm * Data.PosAfflag1pm + Data.dass21_anxietygm +      Data.dass21_anxietygm * Data.PosAfflag1pm
                                             Value  Std.Error   DF   t-value p-value
(Intercept)                              2.1453490 0.08589386 5900 24.976744  0.0000
Data.PosAfflag1pm                        0.1682543 0.01915799 5900  8.782457  0.0000
Data.bdi_baselinegm                     -0.0258469 0.01188837  105 -2.174135  0.0319
Data.dass21_anxietygm                   -0.0040736 0.03419669  105 -0.119123  0.9054
Data.PosAfflag1pm:Data.bdi_baselinegm    0.0011516 0.00253355 5900  0.454545  0.6495
Data.PosAfflag1pm:Data.dass21_anxietygm -0.0035330 0.00736067 5900 -0.479982  0.6313
 Correlation:
                                        (Intr) Dt.PA1 Dt.bd_ Dt.21_ D.PA1:D._
Data.PosAfflag1pm                        0.365
Data.bdi_baselinegm                      0.060  0.022
Data.dass21_anxietygm                    0.001  0.000 -0.561
Data.PosAfflag1pm:Data.bdi_baselinegm    0.023  0.014  0.382 -0.215
Data.PosAfflag1pm:Data.dass21_anxietygm  0.000  0.025 -0.213  0.379 -0.542

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max
-5.74261461 -0.52044796 -0.05377578  0.41246194  5.46180149

> intervals(PosrumSF, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                               lower          est.         upper
(Intercept)                              1.977049663  2.145349026  2.313648388
Data.PosAfflag1pm                        0.130716336  0.168254272  0.205792207
Data.bdi_baselinegm                     -0.049407611 -0.025846930 -0.002286248
Data.dass21_anxietygm                   -0.071845464 -0.004073597  0.063698269
Data.PosAfflag1pm:Data.bdi_baselinegm   -0.003812587  0.001151610  0.006115807
Data.PosAfflag1pm:Data.dass21_anxietygm -0.017955396 -0.003532989  0.010889417
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                        lower      est.     upper
sd((Intercept))                    0.77144185 0.8853361 1.0160454
sd(Data.PosAfflag1pm)              0.08862471 0.1248491 0.1758797
cor((Intercept),Data.PosAfflag1pm) 0.27222477 0.5811605 0.7814802

 Within-group standard error:
    lower      est.     upper
0.6074471 0.6185922 0.6299418

> PosrumEF <- lme(fixed=Data.PosRumEF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_ba
selinegm*Data.PosAfflag1pm
+                 +Data.dass21_anxietygm +Data.dass21_anxietygm*Data.PosAfflag1pm,
+                 random= ~ 1 + Data.PosAfflag1pm | Data.ID,
+                 data=Data2,
+                 method="ML",
+                 na.action=na.exclude)
```

```
> summary(PosrumEF)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
       AIC      BIC    logLik
  12181.95 12248.96 -6080.976

Random effects:
 Formula: ~1 + Data.PosAfflag1pm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                  StdDev    Corr
(Intercept)       0.8064887 (Intr)
Data.PosAfflag1pm 0.1814481 0.233
Residual          0.6353086

Fixed effects: Data.PosRumEF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm +      Data.bdi_baseli
negm * Data.PosAfflag1pm + Data.dass21_anxietygm +      Data.dass21_anxietygm * Data.PosAfflag1pm
                                             Value  Std.Error   DF   t-value p-value
(Intercept)                              2.1655261 0.07835207 5894 27.638402  0.0000
Data.PosAfflag1pm                        0.2104614 0.02413698 5894  8.719461  0.0000
Data.bdi_baselinegm                     -0.0195158 0.01084414  105 -1.799663  0.0748
Data.dass21_anxietygm                    0.0132381 0.03119163  105  0.424413  0.6721
Data.PosAfflag1pm:Data.bdi_baselinegm    0.0013980 0.00323716 5894  0.431866  0.6659
Data.PosAfflag1pm:Data.dass21_anxietygm -0.0024603 0.00934947 5894 -0.263150  0.7924
 Correlation:
                                        (Intr) Dt.PA1 Dt.bd_ Dt.21_ D.PA1:D._
Data.PosAfflag1pm                        0.169
Data.bdi_baselinegm                      0.060  0.010
Data.dass21_anxietygm                    0.001  0.000 -0.561
Data.PosAfflag1pm:Data.bdi_baselinegm    0.011  0.031  0.175 -0.098
Data.PosAfflag1pm:Data.dass21_anxietygm  0.000  0.015 -0.098  0.175 -0.549

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max
-5.75821118 -0.55973086 -0.05617195  0.48468162  4.77844630

