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A Darker Shade of Blue:
Depression Predicts Distortion in Memory for Daily Emotional Experience

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TABLE OF CONTENTS

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ABSTRACT OF THE THESIS

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Professor Susan T. Charles, Chair

Memories for emotional experiences are influenced by a person's mood at the time of recall. This makes evaluating memory accuracy particularly challenging when asking about the daily experiences of people with a history of depression. People who report depressive symptoms typically experience negative moods and report more negative life experiences. As a result, it is unclear the extent to which their memories reflect a negativity bias based on their negative mood at the time of recall, or instead accurately represent their prior experiences. Using data from a daily diary study (N = 1,657), the association between meeting criteria for depression in the past year and bias in memory for positive and negative emotional experiences that occurred during the prior week was examined. It was further tested whether trait negative affect (TNA) and trait positive affect (TPA) explained these associations. Overall, people recalled more negative emotional experiences from the past week than they had indicated in daily reports. Recalled negative emotions, but not positive emotions, differed more from daily reports for those with a recent history of depression. TNA fully explained this association, and both TNA and TPA influenced how emotions were recalled. Specifically, higher TNA was related to greater

overestimation, and higher TPA was related to less overestimation, in recalling negative emotions.

Introduction

People's most vivid memories are often those that contain emotional content (Brown & Kulik, 1977; Rubin & Kozin, 1984; Talarico & Rubin, 2003). Although intense emotional experiences are often most salient in memory, the *accuracy* of emotional memories is disputed (e.g., Levine, 1997; Loftus, 2003; Loftus & Pickrell, 1995). For instance, a person's current mood often influences what is remembered from an earlier experience (Bower, 1981; Levine, Lench, & Safer, 2009). Teasing apart how current mood influences memory for past emotions may be particularly challenging when assessing the memories of people who have been diagnosed with clinical levels of depression (Mathews & MacLeod, 2005). People who report more frequent negative life stressors are more likely to report decreased subjective well-being and greater psychological distress (e.g., Almeida, 2005; Headey, Holmstrom, & Wearing, 1984; Mathews & MacLeod, 2005). Thus, more negative memories might reflect the fact that people with high levels of depressive symptoms actually experience more frequent negative events and emotions in their daily lives, as their diagnosis would indicate. Another possibility, however, is that people with depression suffer from a mood congruent negativity bias when recalling their autobiographical experiences (e.g., Hertel & Brozovich, 2010; Mathews & MacLeod, 2005).

People with a history of depression or dysphoria typically experience persistent negative moods, score higher on trait negative affect (TNA), and lower on trait positive affect (TPA), than non-depressed individuals (e.g., Watson, Clark, & Carey, 1988; Wisco & Nolen-Hoeksema, 2009). Trait affect, as compared to state affect, represents more stable and consistent levels of affect measured over longer intervals of time. As a result of persistent negative moods, people living with depression may remember daily events, and their emotional responses to them, more negatively than the events were experienced at the time. Using a daily-diary method, the current

study examined consistency between daily reports and end-of-week recollections of emotional experiences across 8 days and how discrepancies in these reports are associated with meeting the criteria for a depressive disorder. It was further examined whether trait levels of negative and positive affect underlie this association.

The importance of emotional memories. Emotions help guide current and future behavior, orienting us to information that is relevant to our goals and concerns in the immediate environment (Fredrickson, 1998). Memories of emotional experiences allow us to apply what we learned from the past to present situations. Although emotional memories are not always an accurate reproduction of the original emotional experience, these memories are arguably more important for future behavior than what was actually experienced (Levine et al., 2009). For example, study participants undergoing a cold pressor task were more willing to repeat the trial that they *remembered* as being less painful as opposed to the trial that they had *reported in real-time* as being less painful (Kahneman, Fredrickson, Schreiber, & Redelmeier, 1993). Another study revealed that remembered emotion about a spring break vacation was more predictive of students' willingness to take a similar vacation in the future than either expected or experienced emotion (Wirtz, Kruger, Scollon, & Diener, 2003).

Mood congruent emotional memory. Research on mood congruent memory indicates that a person's mood at the time of retrieval can influence the content and tone of retrieved memories (Blaney, 1986; Bower, 1981; Eich & Forgas, 2003; Mathews & MacLeod, 2005; Matt, Vazquez, & Campbell, 1992). The mood a person is experiencing at a given moment increases the accessibility of information related to that mood from memory. Researchers often refer to mood congruent memory as biased rather than accurate reproductions of past experiences in the sense that memories associated with the congruent mood are reported disproportionately

compared with memories not congruent with the current mood. Mood congruent recall may be functional as memories of past experiences that closely resemble the present situation can aid in decision making processes. People in negative moods may recall more negative memories in the hopes that the past will provide a helpful guide for current behavior. However, when people are in a consistent, repetitive negative mood, such as those suffering from depression, recalling negative experiences may promote rumination and reinforce a cycle of negativity (Wisco & Nolen-Hoeksema, 2010).

