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# Savor the Memory: A Reminiscence Exercise to Increase Positive Emotions and Reduce Depression Risk in Anxious Individuals

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Savor the Memory: A Reminiscence Exercise to Increase Positive Emotions and Reduce Depression Risk  
in Anxious Individuals

by

Bethany H. Morris

A dissertation submitted in partial fulfillment  
of the requirements for the degree of  
Doctor of Philosophy in Clinical Psychology  
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## **Dedication**

This dissertation is dedicated to my amazing husband and our beautiful son. I love our life.

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## Abstract

A growing literature suggests that experiencing positive emotions provides psychological benefits (e.g., Coifman et al. 2007), and interventions increasing positive emotions may reduce depression risk (Geschwind et al., 2011). The present study tested whether reminiscence, a method of positive emotion savoring (Quoidbach et al., 2010), can mitigate depression risk by increasing positive emotions in an unselected sample and a subsample of at-risk anxious individuals. Female participants ( $n=336$ ) were randomized to a reminiscence or control condition and asked to complete daily mental imagery exercises focusing on a positive memory (reminiscence) or a neutral laboratory memory (control) for one week. As expected, reminiscence exercises produced immediate positive emotion increases compared to control exercises. Contrary to prediction, reminiscence participants did not report higher positive affect or lower depression symptoms at the end of the study week or one month follow up period compared to controls. Future studies in treatment-seeking samples are needed before strong conclusions can be drawn about the long term affective benefits of reminiscence in at-risk or clinical populations. Findings in the anxious subsample revealed no greater benefit of reminiscence versus neutral mental imagery for those with high anxiety. However, across both conditions, anxiety was a strong predictor of positive emotional functioning, with high anxiety predicting low positive emotions even after accounting for depression symptoms. These findings add to prior work suggesting anxiety can blunt positive emotional functioning, and warrant future studies to further elucidate the impact of anxiety on positive emotional functioning and the potential utility of intervening on positive emotions in anxious individuals.

## Introduction

A growing literature suggests that experiencing positive emotions provides psychological benefits, including reduced depression risk (Coifman, Bonanno, & Rafaeli, 2007; Ong, Bergeman, Bisconti, & Wallace, 2006; 2004). Some work suggests lasting benefits from interventions increasing positive emotions, including those at increased depression risk (Geschwind, Peeters, Drukker, van Os, & Wichers, 2011; Zautra, et al., 2008). However, no studies specifically examine whether changes in positive emotions, per se, mitigate depression risk in healthy or at-risk individuals. The present study tested whether a reminiscence exercise can mitigate depression risk by increasing positive emotions. Reminiscence exercises show particular promise as a means of increasing positive emotions in unselected samples (Bryant, Smart, & King, 2005; Lyubomirsky, Sousa, & Dickerhoof, 2006). Reminiscence is considered a method of savoring, which encompasses a variety of automatic or intentional attempts to generate, maintain, and enhance positive emotional experience (Bryant, 2003; Quoidbach, Berry, Hansenne, & Mikolajczak, 2010; Tugade & Fredrickson, 2007). Savoring may be a widely beneficial strategy, as it involves awareness and attention toward present positive emotions and could potentially set in motion other strategies to further capitalize on positive emotion (Garland, et al., 2010; Quoidbach, et al., 2010). No previous studies have investigated the effects of savoring exercises, including reminiscence, in groups at increased risk for depression. The present study also investigated whether reminiscence exercises can ameliorate depression risk by increasing positive emotions in anxious individuals, who are at high risk for developing depression through a number of potential pathways (see Bromberger, et al., 2009; Garber, 2006). Although traditional theoretical accounts of anxiety often neglect positive emotions, anxious persons show numerous deficits in the experience and regulation of positive emotions, including difficulty savoring positive emotional experiences (Eisner et al., 2009; see Morris,

2012). A stress resilience approach suggests that anxious persons' positive emotion deficits increase their risk for depression, particularly under stress (see Morris, 2012), and increasing positive emotions in anxious persons, in turn, may decrease their depression risk.

The following sections present findings from naturalistic and experimental studies demonstrating the psychological benefits associated with various indicators of positive emotional functioning in healthy and at risk samples. After discussing positive emotion savoring as a promising target for experimental manipulations, a stress resilience view is described that enables hypotheses concerning the benefits of improving positive emotional functioning in anxious individuals. The purpose and rationale of the present study is then developed, including how the design advances knowledge about positive emotions, anxiety, and depression risk.

### **The Psychological Benefits of Positive Emotions**

A large literature links positive emotions to good physical and mental health outcomes (Bower, Moskowitz, & Epel, 2009; Steptoe, Dockray, & Wardle, 2009). Positive emotion can predict salutary outcomes in surprisingly strong ways. For example, Danner, Snowdon, and Friesen (2001) found positive emotional content in autobiographies written by nuns in early adulthood to predict longevity over six decades. Authentic (Duchenne) smiles in photographs of major league baseball players also predicted longevity (Abel & Kruger, 2010). Likewise, smiling in yearbook photos has also been linked to positive relationship outcomes and well-being decades later (Harker & Keltner, 2001). Given the global nature of the well-being construct and the likelihood that it is multiply determined, it is impressive that brief assessments of positive emotion predict well-being later in life.

Fredrickson's (1998, 2001) broaden-and-build theory is the best developed account of why experiencing and expressing positive emotions in everyday life should be associated with psychological benefits. Historically, positive emotions have been an "afterthought" in emotion theory in part because they are not as tightly linked to specific action tendencies as negative emotions (e.g., fear with escape, anger with attack, see Fredrickson & Levinson, 1998). Fredrickson (2001) countered this view, proposing

that positive emotions are evolutionarily significant and function to broaden behavioral repertoires and build personal resources, which are linked to numerous favorable outcomes. Specifically, what appears to be diffuse behavioral action associated with positive emotion states is actually a result of a broadened behavioral repertoire. According to the theory, whereas negative emotions function to narrow focus and behavior in ways that were beneficial to the survival of human ancestors (running away from a predator or fighting a foe), positive emotions broaden attention and behavior in other ways that were beneficial to survival such as noticing new opportunities and engaging in exploration and creative problem solving (Fredrickson, 2000). In this way, Fredrickson holds that “positive emotions are more than the absence of negative emotions” (Fredrickson, 2000, p. 2).

The capacity of positive emotions to broaden cognitive and behavioral repertoires is one of three functions outlined by Fredrickson and colleagues to explain the link between positive emotions and good outcomes. The broadening function is supported by studies linking positive emotions to breadth of attention, creativity, cognitive flexibility, and wider behavioral repertoires (Fredrickson, 1998; Fredrickson & Branigan, 2005; Fredrickson & Joiner, 2002; Isen, Daubman, & Nowicki, 1987). This broadening capacity enables the second function of positive emotions, which is to “undo” the narrowing effects of negative emotion, including faster emotional and cardiovascular recovery from stress (Fredrickson, Mancuso, Branigan, & Tugade, 2000). In addition, broadened cognitive and behavioral repertoires associated with positive emotions facilitate the third function-- generating new opportunities for experiencing positive emotions, which bring more broadening and so on, a process referred to as “upward spirals toward emotional well-being” (Fredrickson & Joiner, 2002, p. 172). This function is represented in the “build” part of the theory and involves the building of personal and interpersonal resources that “are more durable than the transient emotional states that led to their acquisition” (Fredrickson, 2000, p. 6). Importantly, the product of this building function is that individuals experiencing positive emotions, “not only enjoy improved emotional well-being, but also build their coping arsenal for handling future adversities” (Fredrickson & Joiner. (2002, p. 175).

Unlike the broadening and undoing functions of positive emotions, the function of positive emotions to enhance future coping through upward spirals has not yet been strongly borne out in the empirical literature. Some evidence suggests undergoing interventions to increase positive emotions can lead to increases in personal resources that are maintained more than a year later (Cohn & Fredrickson, 2010). These resources can include physical, intellectual, and social resources that theoretically “can be drawn on later, in other contexts and in other emotional states” to help surmount challenges and stressors (Fredrickson, 2000, p. 6). Tugade and Fredrickson (2007) theorize that individuals who utilize positive emotions more frequently will eventually begin to do so automatically and allow positive emotions to become “chronically accessible” to them, a pattern associated with resilient responses (p. 323). In sum, by broadening cognitive and behavioral repertoires, positive emotions function not only to increase capitalization on opportunities in the environment, but also to recover from negative emotions and to potentially build lasting resources that offer long-term advantages. Each of these functions, either alone or in conjunction with one another, may contribute to resilient responding and favorable life outcomes.

**Positive emotions and resilience.** Resilience is broadly defined as “a class of phenomena characterized by good outcomes in spite of serious threats to adaptation or development” (Masten, 2001, p. 228). Life stressors impose serious threats to well-being (Monroe & Reid, 2009), and yet some individuals are able to “maintain relatively stable, healthy levels of psychological and physical functioning” in the face of adversity (Bonanno, 2004, p. 20). Initial research conceptualizing resilience as trait-like found higher scores on trait self-report measures of resilience such as the Ego Resilience scale (J. Block & Kremen, 1996) predicted faster cardiovascular recovery from lab stress (Souza, et al., 2007) and lower depression symptoms following exposure to a traumatic event (Fredrickson, Tugade, Waugh, & Larkin, 2003). Positive emotions may be the “active ingredient” in trait resilience reports that serve to buffer individuals from the negative emotional impact of stress (Fredrickson, et al., 2003, p. 366). In laboratory and naturalistic life stress studies, the intensity and frequency of experiencing positive emotions has been shown to mediate the relationship between trait resilience and post-stress outcomes (Fredrickson, et al., 2003; Tugade & Fredrickson, 2004). These and other similar data suggest that the

link between high scores on measures of trait resilience and better post-stress adjustment is owed to experiencing positive emotions in the face of stress (e.g., Tugade, Fredrickson, & Feldman Barrett, 2004). Increasingly, the concept of resilience has been redefined as a process of responding flexibly to changing circumstances and bouncing back from stressful experiences (J. Block & Kremen, 1996; see J. H. Block & Block, 1980; Fredrickson, et al., 2003; Lazarus, 1993; Luthar, Cicchetti, & Becker, 2000). Growing evidence shows that individuals who experience positive emotions during stressful times demonstrate resilience to negative psychological outcomes often associated with stress, including resistance to depression symptoms (Coifman, et al., 2007; Ong, et al., 2006; Tugade & Fredrickson, 2004).

A strong empirical base supports the importance of positive emotions in resilient stress responding. In real world settings, individuals who experience and express positive emotions more frequently under stressful conditions exhibit better post-stress emotional adjustment. This effect has been documented in studies examining the benefits of positive emotions in recovery from acute life stressors, such as the immediate wake of conjugal bereavement (Bonanno & Keltner, 1997; Bonanno, Moskowitz, Papa, & Folkman, 2005). Similar results have been demonstrated in correlational studies of chronic life stressors such as perceived racism, where higher reported trait positive emotion reduced the association of perceived racism and depression symptoms (Ong & Edwards, 2008). Positive emotions elicited in a laboratory setting also aid faster physiological recovery from acute stress (Fredrickson & Levenson, 1998; Fredrickson, et al., 2000). Fredrickson, Mancuso, Branigan, & Tugade (2000) induced stress using a speech task and then randomly assigned students to watch a film eliciting contentment, amusement, neutrality, or sadness. Students assigned to the contentment and amusement conditions showed faster cardiovascular recovery than students in the neutral or sadness conditions. Similarly, Papa and Bonanno (2008) found that students who displayed Duchenne (genuine) smiles during a stressful task had larger reductions in negative emotions from the beginning to the end of the speech task and lower distress one year later. In sum, there is growing evidence in laboratory and life stress studies that the ability to experience and express positive emotions, particularly in stressful contexts, can lead to better outcomes, including lower depression symptoms.