> intervals(PosrumEF, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                               lower         est.       upper
(Intercept)                              2.012004098  2.165526128 2.319048157
Data.PosAfflag1pm                        0.163167764  0.210461445 0.257755125
Data.bdi_baselinegm                     -0.041006964 -0.019515788 0.001975387
Data.dass21_anxietygm                   -0.048578188  0.013238142 0.075054472
Data.PosAfflag1pm:Data.bdi_baselinegm   -0.004944825  0.001398019 0.007740864
Data.PosAfflag1pm:Data.dass21_anxietygm -0.020779538 -0.002460314 0.015858911
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                         lower      est.     upper
sd((Intercept))                     0.70370334 0.8064887 0.9242873
sd(Data.PosAfflag1pm)               0.14156764 0.1814481 0.2325630
cor((Intercept),Data.PosAfflag1pm) -0.05331619 0.2332311 0.4842904

 Within-group standard error:
    lower      est.     upper
0.6238445 0.6353086 0.6469833

> Damp <- lme(fixed=Data.Damp ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_baselinegm
*Data.PosAfflag1pm
+             +Data.dass21_anxietygm +Data.dass21_anxietygm*Data.PosAfflag1pm,
+             random= ~ 1 + Data.PosAfflag1pm | Data.ID,
+             data=Data2,
+             method="ML",
+             na.action=na.exclude)

> summary(Damp)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
       AIC      BIC    logLik
  7147.673 7214.683 -3563.837

Random effects:
 Formula: ~1 + Data.PosAfflag1pm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                  StdDev    Corr
(Intercept)       0.4165185 (Intr)
Data.PosAfflag1pm 0.1220097 0.062
```

```
Residual         0.4192542

Fixed effects: Data.Damp ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_baselinegm *
Data.PosAfflag1pm + Data.dass21_anxietygm + Data.dass21_anxietygm *      Data.PosAfflag1pm
                                             Value  Std.Error   DF  t-value p-value
(Intercept)                              1.4581959 0.04062707 5898 35.89222  0.0000
Data.PosAfflag1pm                       -0.0501563 0.01614279 5898 -3.10704  0.0019
Data.bdi_baselinegm                      0.0168449 0.00562247  105  2.99601  0.0034
Data.dass21_anxietygm                    0.0027214 0.01617029  105  0.16829  0.8667
Data.PosAfflag1pm:Data.bdi_baselinegm    0.0013106 0.00216677 5898  0.60487  0.5453
Data.PosAfflag1pm:Data.dass21_anxietygm -0.0096661 0.00625478 5898 -1.54539  0.1223
 Correlation:
                                        (Intr) Dt.PA1 Dt.bd_ Dt.21_ D.PA1:D._
Data.PosAfflag1pm                        0.046
Data.bdi_baselinegm                      0.060  0.003
Data.dass21_anxietygm                    0.002  0.000 -0.560
Data.PosAfflag1pm:Data.bdi_baselinegm    0.003  0.032  0.048 -0.027
Data.PosAfflag1pm:Data.dass21_anxietygm  0.000  0.015 -0.027  0.048 -0.550

Standardized Within-Group Residuals:
       Min         Q1        Med         Q3        Max
-5.3185145 -0.4543449 -0.1007131  0.3387489  8.3319837

> intervals(Damp, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                               lower          est.       upper
(Intercept)                              1.378591760  1.458195931  1.53780010
Data.PosAfflag1pm                       -0.081786274 -0.050156298 -0.01852632
Data.bdi_baselinegm                      0.005702201  0.016844945  0.02798769
Data.dass21_anxietygm                   -0.029325319  0.002721373  0.03476806
Data.PosAfflag1pm:Data.bdi_baselinegm   -0.002934931  0.001310604  0.00555614
Data.PosAfflag1pm:Data.dass21_anxietygm -0.021921601 -0.009666066  0.00258947
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                         lower       est.     upper
sd((Intercept))                     0.36323169 0.41651848 0.4776226
sd(Data.PosAfflag1pm)               0.09795685 0.12200970 0.1519686
cor((Intercept),Data.PosAfflag1pm) -0.13136309 0.06205486 0.2509215

 Within-group standard error:
    lower      est.     upper
0.4117040 0.4192542 0.4269429
```

4. Modeling the role of gender

Prior research has reported gender differences in emotion regulation with women engaging more in emotional support seeking, rumination, and positive self-talk (Tamres, Janicki, & Helgeson, 2002). To explore the role of gender differences in this study, gender was added as a Level-2 predictor of the random intercept in the multilevel models. The results revealed that women engaged less frequently in both self-focused and emotion-focused positive rumination compared to men. No gender differences emerged in the use of dampening of positive emotions. Importantly, the results reported in the main article remained unaltered after accounting for the role of gender.

A. Research Question 1

```
> PosrumSF.PA <- lme(fixed=Data.PosAff ~ 1 +  Data.PosRumSFpm + Data.bdi_baselinegm + Data.bdi_ba
selinegm*Data.PosRumSFpm + Data.Gender,
+                    random= ~ 1 + Data.PosRumSFpm | Data.ID,
+                    data=Data2,
+                    method="ML",
+                    na.action=na.exclude)
> summary(PosrumSF.PA)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
       AIC      BIC    logLik
  12189.98 12251.53 -6085.991