Depression and memory for emotions. The negative affective and cognitive biases that characterize depressive disorders are well-documented (e.g., Beck, 1967; Gotlib & Joorman, 2010). Depression is related to higher TNA and lower TPA, where individuals suffering from depression are more likely to experience persistent, negative moods and a lack of positive moods (Watson et al., 1988; Wisco & Nolen-Hoeksema, 2009). In addition, individuals diagnosed with depressive disorders are thought to hold distorted, negative views of the world, themselves, and their experiences (Beck, 1967; Gotlib & Joorman, 2010). These maladaptive thoughts both predispose individuals for depression and promote the continuation of the disorder (Gotlib & Joorman, 2010).

People with clinical and sub-clinical levels of depression tend to retrieve more negative than positive memories of their own past experiences as well as laboratory stimuli relative to their non-depressed counterparts (e.g., Gaddy & Ingram, 2014; Mathews & MacLeod, 1994), though there is are some discrepancies in the literature regarding induced negative mood versus naturally occurring mood states (e.g., Joorman, Teachman, & Gotlib, 2009). These more negative memories may reflect a mood congruent memory bias related to their depression, where negative information is exaggerated due to higher TNA. Without documenting their daily

emotional experiences, however, researchers cannot rule out the possibility that these people are actually experiencing, and thus accurately remembering, the distress in their daily lives. For example, people with depression sometimes display depressive realism about past experiences, displaying greater memory accuracy than non-depressed individuals (Alloy & Abramson, 1979; Almeida, 2005; Mathews & MacLeod, 2005; Taylor & Brown, 1988). Assessing the accuracy of emotional memories in relation to depression has important clinical applications. Clinical interviews often occur on a weekly basis, and generally rely on retrospective reports made by depressed clients. Understanding whether such reports are biased in the direction of current mood is important for forming an accurate picture of people's daily lives and thus can be used to inform therapeutic interventions.

The current research. To further investigate the relationship between depression history, trait positive and negative affect, and emotional memory bias, end-of-day reports of emotion, averaged across a week, were compared to end-of-week retrospective reports of these same positive and negative emotional experiences. End-of-day reports are also retrospective reports of emotional experience and are therefore susceptible to bias themselves, but these measures allowed us to examine whether discrepancies exist when comparing emotional experiences across differing time intervals.

Based on prior research on memory for emotion, it was hypothesized that people would have a tendency to overestimate the frequency with which they had experienced both positive and negative emotion (Levine et al., 2009). In addition to evaluating overall differences in these reports, differences in reports were examined between people with a history of meeting the criteria for a clinical diagnosis of depression and those without such a history. It was hypothesized that, relative to people with no recent history of depression, those who met the

criteria for a diagnosis of depression would report lower frequencies of positive emotion and higher frequencies of negative emotion both during the week and when later recalling their weekly emotional experiences. It was further hypothesized that people meeting the criteria for depression would show greater inconsistencies between their experienced and recalled emotional experiences, such that their weekly reports would be significantly more negative and less positive than their daily reports. Finally, it was predicted that emotional memory inconsistencies observed for people with a depression history would be driven by the experience of persistent negative affect. Thus, mood congruency effects for both TNA and TPA were examined, where people high in TNA were expected to recall relatively more negative and less positive daily experiences than they had endorsed during the daily interviews. Similarly, people higher in TPA were expected to report more positive and less negative experiences than they had endorsed during daily interviews.

Method

Sample and Design

Participants for the current analyses were recruited from the second National Study of Daily Experiences (NSDE II), a part of the Midlife in the United States Study II (MIDUS II) which took place between 2004 and 2006. Participants first completed MIDUS II questionnaires assessing demographic information, trait affect, and depression, in addition to other health variables. Participants were later contacted by research personnel via telephone to complete the daily diary portion of the study across eight consecutive days (NSDE II). Diary data were collected over the span of a year and 40 "flights", where approximately 38 respondents were interviewed during each flight. Every day, participants shared information on their emotional experiences over the past 24 hours. Past research has found that end-of-day reports are highly

correlated with momentary reports recorded during the day, demonstrating the validity of using end-of-day reports to gather accurate information on daily emotional experiences (Diener & Emmons, 1984; Almeida, Wethington, & Kessler, 2002). On the final day of the diary study, participants provided estimates of their average emotional experiences across the past seven days.