## **The Stress Resilience View**

Findings that positive emotional functioning can influence post-stress outcomes has important implications for the study of clinical depression risk. Depressive episodes are highly tied to the experience of life stressors (Kessler, 1997; Mazure, 1998; Monroe & Reid, 2009), with an estimated 70% of first onset depressive episodes being preceded by recent major life events (Monroe & Harkness, 2005). However, most people who experience life stress do not become depressed, prompting a search for predisposing individual difference variables that enhance the depressogenic effects of stress (i.e., diathesis-stress theories, Kessler, 1997; Monroe & Simons, 1991). Most researchers agree that depression results from the complex interaction of various risk and protective factors with life stress, enhancing or blunting its depressive effects (for reviews see Hammen, 2005; Kessler, 1997; Mazure, 1998; Monroe & Harkness, 2005). One pathway to depression may result when the resilience-fostering effects of positive emotions are impaired.

**A resilience approach to depression risk.** Research on resilience has only begun to merge with the clinical research tradition. Few resilience studies utilize diagnostic data, and outcome measures are often measures of well-being rather than symptomatology. Although this is typical for research on positive functioning, it presents some challenges for clinical application (i.e., integration into a literature of findings on symptom reduction). A small, but growing and supportive, literature applies research findings on resilient responding to groups at risk for psychopathology. Daily diary studies have documented that experiencing positive emotions can mitigate the depressogenic effects of daily stressors in individuals at risk for depression (e.g., bereaved women, Ong, Bergeman, & Bisconti, 2004; chronic pain patients, Ong, Zautra, & Reid, 2010). The ability to derive optimal levels of positive emotion from positive experiences appears to be of particular importance. For instance, Bonnano, Wortman, and Nesse (2004) found that widows who reported feeling the most comfort from recalling positive memories from their spouse were more likely to have resilient trajectories (low depression scores across 18 months post-bereavement), versus those who reported the least comfort from positive memories who were more likely to exhibit trajectories of chronic depression. Geschwind et al. (2010) found similar long term effects in a

large twin sample. Utilizing experience sampling methodology (ESM) to assess positive emotions in response to daily events, results showed that in the wake of a life stressor those who tended to glean greater “positive affect boosts” from pleasant events had lower depression symptoms across a one year follow up period (p.129). Further, this effect was stronger for those at heightened genetic risk of depression elevations (i.e., via having a twin with elevated depression symptoms). Supporting a stress-resilience approach, these findings suggest that capitalizing on opportunities to experience positive emotion, especially in the context of stress, is associated with both short and long term consequences, including reduced depression symptoms.

### **Targeting Positive Emotions**

There is growing empirical interest in how best to intervene on positive emotions. These include developing long term therapies targeting positive emotion relevant factors (i.e., gratitude, well-being) to reduce symptoms or risk of psychopathology, investigating existing interventions that were not designed to impact positive emotions but have that effect nonetheless, and testing brief lab exercises designed to experimentally manipulate positive emotions for effects on various outcomes. In terms of therapeutic strategies, there is evidence that many interventions aimed at positive emotions are helpful to individuals with symptoms of psychopathology (Sin & Lyubomirsky, 2009). For instance, Well-Being Therapy (WBT, Fava & Tomba, 2009; Ruini & Fava, 2009), an adjunct to traditional cognitive behavioral techniques that targets a number of positive emotion relevant outcomes (e.g., personal growth, meaning in life, promoting positive relationships), has been associated with sustained improvements in symptoms and well-being (Fava, et al., 2005), reduced residual symptoms in patients successfully treated for a variety of mood and anxiety disorders (Fava, Rafanelli, Cazzaro, Conti, & Grandi, 1998) and reduced depression relapse rates across several years when incorporated into traditional CBT (Fava, et al., 2004). Although these and other findings like this (e.g., Geschwind et al., 2011) suggest that targeting positive emotions is therapeutically helpful to at-risk individuals (including reducing depression risk), whether increases in positive emotions are driving these effects is yet unclear.

**Manipulating positive emotions in unselected samples.** Directly manipulating positive emotions with a number of brief exercises is one way to increase positive emotions and better understand the relevant processes. For example, Burton and King (2004) had students visit the laboratory to complete a writing exercise for 20 minutes on 3 consecutive days. Participants were instructed to write about an “intensely positive experience” and were asked to “please try your best to re-experience the emotions involved” (p. 155). Compared to a group who completed a descriptive control writing condition, the positive group had higher positive mood ratings averaged over the 3 days, but not less negative affect. Others have utilized self-administered gratitude exercises, which typically involve the participant writing or thinking about things s/he is grateful for, and found them to increase positive emotion and well being, although effects may be short-lived (for a review see Wood, Froh, & Geraghty, 2010). Seligman and colleagues (Seligman, Steen, Park, & Peterson, 2005) examined the long term benefits of a week-long self-administered gratitude exercise (writing and delivering a gratitude letter) in a large unselected convenience sample. Compared to a placebo control exercise, the gratitude letter generated more positive emotion initially (during the first month), but effects faded over the 6 month follow up period. However, the study found longer term effects for two other self-administered tasks. The first involved participants logging three good things that happened each day for a week and stating why each happened, and another involved identifying character strengths and using one in a new way for a week. Both exercises had little effect immediately, but effects emerged at one month and were sustained at 6 months follow up. Importantly, the study found that the long term effects were due to continued practice of the exercises beyond the one week study period, suggesting that even brief, simple interventions can have sustained effects when individuals are able to incorporate them into daily life.

**Manipulating positive emotions in at-risk and symptomatic samples.** A few studies have examined similar exercises to reduce symptoms of psychopathology. For instance, Geraghty, Wood, and Hyland (2010b) found that keeping a gratitude diary for 2 weeks led to reduced worrying in a group self-selected to complete a worry-reduction intervention (compared to a waitlist group). Geraghty and colleagues (2010a) gave gratitude diaries to volunteers self selected for an intervention to decrease body

dissatisfaction. Compared to a waitlist group, the gratitude group showed reduced body dissatisfaction after 2 weeks. However, because neither study measured positive emotions, it is not clear whether positive emotion changes were responsible for decreases in psychopathology symptoms.

Very few studies specifically examine increasing positive emotions as a means of mitigating depression risk. Nevertheless, preliminary findings suggest that some exercises and interventions can be utilized to increase positive emotions in groups at-risk for psychopathology. For instance, Emmons and McCullough (2003) had participants with neuromuscular disease write a brief list of things they were grateful for every day for 3 weeks. Compared to a control condition where participants completed measures only each day, the gratitude group showed increased positive emotions, higher ratings on global one item measures of life satisfaction, optimism about the future, and connectedness with others. The findings for increased positive emotion and life satisfaction for the gratitude group were corroborated by significant results using observer reports of outcome variables. In another study, Moskowitz et al. (2012) report on a pilot intervention for a longer term intervention increasing positive emotions in individuals experiencing stress from being newly diagnosed with HIV. A multiple component skill-based intervention was given one-to-one once per week for 5 weeks, and included skills such as “noticing positive events” and “amplifying/capitalizing” on them and completing skill practice homework and emotion ratings daily (p. 684). The intervention was associated with increased positive emotions immediately after the intervention and over the one month follow up period. The study did not assess depression symptoms.

In sum, evidence suggests that therapeutic interventions may impact depression risk through increasing positive emotions, but mediational studies are needed before it can be concluded that positive emotions are driving therapeutic outcomes. Several brief exercises aimed more directly at positive emotions have been successfully used to increase positive emotions in unselected and at-risk samples, with some evidence for sustained effects when individuals are able to incorporate them into daily life. A key question that remains is whether increasing positive emotions in at-risk individuals can mitigate their depression risk.

## **Savoring: A Promising Target**

Besides the experience of positive emotions, how individuals respond to and regulate positive emotional experiences is also linked to important outcomes. Emotion regulation refers to “the processes by which individuals influence which emotions they have, when they have them, and how they experience and express these emotions” (Gross, 1998, p. 275). Successful emotion regulation has been linked to favorable outcomes including enhanced well-being (Côté, Gyurak, & Levenson, 2010). Emotion regulation researchers often distinguish between regulatory efforts that upregulate (enhance or increase) or downregulate (decrease) an emotion, with studies of emotion regulation in anxiety and depression mainly focused on the downregulation of negative emotions (see Campbell-Sills & Barlow, 2007; Werner & Gross, 2007). The literature on positive emotion regulation is developing, mostly consisting of studies analyzing self-report measures of positive emotion regulation strategies (e.g., Nelis, Quoidbach, & Hansenne, 2011). In terms of positive emotion upregulation, Tugade and Fredrickson (2007) define two types of strategies or processes: The first are those aimed at enhancing positive emotion during negative experiences (smiling when receiving disappointing news, finding positive meaning) or utilizing positive emotions to improve negative mood. Positive emotions happen surprisingly frequently in the context of even the most extreme stressors (e.g., death of a child, spinal cord injury, for a review see Folkman & Moskowitz, 2004) and are consistently linked to successful stress recovery. For instance, Moskowitz, Folkman, and Acree (2003) followed a sample of bereaved men for three years and found that the ability to achieve positive emotional states at one month post-bereavement predicted faster return to low depression levels. These and other data suggest that positive emotions aid in coping and recovery from lab and life stress (e.g., Bonanno & Keltner, 1997; Tugade & Fredrickson, 2004).

The second type of regulation process defined by Tugade and Fredrickson is aimed at maintaining, or savoring, positive emotion in the present moment. A similar concept has been termed “positive rumination” by others (see Feldman, et al., 2008, p. 508). Analyses of self-report data suggest several common behaviors linked to savoring positive emotions (Bryant, 2003; Bryant, Chadwick, & Kluwe, 2011; Quoidbach, et al., 2010). These include external behaviors such as expressing the positive

emotion non-verbally (e.g., smiling, laughing) or verbally (e.g., phoning a friend to share good news). Savoring behaviors can also be internal such as being mindful of the present moment by “deliberately directing attention to the present pleasant experience” (Quoidbach, et al., 2010, p. 2). Savoring can also include generating positive emotions in the present moment by “positive mental time travel” defined as anticipating positive future events or reminiscing about past positive experiences (Quoidbach, et al., 2010, p. 2). Preliminary evidence suggests that utilizing a variety of savoring strategies is more beneficial than utilizing any individual strategy (i.e., "regulatory diversity," Quoidbach, et al., 2010, p. 3). High scores on measures of savoring are linked to high life satisfaction, high self-esteem, and low depression (Bryant, 2003; Feldman, et al., 2008).

Savoring may be a widely beneficial strategy, as it involves awareness and attention toward present positive emotions and could potentially set in motion other strategies to further capitalize on positive emotion (Garland, et al., 2010; Quoidbach, et al., 2010). For instance, stopping to savor the positive emotions brought on by watching a sunset may increase the likelihood of phoning a friend to reminisce about a past shared sunset. The notion of savoring as a gateway to further upregulation of positive emotions is implied by Garland and colleagues' (Garland, et al., 2010) assertion that savoring may be the “linchpin to the upward spiral” (p. 45), meaning that turning attention toward positive emotion is essential for the broadening function of positive emotion to generate increases in personal resources that generate upward spirals to well-being (Fredrickson & Joiner, 2002). Experience sampling data find momentary savoring responses mediate the relationship of positive events to positive emotions, especially for individuals who report high trait savoring, suggesting that the tendency to savor leads to greater increases in positive emotions in response to positive events daily life (Jose, Lim, & Bryant, 2012).