Random effects:
 Formula: ~1 + Data.PosRumSFpm | Data.ID
```

```
 Structure: General positive-definite, Log-Cholesky parametrization
                StdDev    Corr  
(Intercept)     0.6700293 (Intr)
Data.PosRumSFpm 0.2397655 -0.059
Residual        0.5580861       

Fixed effects: Data.PosAff ~ 1 + Data.PosRumSFpm + Data.bdi_baselinegm + Data.bdi_baselinegm * 
Data.PosRumSFpm + Data.Gender 
                                         Value  Std.Error   DF   t-value p-value
(Intercept)                          2.9884716 0.11418476 6785 26.172245  0.0000
Data.PosRumSFpm                      0.3048705 0.02747384 6785 11.096753  0.0000
Data.bdi_baselinegm                 -0.0342142 0.00745577  105 -4.588950  0.0000
Data.Gender1                        -0.2587965 0.13855501  105 -1.867825  0.0646
Data.PosRumSFpm:Data.bdi_baselinegm  0.0019014 0.00319685 6785  0.594775  0.5520
 Correlation: 
                                    (Intr) Dt.PRSF Dt.bd_ Dt.Gn1
Data.PosRumSFpm                     -0.029                      
Data.bdi_baselinegm                  0.075 -0.004               
Data.Gender1                        -0.822  0.001  -0.041       
Data.PosRumSFpm:Data.bdi_baselinegm -0.004  0.096  -0.048  0.003

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max 
-5.56165265 -0.53924448 -0.01909846  0.52852158  5.93629820 

Number of Observations: 6895
Number of Groups: 108 

> intervals(PosrumSF.PA, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                           lower        est.        upper
(Intercept)                          2.764714800  2.98847158  3.212228352
Data.PosRumSFpm                      0.251032648  0.30487047  0.358708292
Data.bdi_baselinegm                 -0.048992239 -0.03421418 -0.019436114
Data.Gender1                        -0.533425899 -0.25879654  0.015832820
Data.PosRumSFpm:Data.bdi_baselinegm -0.004363153  0.00190141  0.008165973
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID 
                                      lower        est.     upper
sd((Intercept))                   0.5855121  0.67002931 0.7667463
sd(Data.PosRumSFpm)               0.1996780  0.23976547 0.2879009
cor((Intercept),Data.PosRumSFpm) -0.3067692 -0.05859128 0.1970467

 Within-group standard error:
    lower      est.     upper 
0.5487051 0.5580861 0.5676274 

> PosrumEF.PA <- lme(fixed=Data.PosAff ~ 1 + Data.PosRumEFpm + Data.bdi_baselinegm + Data.bdi_bas
elinegm*Data.PosRumEFpm + Data.Gender,
+                    random= ~ 1 + Data.PosRumEFpm | Data.ID,
+                    data=Data2,
+                    method="ML",
+                    na.action=na.exclude)
> summary(PosrumEF.PA)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2 
      AIC      BIC    logLik
  11761.1 11822.64 -5871.551

Random effects:
 Formula: ~1 + Data.PosRumEFpm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                StdDev    Corr  
(Intercept)     0.6700444 (Intr)
Data.PosRumEFpm 0.2364224 -0.059
Residual        0.5405897       

Fixed effects: Data.PosAff ~ 1 + Data.PosRumEFpm + Data.bdi_baselinegm + Data.bdi_baselinegm * 
Data.PosRumEFpm + Data.Gender 
                                         Value  Std.Error   DF   t-value p-value
(Intercept)                          2.9819817 0.11413983 6779 26.125689  0.0000
Data.PosRumEFpm                      0.3445940 0.02638997 6779 13.057764  0.0000
Data.bdi_baselinegm                 -0.0342333 0.00745316  105 -4.593120  0.0000
Data.Gender1                        -0.2495432 0.13849632  105 -1.801804  0.0744
Data.PosRumEFpm:Data.bdi_baselinegm  0.0006008 0.00302778 6779  0.198432  0.8427
 Correlation: 
```

```
                                    (Intr) Dt.PREF Dt.bd_ Dt.Gn1
Data.PosRumEFpm                     -0.030
Data.bdi_baselinegm                  0.075 -0.004
Data.Gender1                        -0.822  0.001  -0.041
Data.PosRumEFpm:Data.bdi_baselinegm -0.003  0.069  -0.051  0.001

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max
-5.41252602 -0.54328106 -0.01296134  0.53856481  6.14367718