A total of 2,022 people completed the initial MIDUS II questionnaires and participated in the NSDE II. Due to missing data on key variables, participants were excluded listwise for the model testing the main hypothesis, resulting in 1,657 participants for this analysis. Participants were 56% female and ranged in age from 33 - 84 (M = 56.24). Most of the sample had more than a high school education (70.4%) and most were Caucasian (92.1%, 3.2% African American, 4.7% other ethnicities).

Measures

Demographics information. Demographic information was collected through phone interviews, self-administered questionnaires, and daily diary study. Demographic variables included participant age, gender, ethnicity, and highest level of education completed. Participants were placed into one of 12 categories of highest level of education completed based on their response to the question of what the highest grade of school or year of college they completed. These groups include: no school/some grade school; eight grade/junior high school; some high school (no diploma or GED); GED; graduated from high school; 1 to 2 years of college (no degree yet); 3 or more years of college (no degree yet); graduated from a two-year college or vocational school/associate's degree; graduated from a four- or five-year college/bachelor's degree; some graduate school; Master's degree; professional degree (Ph.D., Ed.D., MD, DDS, LLB, LLD, JD).

Trait affect. Trait positive and negative affect were assessed in the initial MIDUS II questionnaire. Participants were asked how much of the time in the past 30 days they felt each of 13 positive and 14 negative emotion variables. The positive emotion items included feeling cheerful, in good spirits, extremely happy, calm and peaceful, satisfied, full of life, enthusiastic, attentive, proud, active, close to others, like you belong, and confident ($\alpha = .94$). The negative emotion items included feeling worthless, so sad nothing could cheer you up, nervous, restless or fidgety, hopeless, that everything was an effort, worthless, afraid, jittery, irritable, ashamed, upset, lonely, angry, and frustrated, ($\alpha = .92$). Items were initially coded on a scale from 1 to 5 (all of the time to none of the time), but were reverse-coded and transformed into a scale from 0 to 4 (none of the time to all of the time) to mirror the daily affect scale. The positive item ratings were averaged to create the TPA score. Likewise, negative item ratings were averaged to create the TNA score.

Daily experienced emotion. Reports of daily positive and negative emotional experiences were collected through daily diary information. Each day, participants reported how much of the time during that day they felt each of 13 positive and 14 negative emotions on a scale of 0 to 4 (none of the time to all of the time). The positive emotion and negative emotions matched those used to assess trait affect.

Experienced positive emotion. For each individual, the frequency of all positive affect items for each day were averaged to calculate the average daily frequency of positive emotions. Next, these daily values, $\alpha = .96$, were averaged. This produced one value reflecting the average frequency of positive emotions experienced during the week.

Experienced negative emotion. **T**he same technique was used to calculate an average daily level of negative emotion. Responses to the 14 negative items were averaged together for

each day. The daily scores, $\alpha = .90$, were then averaged to create one score reflecting the average frequency of negative emotions experienced during the week.

Recalled emotion. On the eighth day of the daily diary study, participants were asked to think over the past week and rate how frequently they felt each of the same 13 positive and 14 negative emotion items on a scale of 0 to 4 (none of the time to all of the time). The 13 positive emotion frequencies were averaged, resulting in one recalled positive emotion score. Similarly, the 14 negative emotion frequencies were averaged to get one recalled negative emotion score (recalled positive: $\alpha = .95$; recalled negative: $\alpha = .88$).

History of a depression diagnosis. In the initial MIDUS II telephone interview, participants were screened for symptoms that met criteria for a depressive disorder using the Composite International Diagnostic Interview Short Form (CIDI-SF; Kessler, Andrews, Mroczek, Ustun, & Wittchen, 1998). This measure was developed using criteria from the DSM-III-R (American Psychiatric Association, 1987) by the World Health Organization. Participants were asked whether they felt sad, blue, or depressed for two weeks or more in a row during the past 12 month period. The 353 (of the total 1,657) who reported yes were then asked, on the days they felt depressed, how much of the day they felt depressed. Those who reported feeling depressed at least most of the day ($n = 198$) were further asked how frequently they felt their most depressed. If they responded feeling their worst almost every day during the two week period ($n = 184$), they were screened for experiencing seven different depressive symptoms (e.g., losing interest in most things, feeling tired out, loss of appetite) and six anhedonia symptoms (e.g., feeling low on energy, having trouble concentrating) for the duration of the time they felt depressed in the preceding 12 months. Based on the DSM-III-R guidelines, participants met the criteria for a depressive disorder if they reported feeling at least 4 of the depressed affect items or

4 of the anhedonia items almost every day for most days. Participants were given a score of either 0 or 1 for having met criteria. Because this measure was assessed prior to the daily diary study and it was not possible to ascertain whether people were currently depressed or were no longer depressed, this measure is referred to as indicating a history of depression.