Few studies have attempted to intervene directly on daily savoring, and findings are preliminary. For instance, in a large community sample Schueller (2010) examined a one week daily savoring exercise where participants were asked to “reflect each day for at least 2-3 minutes on 2 pleasurable experiences and to make the pleasure last as long as possible” (p. 194). The exercise, which was administered online, related to increased happiness and decreased depression symptoms at the end of the week, but the study

lacked a control group needed to distinguish the effect of the exercise from the passage of time (and other alternative explanations). Hurley and Kwon (2012) randomly assigned students to either a savoring intervention or a control group. The savoring exercise involved group psychoeducation delivered in a laboratory setting about various ways to savor events. Participants listed 3 positive events of the last week and ways they could have savored them, for the purpose of increasing savoring of naturally occurring positive events over the following 2 weeks. Participants logged the number of times they savored events during each day and received reminders and tips via email. At the end of 2 weeks, compared to a control group the savoring group reported decreased depression symptoms, but no changes in positive emotions (Hurley & Kwon, 2012). The study did not assess self-reported savoring as an outcome.

Other brief exercises to increase savoring show more promise for increasing positive emotions in unselected samples. In particular, “positive mental time travel,” a savoring strategy that involves imagining oneself enjoying a positive event that has either already happened (reminiscing) or could happen in the future (anticipating), has been shown to increase positive emotions in healthy samples (see Quoidbach, et al., 2010). Quoidbach and colleagues had participants complete a computer-aided positive anticipation exercise daily for two weeks and found the exercise increased positive emotions compared to control conditions (Quoidbach, Wood, & Hansenne, 2009). These findings suggest that by practicing savoring through mental time travel exercises, individuals can potentially increase the positive emotions in their daily lives.

**Savoring through reminiscence.** Reminiscence has been studied mainly in the context of older adults, where longer term interventions (e.g., 3 one hour sessions or more) involving positive reminiscence have been shown to reduce depression symptoms (Pinquart & Forstmeier, in press) and increase well-being (Bohlmeijer, Roemer, Phd, & Smit, 2007). Correlational and experimental findings in younger adult samples suggests that imagining positive past events can increase a sense of meaning in life, even when compared to imagining potential positive future events (Routledge, et al., 2011; Routledge, Wildschut, Sedikides, Juhl, & Arndt, 2012), as well as increasing feelings of social connectedness and social support (see Wildschut, Sedikides, & Cordaro, 2011). Individuals who report

more positive emotion savoring through reminiscence are the most able to savor positive emotions in the present moment (Bryant, 2003; Bryant, et al., 2005). Correlational findings suggest that individuals most frequently reminisce about recent experiences with family, friends, or romantic relationships (Bryant, et al., 2005). Studies of nostalgia, a phenomenon related to reminiscence, have found conceptually similar results. Wildschut and colleagues have found that nostalgic experiences tend to include past events with others close to them and important life events (see Wildschut, et al., 2011). Inducing reminiscence or nostalgia in the laboratory increases positive emotions. For instance, Wildschut, Sedikides, Arndt, and Routledge (2006) assigned participants to complete a writing exercise in either a control or nostalgia condition. Participants in the nostalgia condition were asked to spend time thinking of a past nostalgic event (defined as a past event with personal meaning that you “think about in a nostalgic way,” p.987) and write about how it made them feel. Participants were asked to “immerse yourself in the nostalgic experience” (p. 987). Compared to the control condition, where participants thought about and wrote about an ordinary event in their life and were asked to write “as though you were an historian recording factual details” (p. 987), participants in the nostalgia condition reported more positive affect, but not less negative affect.

There is also evidence that people use reminiscence to improve negative mood. Bryant et al. (2005) found that twice as many participants reported reminiscing when they felt down than when they felt happy. Studies of nostalgia have also found individuals to report that they generate positive affect and are often triggered in response to low mood (Wildschut, et al., 2006). College students who underwent a negative mood induction reported more nostalgia than those who underwent neutral or positive mood induction, further suggesting that people may use positive emotional memories to combat negative mood (Wildschut, et al., 2006). Other findings suggest that using imagery while reminiscing enhances its effectiveness. Individuals who use cognitive imagery to intensify reminiscence experiences report the highest positive emotion savoring in daily life (Bryant, et al., 2005). The findings regarding imagery are in line with research suggesting images have more powerful effects on emotion intensity versus verbal processing of negative material (Holmes & Mathews, 2005), and for positive (Holmes, Mathews,

Dalgleish, & Mackintosh, 2006). Additionally, specific qualities of mental imagery enhance the effect on positive emotion, such as imagining from one's own perspective versus from an observer's perspective (Holmes, Coughtrey, & Connor, 2008). Holmes, Lang, and Shah (2009) found that a positive imagery condition not only increased positive affect versus a verbal condition, but also increased positive interpretive bias and protected against the effects of a depressive mood induction.

Outside of academic psychology, the notion of utilizing positive memories to boost current mood has gained popularity and led to the invention of internet-based reminiscing programs such as Pensieve, that send email triggers (e.g., photos, words) that are supposed to spontaneously trigger positive memories for a user (Peesapati, et al., 2010). One function of the program is to send question prompts about random topics to the user to remind them to reminisce. The program's developers report that even when people don't respond to the trigger email's content, it reminds them to reminisce about other topics. The popularity of such systems underscores reminiscence as a widely practiced exercise that is readily understood, available to the public, and potentially easily incorporated into daily life, making it a natural target of further research to examine its effects on positive emotions.

**Daily reminiscence exercises.** Three prior studies have tested the effects of daily reminiscence exercises to increase positive emotions in unselected samples. Bryant et al. (2005) randomly assigned 65 students to reminisce for 10 minutes twice per day for a week, using either cognitive imagery ( $n=22$ ) or nostalgic memorabilia ( $n=21$ ) to elicit positive memories, or to a control group ( $n=22$ ) who spent time thinking about current daily concerns. Both cognitive and memorabilia reminiscence groups showed increases in percentage of time feeling happy at the end of the week, with no change for the controls. The cognitive imagery group showed a greater increase in happiness than the memorabilia group. In two other studies, Lyubomirsky et al. (2006) had students think about their happiest life experience. In the first study, students who thought of their happiest life experience for 15 minutes per day for 3 days did not differ from a comparison group on positive affect or life satisfaction 4 weeks later. In the second study, however, students in a think/replay group ( $n=30$ ) were asked to think and replay the memory "as though you were rewinding a videotape and playing it back" (p.702) and had significantly higher positive

emotion scores at the 4 week follow up than students who wrote about or analyzed their positive experience. There were no group effects for negative affect (Lyubomirsky, et al., 2006). Although the think/replay group was not specifically instructed to use visualization, instructions to replay the memory like a videotape imply the use of mental imagery (versus analyzing or writing about the experience). Overall, early work suggests that brief daily reminiscence exercises, particularly those involving imagery, can increase positive emotions for up to one month. Previous research with other brief positive emotion exercises suggests that prolonged effects may be due to participants continuing to practice the exercise in daily life (Seligman, et al., 2005). Although reminiscence is considered a savoring strategy, no studies have documented effects of reminiscence interventions on gold standard measures of savoring. No previous studies have investigated the effects of brief savoring exercises, including reminiscence, in groups at risk for depression.

### **Application to Anxious Individuals at Increased Depression Risk**

It has been suggested that an individual's risk profile influences what factors bring about resilience and the prevention of depression. For instance, some suggest that factors promoting resilience for a given outcome (e.g., depression) may vary depending on what external risk factors are present for that outcome (e.g., bereavement, Davydov, Stewart, Ritchie, & Chaudieu, 2010). The same may be true for internal risk factors such as anxiety, low self-esteem, and certain cognitive styles (Garber, 2006). Anxious individuals are at high risk for depression, which may develop through a number of potential pathways (see Bromberger, et al., 2009; Garber, 2006).

Despite the high rates of depression development among anxious individuals, little is known about the mechanisms of comorbidity (see Goodwin, 2002; Wittchen, Kessler, Pfister, & Lieb, 2000). Importantly, the transition to comorbid anxiety-depression actually follows predictable temporal patterns, with anxiety typically preceding depression onset (e.g., Wittchen, Hoyer, & Friis, 2001). Commentators have suggested the need to better account for the temporal precedence of anxiety and the process of transitioning to depression (i.e., comorbidity mechanisms, Andover, Izzo, & Kelly, 2011; Avenevoli,

Stolar, Li, Dierker, & Ries Merikangas, 2001; Goodwin, 2002; Wittchen, et al., 2000). Surprisingly few studies examine the transition process from anxiety to depression. Current views of comorbidity often take a cross-sectional approach, including the most widely accepted affective model, which holds that anxiety and depression co-occur because they share a common negative emotion component (e.g., tripartite model, Mineka, Watson, & Clark, 1998). However, a growing evidence base suggests that individuals whose risk profile includes anxiety may exhibit a number of deficits that result in diminished positive emotional functioning (Morris, 2012), potentially explaining one pathway by which anxiety may increase depression risk. As such, increasing positive emotions may be one route to promoting resilience and reducing risk in anxious individuals.

**Positive emotion deficits in anxious individuals.** Positive emotion deficits have often been overlooked in the context of anxiety. Established theories do not see positive emotions as integral to anxiety, and empirical studies investigating positive emotions in anxiety have often done so for other motives (i.e., differentiating anxiety and depression). Compared with depressed persons, anxious persons generally report better positive emotional functioning on trait scales (Dyck, Jolly, & Kramer, 1994; Jolly, Dyck, Kramer, & Wherry, 1994; Watson, Clark, & Carey, 1988). Despite the relative dearth of studies focusing specifically on positive emotions in anxiety, a closer look at the literature suggests that anxiety can influence positive emotional functioning, perhaps particularly under stressful conditions. Importantly, several studies have found that positive emotion deficits present in anxious individuals cannot be accounted for by concurrent depression symptoms (e.g., Kashdan & Breen, 2008; Newton & Ho, 2008). In light of evidence supporting positive emotions as key to resilient responding and beneficial in reducing depression risk, finding positive emotion deficits in anxious groups enables the following hypothesis: anxious individuals' increased depression risk reflects the absence of resilience-fostering benefits of experiencing positive emotion.

The literature on positive emotional deficits in anxious groups is modest but growing. Various anxious groups exhibit deficits in the experience of positive emotions, as assessed across a variety of emotion indicators. Symptoms of certain anxiety disorders have been associated with global reports of

reduced positive emotional experiences (e.g., social anxiety, Sellbom, Ben-Porath, & Bagby, 2008). Daily diary studies find various anxious groups (e.g., veterans with PTSD, students with high social anxiety), report less intense and less frequent positive emotions than their non-anxious counterparts, and this effect holds when controlling for depression history and symptoms (Beckham, et al., 2000; Kashdan & Steger, 2006). Research investigating the presence of positive emotion deficits in anxiety disorders has far-reaching implications for our understanding of these disorders; for instance, the language used for PTSD diagnostic criteria in the *Diagnostic and Statistical Manual of Mental Disorders, 4<sup>th</sup> edition (DSM IV-TR, APA, 2000)* listed “restricted range of affect” as a symptom, (p. 468) whereas the *5<sup>th</sup> Edition (DSM V, APA 2013)*, which no longer considers PTSD an anxiety disorder, now specifies “inability to experience positive emotions” as a symptom (p. 271).

Some laboratory work finds anxious individuals report blunted reactivity to positive emotional stimuli compared to controls (Elman et al., 2009; Srivastava, Sharma, & Mandal, 2003). Other data suggest anxious individuals’ positive emotional deficits may be particularly strong at peak anxiety times or in the context of stressors. For instance, Litz et al. (2000) found veterans with PTSD showed blunted responses to positive stimuli in the context of trauma cues (but not neutral cues) when compared to those without PTSD. In addition, inducing anxiety in the laboratory has been shown to decrease positive emotion in college students (McLaughlin, Borkovec, & Sibrava, 2007). In sum, anxiety may involve experiencing fewer and less intense positive emotions as well as diminished responses to positive emotion eliciting stimuli, and increases in anxiety are linked to decreases in positive emotions.