Number of Observations: 6889
Number of Groups: 108

> intervals(PosrumEF.PA, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                           lower           est.        upper
(Intercept)                          2.758312962  2.9819816506  3.205650339
Data.PosRumEFpm                      0.292880106  0.3445939507  0.396307796
Data.bdi_baselinegm                 -0.049006150 -0.0342332683 -0.019460387
Data.Gender1                        -0.524056148 -0.2495432044  0.024969739
Data.PosRumEFpm:Data.bdi_baselinegm -0.005332439  0.0006008088  0.006534056
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                      lower         est.     upper
sd((Intercept))                   0.5835397  0.67004435 0.7693726
sd(Data.PosRumEFpm)               0.1976421  0.23642235 0.2828118
cor((Intercept),Data.PosRumEFpm) -0.4125285 -0.05924059 0.3095380

 Within-group standard error:
    lower      est.     upper
0.5314945 0.5405897 0.5498405

> Damp.PA <- lme(fixed=Data.PosAff ~ 1 + Data.Damppm + Data.bdi_baselinegm + Data.bdi_baselinegm*
Data.Damppm + Data.Gender,
+                random= ~ 1 + Data.Damppm | Data.ID,
+                data=Data2,
+                method="ML",
+                na.action=na.exclude)
> summary(Damp.PA)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
      AIC      BIC  logLik
  12692.6 12754.14 -6337.3

Random effects:
 Formula: ~1 + Data.Damppm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
            StdDev    Corr
(Intercept) 0.6695432 (Intr)
Data.Damppm 0.3845096 -0.211
Residual    0.5796873

Fixed effects: Data.PosAff ~ 1 + Data.Damppm + Data.bdi_baselinegm + Data.bdi_baselinegm *      D
ata.Damppm + Data.Gender
                                     Value  Std.Error   DF   t-value p-value
(Intercept)                      3.0098899 0.11307384 6783 26.618799  0.0000
Data.Damppm                     -0.2994664 0.04487525 6783 -6.673310  0.0000
Data.bdi_baselinegm             -0.0341518 0.00745384  105 -4.581775  0.0000
Data.Gender1                    -0.2905949 0.13657111  105 -2.127792  0.0357
Data.Damppm:Data.bdi_baselinegm  0.0016850 0.00485531 6783  0.347040  0.7286
 Correlation:
                                (Intr) Dt.Dmp Dt.bd_ Dt.Gn1
Data.Damppm                     -0.102
Data.bdi_baselinegm              0.075 -0.013
Data.Gender1                    -0.818  0.003 -0.040
Data.Damppm:Data.bdi_baselinegm -0.010 -0.013 -0.184  0.003

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max
-5.58969125 -0.52787567 -0.02617672  0.51751463  4.83064855

Number of Observations: 6893
Number of Groups: 108
> intervals(Damp.PA, 0.95)
Approximate 95% confidence intervals
```

```
 Fixed effects:
                                       lower         est.       upper
(Intercept)                      2.788310103  3.009889909  3.23146972
Data.Damppm                     -0.387404106 -0.299466445 -0.21152878
Data.bdi_baselinegm             -0.048926039 -0.034151814 -0.01937759
Data.Gender1                    -0.561291943 -0.290594887 -0.01989783
Data.Damppm:Data.bdi_baselinegm -0.007829492  0.001684986  0.01119946
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                  lower       est.      upper
sd((Intercept))               0.5848452  0.6695432 0.76650734
sd(Data.Damppm)               0.3194498  0.3845096 0.46281955
cor((Intercept),Data.Damppm) -0.4350633 -0.2112075 0.03723819

 Within-group standard error:
    lower      est.     upper
0.5699482 0.5796873 0.5895929
```

B. Research Question 2

```
> PosrumSF <- lme(fixed=Data.PosRumSF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_ba
selinegm*Data.PosAfflag1pm + Data.Gender,
+                 random= ~ 1 + Data.PosAfflag1pm | Data.ID,
+                 data=Data2,
+                 method="ML",
+                 na.action=na.exclude)

> summary(PosrumSF)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
       AIC      BIC    logLik
  11840.03 11900.34 -5911.014

Random effects:
 Formula: ~1 + Data.PosAfflag1pm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                  StdDev    Corr
(Intercept)       0.8398647 (Intr)
Data.PosAfflag1pm 0.1224500 0.586
Residual          0.6186869

Fixed effects: Data.PosRumSF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm +      Data.bdi_baseli
negm * Data.PosAfflag1pm + Data.Gender
                                          Value  Std.Error   DF   t-value p-value
(Intercept)                           2.5256275 0.13718871 5901 18.409878  0.0000
Data.PosAfflag1pm                     0.1666942 0.01897660 5901  8.784199  0.0000
Data.bdi_baselinegm                  -0.0254105 0.00934600  105 -2.718867  0.0077
Data.Gender1                         -0.5613644 0.16288077  105 -3.446474  0.0008
Data.PosAfflag1pm:Data.bdi_baselinegm  0.0007556 0.00210989 5901  0.358112  0.7203
 Correlation:
                                      (Intr) Dt.PA1 Dt.bd_ Dt.Gn1
Data.PosAfflag1pm                      0.192
Data.bdi_baselinegm                    0.074  0.025
Data.Gender1                          -0.804  0.030 -0.038
Data.PosAfflag1pm:Data.bdi_baselinegm  0.051  0.030  0.377 -0.044