Results

A total of 158 (9.5%) participants reported symptoms that met the criteria for having a clinical diagnosis of depression (depression group) in the prior year and 1,499 did not meet criteria (non-depressed group). Age, gender, and education were examined as potential covariates. Age was included because of the well-documented positive relationship between age and affective well-being (see Reed & Carstensen, 2012 for a review). Consistent with prior research, age was related to significantly higher positive emotion (experienced: $r = .20$, $p < .01$; recalled: $r = .17$, $p < .01$) and lower negative emotion (experienced: $r = -.16$, $p < .01$; recalled: $r = -.23$, $p < .01$). Furthermore, individuals who met criteria for a clinical diagnosis of a depressive episode in the past year were younger than those not meeting criteria; $r = -.12$, $p < .01$; $t\,(1840) = 5.26$, $p < .001$. Compared to men, women reported greater negative emotion: experienced: $t(1945.45) = -3.03$, $p = .003$; recalled: $t(1726.56) = -4.19$, $p < .001$; but men and women did not report significantly different levels of positive emotion. Women were also more likely than men to have met the criteria for a clinical diagnosis of depression , $\chi^2(1) = 20.94$, $p < .001$, consistent with the higher rates of depression among women (Nolen-Hoeksema, 2001).

Higher levels of education have been associated with lower levels of emotional distress (e.g., Grzywacz, Almeida, Neupert & Ettner, 2004). Associations between emotion and education were examined using Spearman' rho correlations based on the ordinal measurement scale for education. In contrast to prior research, more education was not related to experienced

negative emotion (r_{rho} = .003), and was slightly related to greater negative recalled emotion (r_{rho} = .07, p = .005), lower positive experienced emotion (r_{rho} =.06, p =.014), and lower positive recalled emotion (r_{rho} = -.07, p =.04). Individuals with less education were slightly more likely to have a history of depression (r_{rho} = -.04, p = .02). Education was also related to younger age (r_{rho} = -.12, p <.01). As a result, age, gender, and education were included as covariates in all models.

Hypothesis Testing

A General Linear Model (GLM) was used to examine how experienced emotion versus recollected emotion (Report Type) varied for both negative versus positive emotion (Valence) within individuals, and how these reports varied as a function of meeting the criteria for depression (between-subject variable: depression group). For all of these analyses, the between-subject covariates of age, gender, and education level were included to explore their potential interactions with the affective reports. For these exploratory interactions with the covariates, the stricter $p < .01$ criterion will be adhered to rather than $p < .05$, given a lack of a priori predictions.

Depression history and emotional experience. It was predicted that people reporting a history of depression would report less positive and more negative emotion for both their experiences during the week and their recollections at the end of the week, indicated by a significant interaction between depression group and valence. It was further predicted that people with a history of depression would recall more negative and less positive emotions at the end of the week compared to their averaged daily reports than would people without a depression history, as indicated by a significant three-way interaction between valence, type of recall, and depression group. Results of the GLM examining how depression history relates to average reports and end of week recollections of emotional experience are presented in Appendix A).

Significant two-way interactions, one between depression and valence, and another between depression and report type were further qualified by a three-way interaction between valence, report type, and depression, F (1, 1651) = 18.12, $p < .001$, $\eta^2 = .011$.

As predicted, the depressed group reported higher levels of experienced negative emotion (depressed M = .36, SE = .018; non-depressed M =.16, SE = .005) and recalled negative emotion (depressed M = 0.68, SE = .032; non-depressed M = 0.35, SE = .009). They also reported experiencing lower positive emotion (depressed M = 2.36, SE = .058; non-depressed M = 2.79, SE = .017) and recalled lower positive emotion at the end of the week (depressed M = 2.37, SE = .057; non-depressed M = 2.82, SD = .017). In addition, both the depressed group and the non-depressed group reported higher frequency of positive than negative emotion.

Comparisons between experienced and recalled affect indicated that the depressed group overestimated the amount of negative emotion during recall significantly more than did the non-depressed group, (see Appendix C; depressed M_{diff} = 0.32*;* non-depressed M_{diff} = 0.19). In contrast to the hypotheses, however, the discrepancy between reports was significant only for *negative* emotion; experienced and recalled positive emotion did not differ significantly for either group (depressed M_{diff} = 0.01*;* non-depressed M_{diff} = 0.03*).*

Appendix A presents additional findings not qualified by the interactions described above that include interactions with covariates. Because there were no apriori hypotheses, only results involving covariates that are significant at $p < .01$ as opposed to the less stringent $p < .05$ will be discussed. Significant effects of age, valence and age, and report type and age were further qualified by a three-way interaction between age, valence, and report type. Age was related to a greater frequency of positive and a lower frequency of negative emotions for both

experienced and recalled. Moreover, age was related to a smaller difference between these report types.