There is also evidence of deficits in how anxious individuals respond to and regulate positive emotions. Research on dampening, or downregulating, positive emotion is limited. Based on self report data in unselected samples, Quoidbach et al. (2010, p. 2) concluded that the most common emotion regulation processes that dampen positive emotions include suppression, distraction (engaging in cognitions, including worry, that draw attention away from the current positive experience), fault finding (focusing on the negative in an otherwise positive situation, including how the situation could have been even better), and “negative mental time travel” (negative cognitions about the causes of a positive

experience or worries about potential negative outcomes that could occur as a result). Quoidbach et al. (2010) found distraction was most highly negatively related to positive emotion, suggesting that when an individual's attention is drawn away from the positive emotional content of the present moment, the associated positive emotion is downregulated. In particular, anxious individuals tend to dampen rather than savor positive emotional experiences (e.g., Eisner, et al., 2009), and anxious individuals report engaging in behaviors that downregulate positive emotional experiences (e.g., concealing or suppressing emotions, Decker, Turk, Hess, & Murray, 2008; Hoyt, et al., 2010; Kashdan & Steger, 2006; Roemer, Salters, Raffa, & Orsillo, 2005; Turk, Heimberg, Luterek, Mennin, & Fresco, 2005). To the extent that anxious individuals engage in these and other downregulation strategies (either automatically or intentionally), positive emotional experiences are diminished in daily life.

Deficits in positive emotion experiences (frequency, duration, intensity of positive emotions in daily life) and deficits in positive emotion regulation (appropriate responses to experiencing positive emotions) represent related but theoretically separable pathways by which positive emotional functioning may increase depression risk in anxious individuals. Though separable, emotion experience and emotion regulation are tightly intertwined in practice as emotion experience can be enhanced or dampened by automatic or intentional emotion regulation efforts. Whether positive emotion experience is deficient due to reduced reactivity to positive stimuli, faulty cognitive processing, maladaptive regulation, or a combination of these and other potential factors, positive emotion deficits are deleterious to anxious individuals. From a broaden-and-build perspective (Fredrickson, 1998, 2001), to the extent that everyday positive emotional experiences are diminished in anxious individuals, so too are positive-emotion-related benefits. Importantly, many of these positive emotion benefits that anxious individuals miss out on, such as attention to environmental rewards, flexible cognitive strategies, and the building of social support, have been associated with low depression risk (see Fredrickson, 2000; Layous, Chancellor, Lyubomirsky, Wang, & Doraiswamy, 2011). Theoretically, missing these benefits, which include a more flexible cognitive/behavioral repertoire and the garnering of personal resources that can be harnessed during difficulty, compromises anxious individuals when dealing with life stress. Interestingly, anxious groups

that exhibit positive emotion deficits have higher MDD comorbidity rates than those who do not exhibit positive emotion deficits (Kashdan & Hofmann, 2008; Kashdan, McKnight, Richey, & Hofmann, 2009). Taken together, these findings motivate the hypothesis that anxiety may adversely affect the experience of positive emotions, which leaves anxious individuals at higher risk for depression. That is, diminished positive emotion responses may be one mechanism by which anxiety transitions into comorbid anxiety-depression.

**Stress resilience view of anxiety and depression.** The stress resilience view focuses on resilient responding as one process that may prevent depression in at-risk individuals. Just as there are a number of pathways to depression, there are likely a number of pathways to resilience (Bonanno, 2004). Resilience research generally investigates factors that promote health and well-being (see Seligman & Csikszentmihalyi, 2000), supplementing the traditional approach of studying risk factors that contribute to poor psychological outcomes following stress (see Folkman, 2008). Findings from resilience studies suggest that the experience and successful regulation of positive emotions, particularly under stressful circumstances, leads to good outcomes, including lower depression risk and increased well-being (e.g., Tugade & Fredrickson, 2007). This complements findings from the clinical literature, which suggests positive emotion deficits are a risk factor for developing depression, manifest in the cardinal symptom of anhedonia during a depressive episode, and predict a poorer depression course (see Forbes, 2009; Morris, Blyisma, & Rottenberg, 2009). The stress resilience view merges these perspectives to create a framework for depression risk associated with anxiety, suggesting that positive emotion deficits place anxious individuals at increased depression risk and that these deficits can be intervened upon to promote resilience in anxious individuals (see Morris, 2012).

### **The Present Study**

The present study investigated whether a reminiscence exercise can mitigate depression risk by increasing positive emotions, and whether this effect was present in a subsample of at-risk anxious individuals. An unselected sample of individuals was recruited to complete either a week long

intervention of daily reminiscence exercises or control exercises. Participants completed pre-post assessments of positive emotions and depression symptoms in order to test primary hypotheses. Participants were re-tested at a one month follow up to address the longer term effects of these exercises. A portion of the sample were selected based on high self-reported anxiety symptoms, and the study investigated the applicability of this exercise to reduce depression risk by increasing positive emotions in those at increased risk for depression.

Previous studies have shown that interventions aimed at increasing positive emotions can reduce depression risk, but it is unclear whether changes in positive emotion are responsible for this effect. The present study provided a fine-grained analysis of the role of positive emotions in reducing depression risk by manipulating positive emotions more directly and by examining positive emotions as a mediator of effects on depression risk. Exploratory analyses were planned to investigate other potential mediators including negative emotion and emotion regulation skills (not specific to positive emotion), which would constitute alternative explanations for exercise effects on depression risk. Additionally, the present study utilized a more comprehensive assessment of positive emotions than previous studies, enabling examination of various aspects of positive emotion experience, such as frequency, duration, and peak intensity.

To manipulate positive emotions, this study utilized reminiscence, a method of savoring positive emotional experiences. The ability to savor positive emotional experiences may be a fundamental process that serves as a gateway to further benefits of positive emotions (Garland, et al., 2010), including increasing personal resources and well-being (Fredrickson & Joiner, 2002), and is linked to low depression (Bryant, 2003; Feldman, et al., 2008; see Tugade & Fredrickson, 2007). Previous studies have found reminiscence to increase positive emotions, but this study was the first to examine whether reminiscence exercises increase savoring using gold-standard assessments.

Prior studies of savoring have successfully utilized reminiscence exercises to increase positive emotions in unselected samples. However, no previous studies have investigated the effects of brief savoring exercises, including reminiscence, in anxious individuals or other groups at risk for depression.

The present study was the first to examine the effects of savoring exercises among anxious individuals, who tend to dampen positive emotional experiences rather than savor them (Eisner, et al., 2009). According to the stress resilience view, increasing positive emotions in anxious individuals may reduce depression risk (Morris, 2012). Because anxiety symptoms across disorders have been associated with dampening positive emotional experiences, training to increase savoring skills may be helpful across anxious groups. Based on this, the present study examined individuals with high levels of trait anxiety rather than honing in on a particular disorder or cluster of symptoms. Substantiation of primary hypotheses in the anxious sub-sample would support taking a stress-resilience approach to depression risk in anxious individuals. Given the increased vulnerability to the depressogenic effects of stress exhibited by anxious individuals, the study also sought to explore whether the risk-mitigating effects of positive emotions are particularly strong for individuals experiencing a recent life stressor. While the study was not a comprehensive test of the stress-resilience view, it examined a core element of this framework -- the possibility that positive emotions may serve as an intervention target in preventing depression in anxious persons.

The procedure for the present study drew upon elements of previous studies utilizing daily reminiscence exercises that incorporate mental imagery. In the Bryant et al. (2005) study, participants in the cognitive imagery reminiscence group made a list in the laboratory of nostalgic memorabilia associated with positive memories, then described the associated positive memory. Instructions were to “sit quietly alone in their place of residence” for 10 minutes twice per day, and to choose one memory from the list, “sit down, take a deep breath, relax, close your eyes” and think about the memory (p. 242). Instructions prompted participants to “picture the events” and associated details, “imagine the memory” and “let your mind wander freely through the details of the memory” (p. 242). Participants logged the content of the memory and how long they thought, as well as how detailed and vivid their positive memories were. The cognitive imagery group reported more vivid memories than a group looking at memorabilia to reminiscence, and mediation analyses showed that group differences in vividness partially mediated the stronger effect of cognitive imagery over memorabilia on positive emotions (Bryant, et al.,

2005). Participants reminisced for 10 minutes twice per day. The dependent measure, percentage of time spent feeling happy during the last week, was assessed at the beginning and end of the study week. In the Lyubomirsky et al. (2006) study, students in the think/replay reminiscence group were asked to identify “one of the happiest days they had ever experienced” and rate how recent and significant the day was to them (p. 699). Most days reported happened during the last 6 months and were rated as highly significant (Lyubomirsky, et al., 2006). Participants were asked to “privately think” about this day and “replay these thoughts as though you were rewinding a videotape and playing it back. Think about the events of the day with an emphasis on what happened, how you were feeling at the time, and how you behaved” (p. 702). Participants did the reminiscence exercise in the laboratory for 8 minutes on 3 consecutive days (Lyubomirsky, et al., 2006). The dependent measure of positive emotions (which assessed the last 3 months) was administered at baseline and a 4 week follow up.

The daily reminiscence exercise used in this study was brief and self-administered, based on successful procedures from prior studies (Bryant, et al., 2005; Lyubomirsky, et al., 2006). Initial procedure piloting verified the effect of the reminiscence exercise on positive emotions in an unselected sample; the control comparison exercise involved remembering and imagining oneself doing a mundane task. The reminiscence exercise incorporated the following elements, which are supported by prior work. First, the exercise involved utilizing visualization and imagery to maximize its positive emotional potency (see Holmes & Mathews, 2005). The control condition also involved imagery, as well as a being focused on a memory of oneself in the past, allowing us to isolate and test predictions specific to the positive emotional element of the reminiscence exercise. Second, given that gender has been found to interact with depression risk factors including stress and anxiety (Hettema, Kuhn, Prescott, & Kendler, 2006; Kendler, Kuhn, & Prescott, 2004) and gender differences have been noted in studies of savoring and reminiscence (Bryant, 2003; see Bryant, et al., 2011; Bryant, et al., 2005), only female participants were recruited. Finally, participants were given several options for triggering reminiscence such as looking at photos, listening to music, or just thinking back to a previous time. Participants were free to utilize the cue and method of their choice to engage a reminiscence topic and then follow standardized visualization

procedures for the rest of the exercise. A prior study of brief online positive psychology exercises found giving participants more variety in exercises lead to higher reports of exercise usage, and did not affect attrition (Schueller & Parks, 2012), with 2-4 exercise options most beneficial in terms of depression symptom reduction. This accords with prior findings where usage of a variety of savoring strategies predicted higher positive emotions than utilizing any individual strategy (Quoidbach, et al., 2010). Although this study focused on one type of savoring exercise, participants were free to utilize a variety of behavioral cues to help them engage in the task. After completing the exercise, participants completed online questions assessing the quality and content of their reminiscence experience, including the type of cue they chose. Participants rated the effectiveness of the cue as well as their level of engagement and attention during the task, and the level of positive emotion experienced during the exercise. Additionally, participants were asked to provide overall feedback about the perceived feasibility of the exercise, including how easy or difficult it was to incorporate the exercises into their everyday lives, and whether they engaged in any reminiscence outside of the daily sessions. These data were collected to provide a means of analyzing and controlling for the effects of investment in and attention to the exercise, as well as engaging in additional reminiscence outside the allotted time. Further, these assessments were meant to reduce demand as to the effects of the intervention on positive emotions, specifically, and encourage thoughtful participation.