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max
-5.73117809 -0.52463183 -0.05702581  0.41262904  5.47016254

> intervals(PosrumSF, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                             lower         est.        upper
(Intercept)                            2.256799286  2.525627506  2.794455726
Data.PosAfflag1pm                      0.129508630  0.166694239  0.203879847
Data.bdi_baselinegm                   -0.043934188 -0.025410515 -0.006886841
Data.Gender1                          -0.884192495 -0.561364373 -0.238536251
Data.PosAfflag1pm:Data.bdi_baselinegm -0.003378855  0.000755577  0.004890009
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                        lower      est.     upper
sd((Intercept))                    0.73299987 0.8398647 0.9623094
```

```
sd(Data.PosAfflag1pm)              0.08646481 0.1224500 0.1734116
cor((Intercept),Data.PosAfflag1pm) 0.26532701 0.5863867 0.7903835

 Within-group standard error:
    lower      est.     upper 
0.6075369 0.6186869 0.6300416 

> PosrumEF <- lme(fixed=Data.PosRumEF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_ba
selinegm*Data.PosAfflag1pm + Data.Gender,
+                 random= ~ 1 + Data.PosAfflag1pm | Data.ID,
+                 data=Data2,
+                 method="ML",
+                 na.action=na.exclude)

> summary(PosrumEF)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2 
      AIC   BIC    logLik
  12162.7 12223 -6072.349

Random effects:
 Formula: ~1 + Data.PosAfflag1pm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                  StdDev    Corr  
(Intercept)       0.7571499 (Intr)
Data.PosAfflag1pm 0.1797162 0.357 
Residual          0.6353923       

Fixed effects: Data.PosRumEF ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm +      Data.bdi_baseli
negm * Data.PosAfflag1pm + Data.Gender 
                                           Value  Std.Error   DF   t-value p-value
(Intercept)                            2.6219883 0.12657810 5895 20.714391  0.0000
Data.PosAfflag1pm                      0.2090272 0.02392152 5895  8.738040  0.0000
Data.bdi_baselinegm                   -0.0154555 0.00844160  105 -1.830871  0.0700
Data.Gender1                          -0.6739305 0.15200552  105 -4.433593  0.0000
Data.PosAfflag1pm:Data.bdi_baselinegm  0.0008933 0.00268188 5895  0.333104  0.7391
 Correlation: 
                                      (Intr) Dt.PA1 Dt.bd_ Dt.Gn1
Data.PosAfflag1pm                      0.137                     
Data.bdi_baselinegm                    0.075  0.018              
Data.Gender1                          -0.813  0.016 -0.040       
Data.PosAfflag1pm:Data.bdi_baselinegm  0.033  0.046  0.265 -0.026

Standardized Within-Group Residuals:
       Min         Q1        Med         Q3        Max 
-5.7709519 -0.5563812 -0.0623344  0.4837222  4.7613748 

> intervals(PosrumEF, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                             lower          est.        upper
(Intercept)                            2.373952127  2.6219882724  2.870024417
Data.PosAfflag1pm                      0.162151804  0.2090272299  0.255902656
Data.bdi_baselinegm                   -0.032186655 -0.0154554866  0.001275682
Data.Gender1                          -0.975203902 -0.6739305453 -0.372657188
Data.PosAfflag1pm:Data.bdi_baselinegm -0.004361927  0.0008933451  0.006148617
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID 
                                        lower      est.     upper
sd((Intercept))                    0.66147930 0.7571499 0.8666576
sd(Data.PosAfflag1pm)              0.14005265 0.1797162 0.2306128
cor((Intercept),Data.PosAfflag1pm) 0.07435744 0.3570557 0.5866349

 Within-group standard error:
    lower      est.     upper 
0.6239252 0.6353923 0.6470701 

> Damp <- lme(fixed=Data.Damp ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_baselinegm
*Data.PosAfflag1pm + Data.Gender,
+             random= ~ 1 + Data.PosAfflag1pm | Data.ID,
+             data=Data2,
+             method="ML",
+             na.action=na.exclude)

> summary(Damp)
Linear mixed-effects model fit by maximum likelihood
```

```
 Data: Data2
      AIC      BIC    logLik
  7146.93 7207.239 -3564.465

Random effects:
 Formula: ~1 + Data.PosAfflag1pm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                  StdDev    Corr
(Intercept)       0.4142045 (Intr)
Data.PosAfflag1pm 0.1228560 0.054
Residual          0.4193112