Trait affect. To investigate whether greater negative mood or lower positive mood explains this depressive emotional memory discrepancy rather than other factors related to the *diagnosis* of depression, a series of GLM analyses incorporating TNA and TPA as covariates (in addition to the covariates of age, gender, and education) were run. Due to some participants missing data on trait affect, the total sample size for the GLM including TPA was 1,589 (150 depressed, and 1,439 non-depressed). The sample size for the GLM including TNA was 1,587 (152 depressed and 1,435 non-depressed).

When TNA was included in the model, the two-way interaction between report type and depression ($F(1, 1580) = 0.10$, $p = .753$), and the three-way interaction between Valence, Report Type, and depression were no longer significant ($F(1, 1580) = 1.61$, $p = .205$). There was, however, a main effect of TNA ($F(1, 1580) = 78.80$, $p < .001$, $\eta^2 = .048$), a significant two-way interaction between Report Type and TNA ($F(1, 1580) = 81.93$, $p < .001$, $\eta^2 = .049$), and a significant three-way interaction between Valence, Report Type, and TNA ($F(1, 1580) = 40.31$, $p < .001$, $\eta^2 = .025$). Higher TNA was related to higher experienced and recalled negative emotion and lower experienced and recalled positive emotion. TNA was not related to inconsistency between positive emotion reports, but having higher TNA was related to recalling more negative emotion at the end of the week. Thus, higher levels of TNA accounted for differences in reports between people with and without a history of a depressive disorder.

To find out if low levels of TPA would also account for this association, a separate model adjusting for just TPA (in addition to the covariates of age, gender, and education) examined differences by depression history. Just as with TNA, the report type by depression interaction

was non-significant. ($F(1, 1582) = .03$, $p = .864$), but the three-way interaction between Valence, Report Type, and depression was significant ($F(1, 1582) = 4.83$, $p = .028$, $\eta^2 = .003$). There was a main effect of TPA ($F(1, 1582) = 541.07$, $p < .001$, $\eta^2 = .255$), and significant two-way interactions between both Valence and TPA and between Type and TPA, which were further qualified by a significant three-way interaction between Valence, Report Type, and TPA ($F(1, 1582) = 19.47$, $p < .001$, $\eta^2 = .012$). Higher TPA was related to experiencing and recalling higher levels of positive emotion and lower levels of negative emotion. Although recalled negative emotion reports were still higher than reports experienced during the week, high TPA was related to *less* overestimation of negative emotion, but this pattern was not found for positive emotion.

Comparing the effects of TNA and TPA in a final model. To examine the relative influences of TNA versus TPA when comparing experienced versus recalled emotion, a final General Linear Model with both Trait Negative and Positive affect as between-subjects variables with age, gender, and education as covariates was run. In order to directly compare TNA and TPA, depression diagnosis was excluded because it was highly related to TNA. Due to missing data for trait affect, the total sample size for this GLM was 1,585 participants. Results for the full model are presented in Appendix B. Main effects for each trait (TNA and TPA) were qualified by two-way interactions by valence. Higher TNA was related to higher negative and lower positive emotion. In addition, high TNA was also related to even greater overestimations of negative emotion at the end of the week, but was not related to inconsistencies in positive emotion reports. Higher TPA is related to experiencing and recalling higher positive emotion and lower negative emotion. In addition, higher TPA is related to less discrepancy between experienced and recalled emotion.

There was a significant two-way interaction between Report Type and age and between Valence and age, but not a significant age, Report Type by Valence three-way interaction. These results indicate that older adults reported less negative and more positive emotion, and that the tendency for people to recall more frequent emotions relative to emotions experienced during the week was attenuated with age. A significant interaction between valence and education showed that higher education was related to more negative and fewer positive emotions. A significant three-way interaction between Report Type, Valence, and gender indicated that women report less positive and more negative emotions and also overestimate the occurrence of negative emotions at the end of the week than men.

Finally, a significant three-way interaction between Report Type, TPA, and TNA indicated that for positive emotion reports, participants showed a relatively similar inconsistency regardless of trait affect. For negative emotion reports, greater overestimation was associated with participants exhibiting low TPA and high TNA. Participants high in TPA and low in TNA showed the least overestimation for negative emotion reports. Results from the trait affect analyses further demonstrate that inconsistency in emotional reports pertains largely to more chronic negative emotional experiences.