## Method

### Participants

A total of 336 female participants, recruited from the University of South Florida's Psychology undergraduate research participant pool, completed the initial laboratory session. Data was collected from February 2013 to March 2014. Participants were randomly assigned to either the Reminiscence ( $n=162$ ) or Control ( $n=174$ ) condition. Mean age for the initial sample was 20.50 ( $SD=3.803$ ), with 37% ( $n=125$ ) of participants endorsing freshman status, 18% ( $n=61$ ) sophomores, 19% ( $n=64$ ) juniors, 24% ( $n=80$ ) seniors, and 2% ( $n=6$ ) endorsing "other." The sample was 51% ( $n=170$ ) Caucasian, 18% ( $n=59$ ) Hispanic/Latino, 14% ( $n=48$ ) Black/African American, 11% ( $n=38$ ) Asian, 4% ( $n=12$ ) Biracial or Multi-racial, 2% ( $n=7$ ) unknown or not reported, and <1% ( $n=2$ ) American Indian/Alaska Native. Of the initial sample, 157 participants were considered study completers (77 Reminiscence, 80 Control), defined as participants who completed at least 4 of the 7 possible daily online practice sessions, including Day 7 (T2). Demographic information is presented in Table 1 for study completers and non-completers. A total of 49 participants (22 Reminiscence, 27 Control) completed the one month follow up assessment. Participants were compensated with points for course credit. In accordance with university and department policy, participants were not obligated to complete the study to receive course credit, but rather were compensated for each participation activity. Points were awarded immediately and separately for the T1 laboratory session and each online participation day (Days 1-6, Day 7 (T2), and T3). As such, participants were not required to provide justification or reasons for study withdrawal. Thus, the reasons for study attrition at T2 (53%) and for T3 (69%) were unknown (see Attrition Analyses section of Results). Figure 1 illustrates participant flow through the study. Participants who completed the one month follow up assessment were compensated with course credit when possible (i.e., during the school term), or monetary compensation (\$5) if the follow up occurred outside the school term.

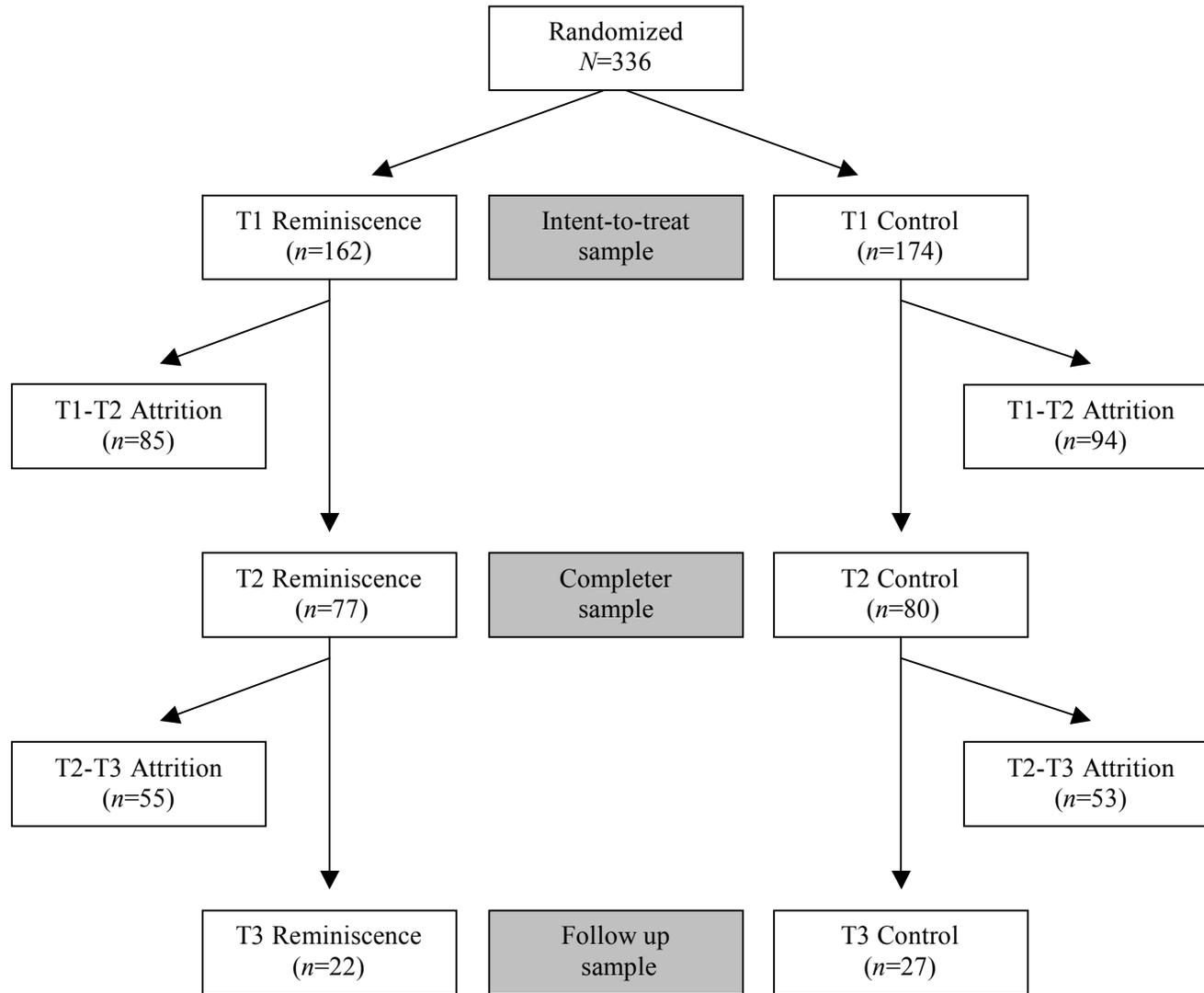
## Measures

**Trait anxiety.** The State Trait Anxiety Inventory, Trait version, form Y (STAI-T; Spielberger et al., 1983) is a widely used measure of trait anxiety symptoms. Responders answer 20 items assessing anxiety symptoms in terms of how they *generally* feel. The STAI-T has excellent psychometric properties and demonstrates convergent validity with other indices of anxiety symptoms. The STAI-T was used to identify individuals with high levels of trait anxiety to include in anxious sub-sample hypotheses tests. It demonstrated excellent reliability in this sample ( $\alpha = .92$ ).

**Stressful life events.** The Stressful Life Events Questionnaire (SLEQ) is a checklist created for this study from two existing life event scales. Following methods used in previous studies of stressful life events in college students (Shih, 2006), items from a measure of negative life events (Saxe & Abramson, 1987) that are particularly relevant to college students (i.e., failing an exam) were merged with items derived from the Inventory for Recent Life Events (Paykel, 1997), which assesses stressors in the following domains: work, education, financial, health, bereavement, migration, courtship, legal, family and social, marital. All items are rated dichotomously as to whether they happened or not during the last 6 months. The SLEQ includes 56 items derived from other measures and 4 open ended items where participants can list up to 4 additional life events. Ratings (0=no, 1=yes) were summed to form a continuous measure of recent life stress.

**History of major depression.** The Inventory to Diagnose Depression, Lifetime (IDD-L, Zimmerman & Coryell, 1987b) is the lifetime version of the 22 item IDD (Zimmerman & Coryell, 1987a) and was used to determine whether or not each participant has a past history of a major depressive episode. In a college sample, it demonstrates 70% sensitivity and 87.5% specificity in identifying depression cases diagnosed via a structured clinical interview (Goldston, O'Hara, & Schartz, 1990). This measure was planned to be used in exploratory moderation analyses. An abridged version of this measure was used, omitting the item assessing suicidality. The IDD-L was reliable in this sample ( $\alpha = .90$ ).

Figure 1. Participant Flow Through the Study



**Reminiscence frequency.** A two item measure of reminiscence frequency was used based on Bryant, Yarnold, and Morgan (1991). Participants responded on a 7 point Likert scale (1= very little, 7 = a great deal) as to 1) how much they think about pleasant memories in order to get a sense of happiness or satisfaction in the present, and 2) how much time they spend thinking about good memories from their past. This measure was used to test for group differences in baseline reminiscence practices. This measure had adequate reliability in this sample ( $\alpha = .77$ ).

**Positive and negative affect.** The Positive and Negative Affect Schedule (PANAS, Watson, Clark, & Tellegen, 1988) is a 20 item self-report measure of positive and negative affect, which can be given in a variety of instruction formats (e.g., present moment, past week, trait). This measure demonstrates excellent psychometric properties and is a valid measure of the two independent constructs of positive and negative affect (Watson, Clark, & Tellegen, 1988). In this study, the PANAS was used to assess emotions experienced during the last week (PANAS-W) for pre-post assessments. The PANAS-W-PA scale assessed positive emotions and had good reliability in this sample ( $\alpha = .85$ ), as did the PANAS-W-NA scale, which assessed negative emotions ( $\alpha = .80$ ). As part of the Daily Questionnaire, the PANAS was also used to assess daily emotions (PANAS-D) Also in the Daily Questionnaire, participants reported the percentage of time they spent feeling good each day, the frequency of positive emotional experiences, their peak positive emotion intensity of the day (on a 10 point scale from 0-none to 10-extremely high), and the typical duration of positive emotion experiences that day. Participants chose from the following options to describe how long they would typically feel good when something good happened that day: 1) less than 1 minute, 2) 1-5 minutes, 3) 6-15 minutes, 4) 15 - 30 minutes, 5) 30 minutes-1 hour, 6) 1-3 hours, 7) more than 3 hours.

**Perceived stress.** The Perceived Stress Scale (PSS, Cohen, Kamarck, & Mermelstein, 1983) is a widely used 14 item self-report measure of perceived life stress during the last month. The PSS has strong psychometric properties in college student samples (Cohen, et al., 1983). The current study utilized a

version with modified instructions so perceived stress is assessed in the last week only, to enable pre-post assessments. The PSS demonstrated good reliability in this sample ( $\alpha = .85$ ).

**Depression symptoms.** A 20 item version of the Beck Depression Inventory (BDI-II, Beck, Steer, & Brown, 1996), a well-validated, self-administered scale, was used to assess current depression symptom severity. The 20 item version included all items except item 9, which assess suicidal intent. Scores range from 0 to 60 with higher scores representing greater severity. Coefficient alphas for the BDI-II are high, ( $\alpha = .91$ ; Beck, Steer, Ball, & Ranieri, 1996). The test-retest reliability is also high ( $r = .93$ ; Beck, Steer, & Brown, 1996). Due to the one week period between T1 and T2 assessments in the current study, the BDI-II instructions were adjusted to assess symptoms during the last week only. The modified BDI-II used in this study showed good reliability in this sample ( $\alpha = .89$ ).

**Mental focus.** A six item measure adapted from a prior study (Lee, Sheldon, & Turban, 2003) was used to assess mental focus, which all participants were told is the outcome variable targeted by the exercises in order to reduce demand. Lee et al. (2003) measured participants' expectations of their mental focus abilities in preparing for an exam in the future. In the present study, the measure included a definition of mental focus (see below) and the items were slightly modified to assess mental focus more generally, with schoolwork used only as an example. The measure instructions included the following definition from Lee et al. (2003): "mental focus refers to the degree to which someone is able to concentrate and become absorbed in an activity" (p.259). The following items were used in combination with the stem, "When I try to focus on something like schoolwork, I...": "become easily absorbed in what I'm doing," "have good concentration," "find my mind wandering to other things," "feel distracted and find it hard to pay attention," "have to work hard to keep my mind on task" and "have a difficult time focusing on what I'm doing." Participants responded as to how much each item describes them using a 4 point Likert scale ranging from 1 (not at all) to 4 (very much). In the Lee et al study, the measure had good internal consistency ( $\alpha = .88$ ) and test-retest reliability ( $r=.68$ ) (Lee, et al., 2003). In this sample, the

scale demonstrated poor reliability ( $\alpha = .57$ ), which was acceptable given the measure was only included for the purpose of manipulating study demand characteristics.