Fixed effects: Data.Damp ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_baselinegm *
Data.PosAfflag1pm + Data.Gender
                                          Value  Std.Error   DF   t-value p-value
(Intercept)                           1.5218119 0.07095602 5899 21.447257  0.0000
Data.PosAfflag1pm                    -0.0498381 0.01620967 5899 -3.074588  0.0021
Data.bdi_baselinegm                   0.0175842 0.00463498  105  3.793804  0.0002
Data.Gender1                         -0.0939468 0.08610648  105 -1.091054  0.2777
Data.PosAfflag1pm:Data.bdi_baselinegm -0.0005133 0.00181818 5899 -0.282310  0.7777
 Correlation:
                                      (Intr) Dt.PA1 Dt.bd_ Dt.Gn1
Data.PosAfflag1pm                      0.021
Data.bdi_baselinegm                    0.075  0.003
Data.Gender1                          -0.822  0.002 -0.041
Data.PosAfflag1pm:Data.bdi_baselinegm  0.005  0.048  0.043 -0.004

Standardized Within-Group Residuals:
       Min         Q1        Med         Q3        Max
-5.3175314 -0.4568949 -0.1039898  0.3431461  8.3124622

Number of Observations: 6009
Number of Groups: 108

> intervals(Damp, 0.95)
Approximate 95% confidence intervals

 Fixed effects:
                                             lower          est.        upper
(Intercept)                            1.382770052  1.5218119454  1.660853839
Data.PosAfflag1pm                     -0.081601713 -0.0498380531 -0.018074393
Data.bdi_baselinegm                    0.008397722  0.0175842072  0.026770692
Data.Gender1                          -0.264608995 -0.0939467963  0.076715402
Data.PosAfflag1pm:Data.bdi_baselinegm -0.004076115 -0.0005132908  0.003049534
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                         lower      est.     upper
sd((Intercept))                     0.36122576 0.4142045 0.4749534
sd(Data.PosAfflag1pm)               0.09837928 0.1228560 0.1534226
cor((Intercept),Data.PosAfflag1pm) -0.27971997 0.0541789 0.3763858

 Within-group standard error:
    lower      est.     upper
0.4117575 0.4193112 0.4270034
```

Supplement 4: Item-based exploratory analyses for dampening

The analyses below examine potential differential relations between the dampening items and mo mentary positive affect. All three dampening items were related to concurrent positive emotions a nd positive emotions predicted subsequent dampening behaviors (in particular item 1 and item 2).

A. Research Question 1

```
Damp.itemlevel<- lme(fixed=Data.PosAff ~ 1 + Damp1pm + Damp2pm + Damp3pm + Data.bdi_baselinegm
+                       + Data.bdi_baselinegm*Damp1pm + Data.bdi_baselinegm*Damp2pm + Data.bdi_ba
selinegm*Damp3pm,
+                       random= ~ 1 + Data.Damppm | Data.ID,
+                       data=Data2,
+                       method="ML",
+                       na.action=na.exclude)
> summary(Damp.itemlevel)
Linear mixed-effects model fit by maximum likelihood
```

```
 Data: Data2
       AIC      BIC   logLik
  12693.28 12775.34 -6334.64

Random effects:
 Formula: ~1 + Data.Damppm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
           StdDev    Corr
(Intercept) 0.6807945 (Intr)
Data.Damppm 0.3777105 -0.186
Residual    0.5793840

Fixed effects: Data.PosAff ~ 1 + Damp1pm + Damp2pm + Damp3pm + Data.bdi_baselinegm +      Data.bd
i_baselinegm * Damp1pm + Data.bdi_baselinegm * Damp2pm +      Data.bdi_baselinegm * Damp3pm
                                Value  Std.Error   DF  t-value p-value
(Intercept)                 2.8127647 0.06612073 6779 42.53983  0.0000
Damp1pm                    -0.0622930 0.02159663 6779 -2.88438  0.0039
Damp2pm                    -0.0980160 0.02097360 6779 -4.67330  0.0000
Damp3pm                    -0.1189290 0.01684647 6779 -7.05958  0.0000
Data.bdi_baselinegm        -0.0347904 0.00757278  106 -4.59414  0.0000
Damp1pm:Data.bdi_baselinegm  0.0020216 0.00223681 6779  0.90380  0.3661
Damp2pm:Data.bdi_baselinegm  0.0010920 0.00211909 6779  0.51530  0.6064
Damp3pm:Data.bdi_baselinegm -0.0010073 0.00186964 6779 -0.53876  0.5901
 Correlation:
                            (Intr) Dmp1pm Dmp2pm Dmp3pm Dt.bd_ D1:D._ D2:D._
Damp1pm                     -0.104
Damp2pm                     -0.107  0.335
Damp3pm                     -0.134  0.370  0.434
Data.bdi_baselinegm          0.073 -0.008 -0.008 -0.010
Damp1pm:Data.bdi_baselinegm -0.008 -0.161  0.033  0.023 -0.115
Damp2pm:Data.bdi_baselinegm -0.009  0.029 -0.082 -0.011 -0.122  0.384
Damp3pm:Data.bdi_baselinegm -0.010  0.029 -0.015  0.010 -0.138  0.378  0.468