Discussion

The current study examined how biases in memory for daily emotion are related to depression and to the experience of naturally occurring, persistent negative moods. Consistent with prior research (e.g., Wirtz et al., 2003), it was found that, for both depressed and non-depressed groups, recollections of emotions experienced during the past week were overestimated. Participants recalled experiencing more positive and more negative emotions than their averaged daily reports suggested, although overestimations of positive emotions did not

reach significance for either group. People who met the criteria for depression reported experiencing more frequent negative emotions and recalled more negative emotions than non-depressed people. Furthermore, the overestimation of negative emotion at the end of the week was greater for the depressed group than the non-depressed group. Trait negative affect fully accounted for the association between depression and bias in recalling negative emotion, demonstrating a trait-related mood congruence. These findings support the view that recollections of past emotional experiences are malleable and do not always align with the real-time experience (Levine, 1997; Levine et al., 2009). Furthermore, in contrast with depressive realism (Alloy & Abramson, 1979), the findings support mood congruent recall and a retrospective negativity bias related to depression (Bower, 1981; Hertel & Brozovich, 2010; Mathews & MacLeod, 2005).

Even non-depressed participants illustrated a slight tendency to exaggerate in recalling the frequency of their negative emotions. The tendency to overestimate past emotions, positive and negative, is well-documented (Breckler, 1994; Fredrickson, 2000; Levine et al., 2009; Thomas & Diener, 1990). One possibility for this overestimation is the tendency for people to rely on memories of their peak emotional experiences when making retrospective reports, which are more accessible in memory than the average emotional experience over a period of time (Fredrickson & Kahneman, 1993). Taken together these findings indicate that people generally are susceptible to bias in remembering emotions but that depressed people are at an even greater risk of exaggerating when remembering their negative emotional experiences.

Further analyses revealed that this depression-related negative inconsistency was due to persistent negative mood and not simply to having met the criteria for a depressive diagnosis. Once TNA and TPA were entered into the model, the negative memory inconsistency associated

with depression disappeared. This shows that consistent negative moods account for this memory bias consistent with past research on mood congruent memory. People who experience consistent, trait-level negative moods are likely experiencing negative moods on a daily basis (Wisco & Nolen-Hoeksema, 2009). Thus, it can be assumed that negative memories are congruent with current, negative moods.

It is important to bear in mind that even the daily level reports of emotion are technically retrospective in nature, and therefore susceptible to bias in and of themselves. If depressive symptoms are related to a greater negativity bias in accounts of past emotional experiences, it is likely that end-of-day recollections are also more negative than the emotions experienced during the day. Even though Thomas and Diener, (1990) have argued for the validity of using end-of-day reports in lieu of moment-to-moment sampling, this methodology limits the ability to draw conclusions about bias in emotional memory compared to the emotions reported in real time. Despite this, from this study one is still able to conclude that reports of experienced negative emotions are susceptible to bias over time, especially among depressed individuals.

One hallmark characteristic of depression, it should be noted, is anhedonia, or the lack of positive affect. People who experience lower levels of positive affect along with higher levels of negative affect are more likely to report depressive symptoms (e.g., Folkman & Moskowitz, 2000). Lower reports of experience and recalled positive emotion in people with depression relative to people without depression demonstrate the existence of anhedonia in this sample. Contrary to the current hypothesis, however, the groups did not differ in consistency of positive emotion reports. Although all participants tended to overestimate their positive emotions, the difference between the experienced and recalled positive emotion was not significantly different between people with depression and those without. Thus, depressive status did not predict a

negative bias for positive emotional experiences. Many researchers have recognized that positive and negative affect, although not entirely independent, often rely on separate underlying systems (e.g., Watson, Wiese, Vaidya, & Tellegen, 1999). While negative affect may increase, positive affect does not necessarily decrease simultaneously (both in experience and in memory). Inconsistency in negative, but not positive recollections of affect could be attributed to the possibility that negative experiences may have stronger implications for survival. Because of this, it may be adaptive to overestimate the extent of previous negative emotions, but not positive ones.

Limitations and Future Directions

One major limitation of this study lies in the fact that participants were given the depression inventory during MIDUS II and not during the daily diary study, NSDE II, which took place an average of six months later. Therefore, participants may not have necessarily qualified as depressed or non-depressed at the time of emotional reports and recollections. Despite this, significant effect of depressive history status on negative emotional memories was observed, suggesting some stability in the affective and cognitive mechanisms underlying depression. Although this study reveals associations among depressive symptoms, more negative emotional experiences, and a negativity bias in memory, it does not allow us to determine causal relations among these variables. Greater exposure to negative events very well could lead to more depressive symptoms, but an individual who has experienced frequent and severe depressive symptoms may also be more vulnerable to negative experiences and later negative memory bias. Furthermore, an individual who negatively interprets past experiences may be more vulnerable to future negative experiences and future depressive symptoms. It can be concluded from this study, however, that people who display depressive symptoms do interpret

past emotions as more negative as time passes even more so than those who do not display depressive symptoms.