**Savoring.** The Savoring Beliefs Inventory (SBI, Bryant, 2003) is a 24 item self report measure that was used to assess participants' beliefs about their ability to enjoy positive events through savoring. The scale produces a total score as well as subscale scores for three temporal forms of savoring: Anticipating, Present Moment, and Reminiscing. Items include: "I get pleasure from looking forward," "I feel fully able to appreciate good things," and "I find it easy to rekindle joy from happy memories." Participants respond using a 7 point Likert scale to indicate the degree to which they agree with each statement. Higher scores represent stronger beliefs in the ability to savor positive emotional experiences. The SBI has consistently demonstrated good internal consistency (alphas ranging from .88-.94) with all subscales showing high test-retest reliability ( $r$ s over .80) (Bryant, 2003). The SBI aims to capture trait savoring, and prior work suggest that subscales of the SBI are influenced by interventions that increase positive emotions (Johnson, et al., 2011). The SBI demonstrated good reliability in this sample ( $\alpha = .89$ ).

**Emotion regulation.** The Difficulties in Emotion Regulation Scale (DERS, Gratz & Roemer, 2004) is a widely used, 41-item measure assessing self-reported emotion regulation abilities. The DERS was designed to assess "clinically relevant" difficulties in emotion regulation and yields a total score as well as 6 subscale scores that reflect difficulties in 1) awareness/understanding of emotions ("I pay attention to how I feel"), 2) acceptance of emotions ("When I'm upset, I feel like I am weak"), 3) the ability to engage in goal-directed behavior ("When I'm upset, I have difficulty focusing on other things"), 4) refraining from impulsive behavior ("When I'm upset, I feel out of control"), 5) accessing emotion regulation strategies ("When I'm upset, I believe there is nothing I can do to make myself feel better"), 6) emotional clarity ("I am confused about how I feel"). The DERS has been used extensively and has high internal consistency ( $\alpha = .93$ ) with all subscales showing alphas over .80 (Gratz & Roemer, 2004). The DERS was included for use in exploratory mediation analyses, testing whether general emotion regulation

skills mediated the effect of the reminiscence intervention on depression risk. The DERS demonstrated excellent reliability in this sample ( $\alpha = .93$ ).

**Experiences during daily exercises.** Two daily exercise questionnaires included items assessing the participant's experience during the reminiscence (EQ-R) and mental imagery (EQ-M) exercises. In the EQ-R, experimental group participants briefly described the content of the exercise (i.e., what memory they used to reminisce), and how recent the experience was that they chose for the exercise. Participants answered questions about the type of trigger used to elicit or enhance the memory (music, photos, video, other memorabilia, conversation, thinking, none) and how effective it was at helping them recreate the good feelings of the memory. Participants also provided ratings of 1) how much they were able to immerse themselves in the memory and feel the same way they felt during the original experience, 2) how good they felt while reminiscing about this memory, 3) how distracted/able to concentrate they were during the exercise, 4) how easy/difficult the task was. In the EQ-M, control participants provided ratings of 1) how much they were able to focus on the mental imagery task 2) how they felt during the task, 3) how distracted they were during the task, 4) how easy/difficult the task was for them. These data were collected to permit statistical control of investment and attention to the assigned exercise, as well as manipulation check analyses of greater positive emotions elicited by the reminiscence task than by the control task.

**Feedback on exercises.** A study feedback questionnaire assessed participants overall experiences with the daily exercises at the end of the week. Participants rated how effective they felt the exercises were in improving mental focus and clarity, how engaged and invested they were in the exercises overall, how easy/difficult it was to incorporate into daily life, and whether they did any other reminiscence/mental imagery outside of the daily exercises. These data were collected to statistically control for any group differences in the perceived feasibility and effectiveness of the task, as well as the extent to which participants incorporated the exercise into daily life.

## Procedure

Upon arrival to the laboratory, all participants were told that the study was investigating the effectiveness of a brief exercise aimed at improving mental focus and clarity, designed specifically to be easy for college students to incorporate into their daily lives. Participants were asked to use this new technique for one week and then offer feedback to the experimenter about the exercise. Participants read the informed consent carefully and were given the opportunity to ask the researcher any questions. Upon providing written consent to participate, participants were randomly assigned to one of two study groups: experimental (reminiscence) or control. Participants were not told that they were being randomly assigned, as psychology students are wise to psychological research methods and this might have introduced the question of whether some participants were participating in a control condition, thereby potentially introducing demand. All participants filled out a demographics questionnaire and baseline assessments (T1) of trait anxiety (STAI-T), depression history (IDD-L), stressful life events (SLEQ), reminiscence frequency, emotion (PANAS-W), perceived stress (PSS), depression symptoms (BDI-II), mental focus, emotion regulation (DERS), and savoring (SBI). Participants in both groups were given instructions for completing online daily questionnaires, as well as for completing measures (PANAS-W, STAI-T, BDI-II, mental focus, PSS, DERS, SBI, study feedback questionnaire) online upon study completion (T2) and at the one month follow up assessment (T3). Control group participants were then given instructions for completing the control condition procedure and experimental group participants were given instructions for the reminiscence condition (See experimental procedure section below). All participants were told that the daily exercises must be completed when participants are alone in a quiet place with access to a clock or watch to time the exercise. Participants were instructed that they must access their Sona accounts to complete daily emotion assessments (PANAS-D) before beginning the exercise, and then return immediately to Sona to complete post-exercise questionnaires. Participants were instructed they would need to time their exercises and were reminded that Sona has a timeout feature if no entries are made in 20 minutes. Study instructions noted that after the 8 minute exercise participants were to complete questions online assessing their experience during the exercise (EQ-R, EQ-M). Participants

were asked to complete exercises for at least 4 of the following 7 days. Participants were provided with study codes that allowed them to access online questionnaires only on the specified day. The laboratory session lasted approximately 30-60 minutes. Upon completion of the laboratory session, participants were compensated with course credit (see Compensation section). Participants were sent daily email reminders to complete practices. Participants who completed at least 4 of the daily exercises, including the 7<sup>th</sup> day post-study measures, were invited to participate in the online follow up study. Participants were contacted via email at approximately four weeks to complete the follow up study. Participants who did not complete the follow up within one week received one reminder email. At the conclusion of data collection, a debriefing form was sent.

**Experimental condition.** Participants were informed that recent research suggests that practicing certain mental skills can improve one’s ability to focus and think clearly. They were told that the study was testing a new technique that was specifically designed to be easy because it involved practicing something most people already do, but just in a new way. Participants were told the following: “Reminiscing about a memory from the past is something that everyone is familiar with, and that although it seems easy, it actually involves a lot of brain processes to happen simultaneously: For instance, after retrieving the memory that you want to think of (which is usually a memory of something positive), your mind can hold that memory as your thoughts wander through what was going at the time. This can involve input from all five of your senses in addition to your thoughts and feelings you were having at the time. Your brain must simultaneously combine all of that information into a sequential series of events that form a memory sort of like a mental movie that replays in your mind exactly what happened. The ability to recreate good memories to be as close to the original as possible takes practice, and practicing helps your brain get better and faster at integrating information efficiently -- that is, your mental focus improves.” Participants were asked to do a reminiscence exercise for 8 minutes daily for one week, and to give feedback at the end of the week about well they thought the exercise was and how easy/difficult they found it to be. Participants were told that the reminiscence exercise involved choosing a positive memory to think back on, and that they were choosing a positive memory not only because that

is the way most people are familiar with reminiscing (i.e., it is uncommon to reminisce about tying their shoelaces), but also because positive memories are typically encoded with much more detail than neutral memories.

Instructions for selecting a past experience to use in the reminiscence exercise were to “choose a memory of a specific time and place when you were feeling really good. This memory can be from any time in your life as long as you recall the details vividly. Perhaps this memory is of a big event like a wedding or vacation, or it could be just a really great day you had doing something fun with a friend or family member. Maybe it is a time when you finished a project and felt proud and on top of the world, or maybe it was a time when you had fun laughing at something with friends or family. You may choose whatever memory you want to focus on, as long as it is one where you were feeling really good at the time.” When going over these instructions, the experimenter gave examples for participants to guide selection to a specific time and place rather than a general timeframe (e.g., being at the prom versus senior year in high school). The experimenter explained that the study permits various ways of generating and enhancing the memory, including looking at photos, listening to music, talking to a friend, or just thinking back to good times. Participants were told that they could use any of these methods to help get them started with the exercise, and that once they decided on which memory to focus on, the next step involved taking 8 minutes to picture themselves back in this place at that time and to mentally re-experience the memory in as much detail as possible. Participants were told that visualizing was the key to the exercise and that previous work shows that just thinking without visualization does not work as well. Based on the instructions used in Bryant et al. (2005), participants were told that the exercise would have the following instructions: “Close your eyes, take a deep breath, relax and begin to picture this memory in your mind. Picture the things that happened as if you were watching a movie. Replay the good parts over again. Let your mind wander through the detailed images of the memory as you imagine yourself feeling the good feelings you felt at the time. If your thoughts start to go off into an unrelated direction, gently try to redirect them back to the memory in your mind. Immerse yourself in the details and good feelings of this memory as much as possible.”

**Control condition.** Participants in the control condition performed a novel, emotionally neutral activity in the laboratory, and then recalled that activity during daily 8 minute mental imagery exercises over the next week. By creating a standardized neutral memory for control participants, the control condition mirrored the experimental condition in terms of using mental imagery during recall of a particular past event and only differed in that the event was neutral (allowing the positive emotional elements of the reminiscence condition to be isolated).

Participants were told that the purpose of the task was to create a mental image of oneself doing an activity that although easy, involves many steps and detailed actions that require the brain to use multiple processes simultaneously. The daily mental imagery task was used to practice mental imagery skills aimed at improving mental clarity and focus. Participants were told that individuals who practice visualizing themselves doing a detailed task can improve their mind's ability to focus, concentrate, and think clearly in daily life. The laboratory activity involved participants holding a shuffled deck of 52 playing cards and pulling out cards of a particular suit one by one in numerical order and placing them in designated rows on the table. The task therefore involved manual manipulation of cards as the participants thumbed through looking for each card. It involved easy cognitive activity (counting and visually searching for a particular card), and creating a visual pattern of cards on the table (cards 2-6 across the top row, cards 7-10 in the second row, Jack-King in third row, and Ace in fourth row to create a pyramid). In addition, it involved stimuli that were already familiar to participants and therefore easy to recall during the daily mental imagery exercises. Because the steps involved simply ordering cards from 2 to Ace, participants could focus on visualizing the steps rather than trying to remember what they were. Participants were asked to do the card task, which lasted approximately 1-2 minutes, a total of four times in the following order: spades, diamonds, clubs, hearts. Between suits, cards were shuffled. The card task was simple, but detailed enough to be memorable, with steps in a particular order that involved stimuli with which participants were already familiar (i.e., easily recalled).

Participants received the following instructions for the daily mental imagery task. "Close your eyes, take a deep breath, relax and begin to picture yourself doing the card task you learned before. You

can choose any suit (spades, diamonds, clubs, hearts) to start with. Picture yourself doing the card task as if you were watching a movie. Try to imagine doing the task in as much detail as possible. Try to picture how the cards looked as you took each one from your hand and placed it in the pyramid on the table. When you finish, repeat using the suit of your choice. You may use the same suit more than once. If your thoughts start to go off into an unrelated direction, gently try to redirect them back to the card task in your mind. Continue visualizing the details of the card task for 8 minutes.”

## Planned Analyses

### Primary Hypothesis Testing

H1: *In the completer sample, the experimental (reminiscence) group will report increases in positive emotion from T1 to T2 compared to the control group.*

A repeated-measures analyses of variance (ANOVA) with group (reminiscence, control) as the between subjects factor and time (T1, T2) as repeating within subjects factors was used to test for effects of the reminiscence exercise on positive emotions, assessed by the PANAS-W, in the full sample. A significant group by time interaction in the hypothesized direction would indicate that the reminiscence condition was associated with greater increases in positive emotions than the control condition. Similar analyses were planned to test for effects on other aspects of positive emotion experience (e.g., frequency, duration, peak intensity).