Standardized Within-Group Residuals:
        Min          Q1         Med          Q3         Max
-5.67304740 -0.52785224 -0.03006535  0.51893402  4.83006151

Number of Observations: 6893
Number of Groups: 108
> intervals(Damp.itemlevel)
Approximate 95% confidence intervals

 Fixed effects:
                                   lower          est.         upper
(Intercept)                  2.683222528  2.812764680  2.942306832
Damp1pm                     -0.104604579 -0.062292981 -0.019981384
Damp2pm                     -0.139106967 -0.098015998 -0.056925028
Damp3pm                     -0.151934235 -0.118929040 -0.085923846
Data.bdi_baselinegm         -0.049795430 -0.034790379 -0.019785329
Damp1pm:Data.bdi_baselinegm -0.002360679  0.002021634  0.006403947
Damp2pm:Data.bdi_baselinegm -0.003059700  0.001091962  0.005243624
Damp3pm:Data.bdi_baselinegm -0.004670236 -0.001007280  0.002655676
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                 lower       est.      upper
sd((Intercept))              0.5948254  0.6807945 0.77918852
sd(Data.Damppm)              0.3132684  0.3777105 0.45540876
cor((Intercept),Data.Damppm) -0.4152298 -0.1864759 0.06445735
```

B. Research Question 2

Dampening Item 1

```
Damp1RQ2 <- lme(fixed=Data.Damp1 ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_baselin
egm*Data.PosAfflag1pm,
+             random= ~ 1 + Data.PosAfflag1pm | Data.ID,
+             data=Data2,
+             method="ML",
+             na.action=na.exclude)
> summary(Damp1RQ2)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
       AIC      BIC    logLik
  9654.821 9708.432 -4819.411

Random effects:
```

```
 Formula: ~1 + Data.PosAfflag1pm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                  StdDev    Corr  
(Intercept)       0.4801121 (Intr)
Data.PosAfflag1pm 0.1141857 -0.048
Residual          0.5184061       

Fixed effects: Data.Damp1 ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_baselinegm * 
Data.PosAfflag1pm 
                                         Value  Std.Error   DF   t-value p-value
(Intercept)                          1.3276031 0.04689355 5901 28.310997  0.0000
Data.PosAfflag1pm                   -0.0373484 0.01706594 5901 -2.188476  0.0287
Data.bdi_baselinegm                  0.0145208 0.00537593  106  2.701076  0.0080
Data.PosAfflag1pm:Data.bdi_baselinegm -0.0013843 0.00190173 5901 -0.727940  0.4667
 Correlation: 
                                      (Intr) Dt.PA1 Dt.bd_
Data.PosAfflag1pm                     -0.030              
Data.bdi_baselinegm                    0.073 -0.002       
Data.PosAfflag1pm:Data.bdi_baselinegm -0.002  0.038 -0.029

Standardized Within-Group Residuals:
         Min           Q1          Med           Q3          Max 
-4.813685209 -0.289661696 -0.055717829 -0.003983754  7.596104923 

Number of Observations: 6011
Number of Groups: 108 
> intervals(Damp1RQ2)
Approximate 95% confidence intervals

 Fixed effects:
                                             lower         est.        upper
(Intercept)                            1.235705168  1.327603098  1.419501029
Data.PosAfflag1pm                     -0.070792741 -0.037348394 -0.003904046
Data.bdi_baselinegm                    0.003866040  0.014520803  0.025175566
Data.PosAfflag1pm:Data.bdi_baselinegm -0.005111184 -0.001384344  0.002342497
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID 
                                        lower        est.     upper
sd((Intercept))                    0.41847085  0.48011211 0.5508332
sd(Data.PosAfflag1pm)              0.08630761  0.11418569 0.1510686
cor((Intercept),Data.PosAfflag1pm) -0.33845753 -0.04801463 0.2507813

 Within-group standard error:
    lower      est.     upper 
0.5090759 0.5184061 0.5279072 
```

Dampening Item 2

```
Damp2RQ2 <- lme(fixed=Data.Damp2 ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_baselin
egm*Data.PosAfflag1pm,
+               random= ~ 1 + Data.PosAfflag1pm | Data.ID,
+               data=Data2,
+               method="ML",
+               na.action=na.exclude)
> summary(Damp2RQ2)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2 
       AIC      BIC    logLik
  9724.211 9777.821 -4854.105

Random effects:
 Formula: ~1 + Data.PosAfflag1pm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                  StdDev    Corr  
(Intercept)       0.4334483 (Intr)
Data.PosAfflag1pm 0.1071200 0.149 
Residual          0.5227219       