Importantly, this study expanded upon previous research in that it examined recollection for every-day emotional experiences occurring in naturalistic settings using naturally occurring mood states. Much of the previous literature on mood and memory focuses on laboratory based autobiographical memory (e.g., Hertel & Brozovich, 2010; Joorman et al., 2009; Mathews & MacLeod, 2005; Matt et al., 1992; Storbeck & Clore, 2005) as well as induced negative and positive moods, but the design of the current study allowed us to examine these processes as the occur in daily life. In this way, results of this study are essential in informing therapeutic techniques for *everyday* depressive symptoms. Often, treatment settings are structured around weekly meetings. During those meetings, clinicians ask patients to recall the emotions they experienced over the past week. Research presented here shows that these reports are likely to be negatively biased. Clinicians could apply this knowledge to the more constructive treatment of their patients.

Despite the contributions of the current study, future studies would do well to address the *mechanisms* behind memory for emotion, such as rumination, self-focused thinking, and overgeneral memory. For example, it would be useful to know why the depressed group overestimated the negative emotions but did not underestimate positive emotions compared to the non-depressed group. Depressed participants could have been ruminating on the negative emotions more so than the positive and thus exaggerate the extent of their negative affect. Furthermore, previous research has illustrated the tendency for depressed people to have difficulty in recalling specific memories and instead produce overgeneral memories (Williams, 1996), especially for positively valenced memories. It is possible that depressed participants

were able to recall specific negative memories, but tended to recall overgeneral positive memories and again overestimated the extent of their negative emotions and not their positive. Previous literature has also discovered that depressed individuals are more likely to focus on the self and that extending their focus externally helps to decrease depressed affect (Pyszczynski, Hamilton, Herring, & Greenberg, 1989). It is likely that participants in this study tended to focus on the self and manipulating the focus outside of themselves might have decreased their negativity bias. Future studies could extend the research on self-focus, overgenerality, and depressive symptoms in real-life settings and how these potential mechanisms could inform therapeutic interventions.

From the results presented here, people with higher levels of depressive symptoms seem not to be making as large of errors in positive emotion recall. In fact, depressed and non-depressed people alike were quite consistent in their positive affect reports and if anything, over-reported their experience of positive affect. The discrepancy between recalled and reported affect in relation to depressive symptoms seems to lie primarily in reports of negative affect. These findings underscore the importance of focusing on consistent recollections of negative events in addition to focusing on decreasing negative affect in the moment. This approach provides further support for cognitive behavioral interventions that focus on decreasing negative, maladaptive thoughts.

Conclusion

The current research provides evidence that negative memories are in fact a combination of both the experience of more negative emotions as well as a negative memory bias in relation to depressive symptoms. Results of this 8-day daily diary study add to the current literature in expanding the generalizability of the depressive-autobiographical memory bias link by using

data from real-life experiences. In addition to providing further evidence of the general malleability of emotional memories, data from this study provide evidence for a mood congruent depressive recall bias for negative emotions. The current findings suggest that re-evaluating recollections of negative emotions might hold more clinical significance than re-evaluating recollections of positive emotions. Recalling more negative emotional experiences has strong implications for the prognosis of depression. Depressed individuals not only experience more negative feeling states, they are more likely to dwell on them. This in turn can reinforce their negative feelings, thus creating a negative feedback loop. Finally, the tendency to remember past emotions as even more negative than they were originally experienced *on top of* experiencing more negative emotions in the first place creates a sort of double vulnerability for developing depression and an increased resistance against overcoming it.

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Appendix A

General Linear Model of Emotional Consistency by Presence of History of Depression and Covariates

		F (1, 1651)	η^2
Within Subjects Main Effects	Valence	178.77***	.098
	Report Type	95.05***	.054
Between Subjects Main Effects	Depression	12.85***	.008
	Age	18.45***	.011
	Gender	0.02	.000
	Education	3.33	.002
Two-way Interactions	Valence X Report Type	26.97***	.016
	Valence X Depression	89.38***	.051
	Valence X Age	59.76***	.035
	Valence X Gender	4.15*	.003
	Valence X Education	6.76**	.004
	Report Type X Depression	12.43***	.007
	Report Type X Age	53.41***	.031
	Report Type X Gender	11.39**	.007
	Report Type X Education	5.29*	.003
	Depression X Gender	1.69	.001
Three-way Interactions	Valence X Report Type X Depression	18.11***	.011
	Valence X Report Type X Age	7.04**	.004
	Valence X Report Type X Gender	0.02	.000
	Valence X Report Type X Education	5.45*	.003
	Valence X Depression X Gender	4.12*	.002
	Report Type X Depression X Gender	9.28**	.006
Four-way Interaction	Valence X Report Type X Depression X Gender	4.48*	.003

Note. Report Type refers to experienced emotion during the week versus recollected emotion at the end of the week. A main effect of Report Type indicates inconsistency between these two reports. Depression refers to the grouping of participants who met the criteria for a clinical diagnosis of a depressive episode within the past 12 months (n = 158) and those who did not (n = 1499).