H1a: *Among high anxious completers, the experimental (reminiscence) group will report increases in positive emotion from T1 to T2 compared to the control group.*

Exploratory analyses were planned to test whether trait anxiety influenced the effects of the reminiscence exercise on positive affect. A significant covariate test for anxiety effects in the main H1 analysis would be followed by a repeat of the main analysis, including significant covariates and a group x anxiety interaction term. A significant group x anxiety x time interaction would be followed by repeating main analyses in subgroups of low and high anxious participants. A significant group by time interaction in the hypothesized direction among high anxious participants would indicate that the reminiscence condition was associated with greater increases in positive affect than the control condition. Similar analyses were planned to test for effects on other aspects of positive emotion experience (e.g., frequency, duration, peak intensity).

*H2: In the completer sample, the experimental (reminiscence) group will report decreases in depression symptoms from T1 to T2 compared to the control group.*

A repeated-measures analyses of variance (ANOVA) with group (reminiscence, control) as the between subjects factor and time (T1, T2) as repeating within subjects factors was planned to test for effects of the reminiscence exercise on depression symptoms, assessed by the BDI, in the full sample. A significant group by time interaction in the hypothesized direction would indicate that the reminiscence condition was associated with greater decreases in depression symptoms than the control condition.

*H2a: Among high anxious completers, the experimental (reminiscence) group will report decreases in depression symptoms from T1 to T2 compared to the control group.*

Exploratory analyses were planned to test whether trait anxiety influenced the effects of the reminiscence exercise on depression symptoms. A significant covariate test for anxiety effects in the main H2 analysis would be followed by a repeat of the main analysis, including significant covariates and a group x anxiety interaction term. A significant group x anxiety x time interaction would be followed by repeating main analyses in subgroups of low and high anxious participants. A significant group by time interaction in the hypothesized direction among high anxious participants would indicate that the reminiscence condition was associated with greater decreases in depression symptoms than the control condition.

*H3: In the completer sample, the experimental (reminiscence) group will report increases in savoring from T1 to T2.*

A repeated-measures analysis of variance (ANOVA) with group (reminiscence, control) as the between subjects factor and time (T1, T2) as repeating within subjects factors was planned to test for effects of the reminiscence exercise on savoring, assessed by the SBI, in the full sample. A significant group by time interaction in the hypothesized direction would indicate that the reminiscence condition was associated with greater increases in savoring than the control condition.

H3a: *Among high anxious completers, the experimental (reminiscence) group will report increases in savoring from T1 to T2 compared to controls.*

Exploratory analyses were planned to test whether trait anxiety influenced the effects of the reminiscence exercise on savoring. A significant covariate test for anxiety effects in the main H3 analysis would be followed by a repeat of the main analysis, including significant covariates and a group x anxiety interaction term. A significant group x anxiety x time interaction would be followed by repeating main analyses in subgroups of low and high anxious participants. A significant group by time interaction in the hypothesized direction among high anxious participants would indicate that the reminiscence condition was associated with greater increases in savoring than the control condition for high anxious participants.

H4: *Group differences in positive affect will be maintained at a one month follow up assessment. In the completer sample, the experimental (reminiscence) group will report increases in positive emotion from T1 to T3 compared to the control group.*

A repeated-measures analyses of variance (ANOVA) with group (reminiscence, control) as the between subjects factor and time (T1, T3) as repeating within subjects factors was planned to test for long term effects of the reminiscence exercise on positive emotions, assessed by the PANAS, in the completer sample. A significant group by time interaction in the hypothesized direction would indicate that the reminiscence condition was associated with greater long term increases in positive emotions than the control condition.

H4a: *Among high anxious completers, group differences in positive affect will be maintained at a one month follow up assessment. Among high anxious completers, the experimental (reminiscence) group will report increases in positive emotion from T1 to T3 compared to the control group.*

Exploratory analyses were planned to test whether trait anxiety influenced the long term effects of the reminiscence exercise on positive affect. A significant covariate test for anxiety effects in the main H4 analysis would be followed by a repeat of the main analysis, including significant covariates and a group

x anxiety interaction term. A significant group x anxiety x time interaction would be followed by repeating main analyses in subgroups of low and high anxious participants. A significant group by time interaction in the hypothesized direction among high anxious participants would indicate that the reminiscence condition was associated with greater long term increases in positive emotions than the control condition for high anxious participants.

*H5: The effects of the experimental (reminiscence) condition on depression will be mediated by changes in positive emotions.*

Mediation analyses using the Preacher and Hayes (Preacher & Hayes, 2004) bootstrapping method were planned to test for potential mediation of the relationship between group (X) and T2 depression symptoms (Y) by T2 positive emotions (M). This version of the Sobel test generates an unstandardized regression coefficient for the mediator variable, M, regressed on an independent variable X ( $a_1$ ), as well as conditional coefficients for the outcome variable Y regressed on M ( $b_1$ ) and X ( $c'$ ), where M and X are entered simultaneously as predictors of Y. The test allows for a significance test of the difference between the total effect (c), or the effect of X on Y not accounting for M, and the direct effect ( $c'$ ) with the null hypothesis that  $c-c'=0$ . This method uses a bootstrapping method to resample the data to create sampling distributions for test statistics and is well-suited for assessing mediation in small samples. Statistical macros are publicly available that utilize this method of bootstrapping and can accommodate covariates as well as multiple mediators and moderated mediators (Preacher, Rucker, & Hayes, 2007). The analysis would include T1 depression symptoms and positive emotions as covariates. A significant test in the hypothesized direction would indicate that, controlling for T1 measures, group differences in T2 depression symptoms are accounted for by group differences in T2 positive emotions. That is, a significant test would support the hypothesis that the effect of the reminiscence exercise on depression symptoms is owed to its effect on positive emotions.

## Exploratory Mediation Analyses

Moderated mediation analyses using the bootstrapping method discussed above (Preacher, et al., 2007) were planned to test whether stress moderates the mediation relationship of positive emotions and depression symptoms. Previous work suggests that positive emotions are particularly beneficial under stressful conditions; the relationship of higher positive emotions to lower depression symptoms is especially strong in the context of stress (Geschwind, et al., 2010; Ong, et al., 2004). Several types of moderated mediation effects can be investigated using bootstrapping methods (Preacher, et al., 2007) depending on the hypothesized nature of the moderator. This analysis would provide a significance test for a model where a moderator variable (W) moderates the  $b_1$  pathway (variable Y regressed on M, where M and X are entered simultaneously as predictors of Y). In this model, the moderator (W) does not influence the effect of the independent variable (X) on the mediator (M), but does influence the effect of the mediator (M) on the outcome variable (Y) (Preacher, et al., 2007). In other words, the test would not assess whether stress moderates the group effect of reminiscence versus control on positive emotions, but rather would assess whether stress moderates the effect of positive emotions on depression symptoms. A significant result would indicate that positive emotions generated by the reminiscence exercise have a more profound effect on depression symptoms for individuals higher in stress. This finding would lend support to the stress resilience view, which suggests that positive emotions may be particularly beneficial to individuals encountering stress. Analyses were planned using both the SLEQ and PSS to assess moderation by recent stressful life events and current perceived stress, respectively. Additional analyses were planned to examine trait anxiety and depression history as additional potential moderators.

In addition to examining positive emotions in the above mediation analyses, exploratory mediation analyses were also planned to examine savoring, negative emotion and emotion regulation difficulties as potential alternative pathways by which reminiscence influences depression risk. If savoring emerged as a significant mediator in exploratory mediation analyses, parallel moderated mediation analyses would be examined for moderated mediation of savoring by stress, as well as trait anxiety and depression history.

**Exploratory mediation analyses in high anxious subsample.** Moderated mediation analyses using the bootstrapping method discussed above (Preacher, et al., 2007) were planned to test whether stress moderates the mediation relationship of positive emotions and depression symptoms. Previous work suggests that positive emotions are particularly beneficial under stressful conditions; the relationship of higher positive emotions to lower depression symptoms is especially strong in the context of stress (Geschwind, et al., 2010; Ong, et al., 2004). Several types of moderated mediation effects can be investigated using bootstrapping methods (Preacher, et al., 2007) depending on the hypothesized nature of the moderator. This analysis would provide a significance test for a model where a moderator variable (W) moderates the  $b_1$  pathway (variable Y regressed on M, where M and X are entered simultaneously as predictors of Y). In this model, the moderator (W) does not influence the effect of the independent variable (X) on the mediator (M), but does influence the effect of the mediator (M) on the outcome variable (Y) (Preacher, et al., 2007). In other words, the test would not assess whether stress moderates the group effect of reminiscence versus controls on positive emotions, but rather would assess whether stress moderates the effect of positive emotions on depression symptoms. A significant result would indicate that positive emotions generated by the reminiscence exercise have a more profound effect on depression symptoms for individuals higher in stress. Analyses were planned using both the SLEQ and PSS to assess moderation by recent stressful life events and current perceived stress, respectively. Additional analyses were planned to examine depression history as an additional potential moderator.

### **Power Analysis**

The study was powered to detect a small to medium interaction effect of group and time in a repeated measures ANOVA with two groups (reminiscence, control) and two assessments (pre-post). With an overall group size of 150, the ANOVA would have 95% power to detect a small to medium effect ( $f = .15$ ) and 99% power to detect a medium effect ( $f = .25$ ) in the main analyses (G\*power 3, Faul, Erdfelder, Lang, & Buchner, 2007). Estimating the anxious sub-sample size at 50, analyses in the control group would have 93% power to detect a medium effect ( $f = .25$ ) (G\*power 3, Faul, et al., 2007).

## Results

### Checking Model Assumptions

General Linear Model assumptions were evaluated for the main continuous outcome variables (positive affect, depression, savoring) in study completers. Initial visual inspection of histograms suggested positive affect (PANASW-PA) scores were normally distributed data at T1 and T2. Skewness and kurtosis values for positive affect scores were not significant, and Shapiro-Wilk test of normality confirmed a normal distribution at T1 ( $W=.991, p=.430$ ) and T2 ( $W=.985, p=.088$ ). Visual inspection suggested depression symptoms (BDI) scores were slightly positively skewed, and skewness values were significantly elevated at T1 ( $z=7.05$ ) and T2 ( $z=5.41$ ). Kurtosis values were not elevated at T1, but were at T2 ( $z=5.95$ ), and Shapiro-Wilk tests of normality were significant at T1 ( $W=.891, p<.01$ ) and T2 ( $W=.886, p<.01$ ). Visual inspection of histograms suggested savoring (SBI) scores were slightly negatively skewed, and skewness values were significantly elevated at T1 ( $z=4.26$ ) and T2 ( $z=5.26$ ). Kurtosis values were not elevated at T1, but were at T2 ( $z=3.60$ ). Shapiro-Wilk tests of normality were significant at T1 ( $W=.950, p<.01$ ) and T2 ( $W=.930, p<.01$ ). The assumption of independence of observations was met as part of the design: the behavior and responses of each participant was independent of all others. Levene's test for homogeneity of variance was not significant for dependent variables, except T2 positive affect scores,  $F(1,154)=5.639, p=.019$ , and savoring scores at T1,  $F(1,155)=15.091, p<.01$  and T2,  $F(1,154)=5.214, p=.024$ . Given that analyses of variance statistical tests are robust to normality violations and to violations of variance homogeneity when cell sizes are equal, analyses were performed as planned.