Fixed effects: Data.Damp2 ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_baselinegm * 
Data.PosAfflag1pm 
                                         Value  Std.Error   DF   t-value p-value
(Intercept)                          1.3021321 0.04245785 5901 30.668817  0.0000
Data.PosAfflag1pm                   -0.0276472 0.01658193 5901 -1.667308  0.0955
Data.bdi_baselinegm                  0.0150125 0.00486900  106  3.083275  0.0026
Data.PosAfflag1pm:Data.bdi_baselinegm -0.0020991 0.00184458 5901 -1.138002  0.2552
 Correlation: 
                                      (Intr) Dt.PA1 Dt.bd_
```

```
Data.PosAfflag1pm                     0.093
Data.bdi_baselinegm                   0.073  0.007
Data.PosAfflag1pm:Data.bdi_baselinegm 0.007  0.034  0.097

Standardized Within-Group Residuals:
         Min           Q1          Med           Q3          Max
-4.338759292 -0.273991652 -0.048275723 -0.005462143  7.448866591

Number of Observations: 6011
Number of Groups: 108
> intervals(Damp2RQ2)
Approximate 95% confidence intervals

 Fixed effects:
                                             lower         est.       upper
(Intercept)                            1.218926858  1.302132091 1.385337325
Data.PosAfflag1pm                     -0.060143018 -0.027647182 0.004848654
Data.bdi_baselinegm                    0.005362408  0.015012454 0.024662500
Data.PosAfflag1pm:Data.bdi_baselinegm -0.005713985 -0.002099135 0.001515714
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                         lower      est.     upper
sd((Intercept))                     0.37761041 0.4334483 0.4975431
sd(Data.PosAfflag1pm)               0.08069688 0.1071200 0.1421949
cor((Intercept),Data.PosAfflag1pm) -0.14990755 0.1485731 0.4222343

 Within-group standard error:
    lower      est.     upper
0.5133149 0.5227219 0.5323013
```

Dampening Item 3

```
Damp3RQ2 <- lme(fixed=Data.Damp3 ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_baselin
egm*Data.PosAfflag1pm,
+               random= ~ 1 + Data.PosAfflag1pm | Data.ID,
+               data=Data2,
+               method="ML",
+               na.action=na.exclude)
> summary(Damp3RQ2)
Linear mixed-effects model fit by maximum likelihood
 Data: Data2
       AIC      BIC    logLik
  13490.41 13544.03 -6737.206

Random effects:
 Formula: ~1 + Data.PosAfflag1pm | Data.ID
 Structure: General positive-definite, Log-Cholesky parametrization
                  StdDev    Corr
(Intercept)       0.4894387 (Intr)
Data.PosAfflag1pm 0.2073486 -0.159
Residual          0.7151380

Fixed effects: Data.Damp3 ~ 1 + Data.PosAfflag1pm + Data.bdi_baselinegm + Data.bdi_baselinegm *
Data.PosAfflag1pm
                                           Value  Std.Error   DF  t-value p-value
(Intercept)                            1.7448121 0.04826659 5903 36.14948  0.0000
Data.PosAfflag1pm                     -0.0787007 0.02743433 5903 -2.86869  0.0041
Data.bdi_baselinegm                    0.0225692 0.00553904  106  4.07456  0.0001
Data.PosAfflag1pm:Data.bdi_baselinegm  0.0012312 0.00307639 5903  0.40021  0.6890
 Correlation:
                                      (Intr) Dt.PA1 Dt.bd_
Data.PosAfflag1pm                     -0.113
Data.bdi_baselinegm                    0.073 -0.008
Data.PosAfflag1pm:Data.bdi_baselinegm -0.008  0.047 -0.113

Standardized Within-Group Residuals:
       Min         Q1        Med         Q3        Max
-3.0080718 -0.5285363 -0.1236434  0.3396478  5.4896024

Number of Observations: 6013
Number of Groups: 108
> intervals(Damp3RQ2)
Approximate 95% confidence intervals

 Fixed effects:
                                             lower         est.        upper
(Intercept)                            1.650223378  1.744812085  1.839400793
```

```
Data.PosAfflag1pm                      -0.132464118 -0.078700677 -0.024937235
Data.bdi_baselinegm                     0.011591135  0.022569174  0.033547214
Data.PosAfflag1pm:Data.bdi_baselinegm -0.004797627  0.001231211  0.007260048
attr(,"label")
[1] "Fixed effects:"

 Random Effects:
  Level: Data.ID
                                     lower       est.      upper
sd((Intercept))                  0.4254725  0.4894387 0.56302163
sd(Data.PosAfflag1pm)            0.1649080  0.2073486 0.26071169
cor((Intercept),Data.PosAfflag1pm) -0.3977327 -0.1594556 0.09897151

 Within-group standard error:
    lower      est.     upper
0.7022606 0.7151380 0.7282515
```