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

Appendix B

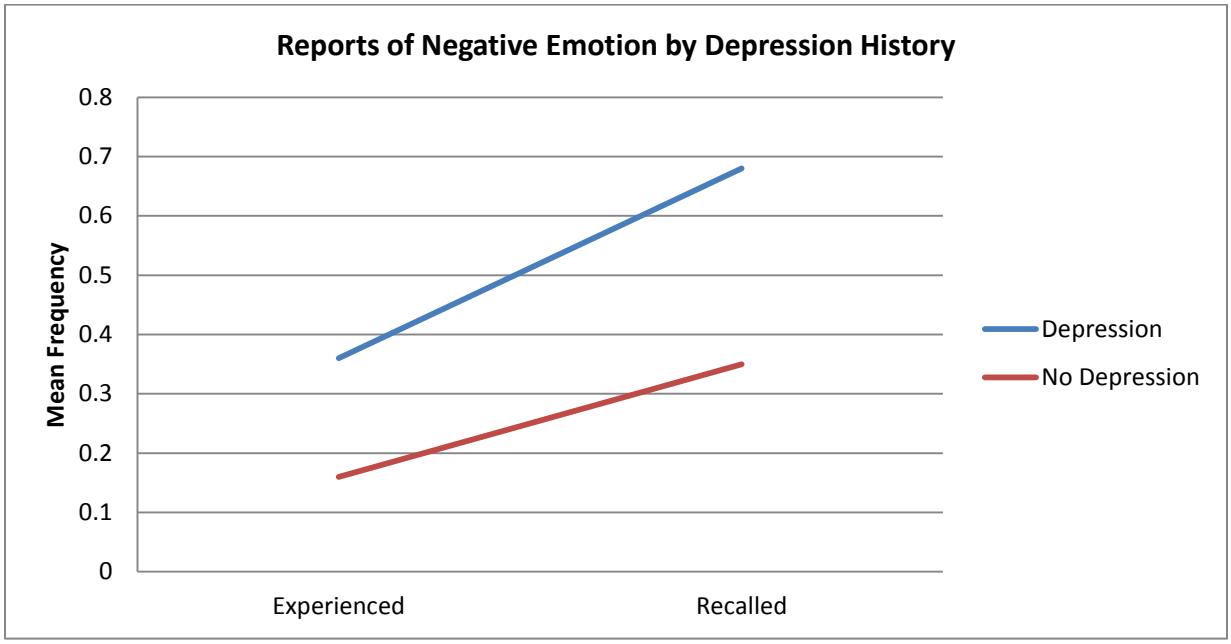
General Linear Model of Emotional Consistency by Trait Positive and Negative Emotion and Covariates

		F (1, 1578)	η^2
Within Subjects Main Effects	Valence	45.27***	.028
	Report Type	51.97***	.032
Between Subjects Main Effects	TPA	347.53***	.180
	TNA	17.74***	.011
	Age	1.07	.001
	Gender	3.42	.002
	Education	8.70**	.005
Two-way Interactions	TPA X TNA	3.66	.002
	Valence X Report Type	3.89*	.002
	Valence X TPA	245.69***	.135
	Valence X TNA	9.40**	.006
	Valence X Age	12.23***	.008
	Valence X Gender	0.70	.000
	Valence X Education	22.04***	.014
	Report Type X TPA	27.96***	.017
	Report Type X TNA	0.04	.000
	Report Type X Age	25.98***	.016
	Report Type X Gender	2.72	.002
	Report Type X Education	10.00**	.006
Three-way Interactions	Valence X Report Type X TPA	0.77	.000
	Valence X Report Type X TNA	5.94*	.004
	Valence X Report Type X Age	2.26	.001
	Valence X Report Type X Gender	10.02**	.006
	Valence X Report Type X Education	5.98*	.004

	Valence X TPA X TNA	2.25	.001
	Report Type X TPA X TNA	7.50**	.005
Four-way Interaction	Valence X Report Type X TPA X TNA	0.01	.000

Note. Report Type refers to experienced emotion during the week versus recollected emotion at the end of the week. A main effect of Report Type indicates inconsistency between these two reports. TPA stands for Trait Positive Affect; TNA stands for Trait Negative Affect. (N = 1,585).
***p < .001; **p < .01; *p < .05

Appendix C



***Note*.** Depression refers to the grouping of participants who met the criteria for a clinical diagnosis of a depressive episode within the past 12 months (n = 158) and No Depression refers to those who did not (n = 1499).