### Attrition Analyses

The attrition rate for study completion, defined as completing at least 4 of 7 daily online practice sessions, including Day 7 (T2), was 53% ( $n=179$ ). See Figure 1. There was a significant effect for age,

with completers ( $M=21.03$ ,  $SD=4.40$ ) older than non-completers ( $M=20.04$ ,  $SD=3.14$ ),  $F(1,335)=5.639$ ,  $p=.018$ . There were no differences between completers and non-completers in ethnicity,  $\chi^2(6, N=336)=7.242$ ,  $p=.299$ , past depression diagnostic status [IDDL,  $\chi^2(1, N=336)=.024$ ,  $p=.909$ ], current depression symptoms [BDI-II,  $F(1,333)=.780$ ,  $p=.378$ ], trait anxiety symptoms [STAI-T,  $F(1,335)=1.095$ ,  $p=.296$ ], initial positive affect [PANASW-PA,  $F(1,334)=2.358$ ,  $p=.126$ ], or initial negative affect [PANASW-NA,  $F(1,335)=.009$ ,  $p=.925$ ]. There were no differences in group status between completers and non-completers,  $\chi^2(1, N=336)=.081$ ,  $p=.775$ , indicating that attrition was similar across study groups (reminiscence, control). Thirty-one percent of non-completers dropped out before completing any practice sessions, with similar numbers in the control ( $n=28$ ) and reminiscence ( $n=28$ ) groups. Completers in both groups scored higher on initial assessments of savoring [SBI,  $F(1,335) = 6.079$ ,  $p=.014$ ] and lower on initial reports of emotion regulation difficulties [DERS,  $F(1,332)= 4.525$ ,  $p=.034$ ] than non-completers. This suggests individuals with low savoring scores and high emotion regulation difficulties had higher attrition rates, regardless of group status. Sample characteristics for completers and non-completers are presented in Table 1.

### Sample Characteristics

Among completers, groups did not differ with regard to age,  $F(1,156)=.424$ ,  $p=.516$ , ethnicity,  $\chi^2(6, N=157)=4.790$ ,  $p=.571$ , or year in school,  $\chi^2(4, N=157)=2.392$ ,  $p=.664$ . There were no group differences in reported number of stressful life events during the last 6 months [SLEQ, overall  $M=10.13$ ,  $SD=4.98$ ,  $F(1,156)=.303$ ,  $p=.583$ ], or reminiscence frequency prior to study,  $F(1,156)=.240$ ,  $p=.625$ . Groups did not differ at T1 in levels of reported positive affect during the last week [PANAS-W-PA,  $F(1,155)=.036$ ,  $p=.850$ ], depression symptoms [BDI-II,  $F(1,156)=2.832$ ,  $p=.094$ ], savoring beliefs [SBI,  $F(1,156)=3.057$ ,  $p=.082$ ], or perceived stress [PSS,  $F(1,155)=1.803$ ,  $p=.181$ ]. Groups did not differ in number of practice days completed [overall  $M=5.54$ ,  $SD=1.05$ ,  $F(1,156)=.040$ ,  $p=.842$ ].

**Table 1. Sample Characteristics**

Measure	Completers Mean (SD) N=157	Non-Completers Mean (SD) N=179
Group		
<i>Control</i>	80	94
<i>Reminiscence</i>	77	85
Age	21.03 (4.40)	20.04 (3.14)
Ethnicity		
<i>Hispanic/Latino</i>	n=24 (15%)	n=35 (19%)
<i>American Indian/Alaska Native</i>	n=1 (<1%)	n=1 (<1%)
<i>Asian</i>	n=16 (10%)	n=22 (12%)
<i>Black/African American</i>	n=23 (15%)	n=25 (14%)
<i>More than one race</i>	n=2 (1%)	n=10 (6%)
<i>Unknown or not reported</i>	n=4 (3%)	n=3 (2%)
<i>Caucasian</i>	n=87 (55%)	n=83 (46%)
Year in School		
<i>Freshman</i>	n=53 (34%)	n=72 (40%)
<i>Sophomore</i>	n=20 (13%)	n=41 (23%)
<i>Junior</i>	n=32 (20%)	n=32 (18%)
<i>Senior</i>	n=49 (31%)	n=31 (17%)
<i>Other</i>	n=3 (2%)	n=3 (2%)
Number of Life Stressors in Last 6 mos	10.13 (4.98)	11.57 (5.13)
Reminiscence Frequency	9.35 (2.59)	8.74 (2.57)
T1 BDI	9.66 (7.92)	10.42 (7.81)
T1 STAI	38.97 (10.70)	40.20 (10.65)
T1 PANASW-PA	32.96 (7.20)	31.78 (6.84)
T1 PANASW-NA	18.76 (6.14)	18.82 (5.81)
T1 SBI	44.49 (16.71)	38.87 (23.86)
T1 DERS	71.06 (22.11)	76.11 (21.22)

There were, however, some group differences among completers at T1. Participants in the reminiscence group were more likely than controls to meet criteria for a past major depressive episode according to the IDDL (34 reminiscence, 20 controls),  $\chi^2(1, N=157)=6.380, p=.012$ . For all participants meeting criteria for a past depressive episode ( $n=54$ ), the episode occurred more than one month prior to study entry ( $M=31.73, SD=32.84$ , in months). The reminiscence group also reported higher trait anxiety

scores,  $F(1,156)=4.856, p=.029$ , higher T1 negative affect during the last week (PANAS-W-NA),  $F(1,156)=7.360, p=.007$ , and more T1 emotion regulation difficulties [DERS,  $F(1,155)=4.128, p=.044$ ] than controls. See Table 2 for means.

**Table 2. Symptom and Trait Measure Means by Condition and Assessment Period**

Measure		T1 Mean (SD)	T2 Mean (SD)	T3 Mean (SD)
BDI-II	Control	8.63 (7.36) ( $n=80$ )	7.66 (7.30) ( $n=79$ )	4.63 (3.91) ( $n=27$ )
	Reminiscence	10.74 (8.37) ( $n=77$ )	8.78 (8.35) ( $n=77$ )	3.20 (4.37) ( $n=22$ )
	Overall	9.66 (7.92) ( $n=157$ )	8.21 (7.83) ( $n=156$ )	4.08 (4.07) ( $n=49$ )
STAI-T	Control	37.15 (8.67) ( $n=80$ )	37.57 (9.48) ( $n=79$ )	35.59 (8.28) ( $n=27$ )
	Reminiscence	40.87 (12.24) ( $n=77$ )	40.27 (11.55) ( $n=77$ )	41.77 (10.97) ( $n=22$ )
	Overall	38.97 (10.70) ( $n=157$ )	38.90 (10.61) ( $n=156$ )	38.36 (9.98) ( $n=49$ )
PANAS-W-PA	Control	33.06 (7.26) ( $n=79$ )	29.59 (6.53) ( $n=79$ )	34.94 (7.58) ( $n=27$ )
	Reminiscence	32.84 (7.18) ( $n=77$ )	29.36 (8.28) ( $n=77$ )	33.80 (7.45) ( $n=22$ )
	Overall	32.96 (7.20) ( $n=156$ )	29.48 (7.42) ( $n=156$ )	34.50 (7.40) ( $n=49$ )
PANAS-W-NA	Control	17.61 (5.32) ( $n=80$ )	16.71 (5.42) ( $n=79$ )	16.63 (5.70) ( $n=27$ )
	Reminiscence	20.08 (6.05) ( $n=77$ )	17.49 (6.59) ( $n=77$ )	15.50 (5.10) ( $n=22$ )
	Overall	18.82 (5.81) ( $n=157$ )	17.10 (6.02) ( $n=156$ )	16.19 (5.40) ( $n=49$ )
SBI Total	Control	46.76 (13.38) ( $n=80$ )	40.71 (19.04) ( $n=79$ )	41.81 (19.32) ( $n=27$ )
	Reminiscence	42.13 (19.39) ( $n=77$ )	39.32 (24.65) ( $n=77$ )	50.40 (24.12) ( $n=22$ )
	Overall	44.49 (16.71) ( $n=157$ )	40.03 (21.93) ( $n=156$ )	45.12 (21.25) ( $n=49$ )
DERS	Control	67.59 (19.05) ( $n=80$ )	69.86 (20.81) ( $n=79$ )	60.80 (13.81) ( $n=26$ )
	Reminiscence	74.71 (24.52) ( $n=76$ )	73.17 (24.91) ( $n=77$ )	61.60 (14.86) ( $n=22$ )
	Overall	71.06 (22.11) ( $n=156$ )	71.49 (22.91) ( $n=156$ )	61.12 (13.93) ( $n=48$ )
PSS	Control	21.66 (6.54) ( $n=79$ )	21.39 (6.43) ( $n=79$ )	18.38 (5.14) ( $n=27$ )
	Reminiscence	23.14 (7.26) ( $n=77$ )	23.05 (7.25) ( $n=77$ )	19.30 (6.00) ( $n=22$ )
	Overall	22.39 (6.92) ( $n=156$ )	22.21 (6.88) ( $n=156$ )	18.73 (5.39) ( $n=49$ )

**Differential attrition analyses.** Analyses were performed to explore whether group differences among study completers were the result of randomization failure or a tendency of symptomatic individuals to be more likely to follow through to study completion in one group than the other. First, group differences in these variables were examined in all randomized participants (completers and non-

completers) at T1 to rule out randomization failure. A one-way ANOVA found no effects of group (remembrance, control) on T1 assessments of trait anxiety (STAIT;  $F(1,335)=.373, p=.542$ ), negative affect (PANASW-NA;  $F(1,335)=.944, p=.332$ ), or emotion regulation difficulties (DERS;  $F(1,335)=.247, p=.640$ ). These results suggest that T1 randomization was successful in creating a remembrance group and a control group with similar levels of symptoms. However, there were significantly more individuals with a past depression history assigned at T1 to the remembrance group ( $n=66$ ) than to the control group ( $n=51$ ),  $\chi^2(1, N=336)=4.829, p=.019$ , suggesting randomization was not successful in creating remembrance and control groups with similar numbers of past depressed individuals. Depression history was therefore statistically controlled in main analyses.

Completers and non-completers in each group were then compared to determine whether higher T1 levels of trait anxiety, negative affect, emotion regulation difficulties, and past depression in the remembrance group was due to differential attrition (i.e., likelihood of following through with study completion in one group versus the other). Depression history was unrelated to completer status in both groups [remembrance,  $\chi^2(1, N=162)=.709, p=.248$ ; control,  $\chi^2(1, N=174)=1.328, p=.162$ ]. In the remembrance group, there were no significant differences between completers and non-completers on T1 assessments of trait anxiety (STAIT;  $F(1,161)=.891, p=.347$ ), negative affect (PANASW-NA;  $F(1,161)=3.727, p=.055$ ), or emotion regulation difficulties (DERS;  $F(1,158)=.035, p=.852$ ). In the control group, there was no significant difference between completers and non-completers in T1 negative affect (PANASW-NA;  $F(1,173)=3.27, p=.072$ ); however, completers had significantly lower T1 scores for trait anxiety (STAIT;  $F(1,173)=6.767, p=.010$ ) and emotion regulation difficulties (DERS;  $F(1,173)=10.762, p=.001$ ). These results suggest that groups were appropriately randomized at T1 on all variables of interest except for past depression, which had no subsequent effect on whether participants completed study requirements for either group. Further, they suggest differential attrition effects such that individuals with higher levels of trait anxiety and emotion regulation difficulties were more likely to drop out if they were in the control group versus their symptomatic counterparts randomized to the

reminiscence group, which may have contributed to the reminiscence group having higher mean levels of trait anxiety and emotion regulation difficulties at T2.

Differential attrition introduces potential bias into the study by limiting the researcher's ability to conclusively attribute study results to the experimental manipulation versus self-selection through participant attrition (Flick, 1988). The gold standard procedure for addressing differential attrition in randomized controlled trials is to perform analyses on an intent-to-treat (ITT) sample, which includes all individuals randomized in the study (completers and non-completers) (Chambliss & Hollon, 1998). By including non-completers, "the validity of the study is not directly threatened by subject self-selection" (Flick, 1988, p.509). The most common method of imputing missing outcome data in randomized controlled trials is the last observation carried forward (LOCF) method, which involves replacing missing outcome data with the most recent assessment of the outcome variable (Gupta, 2011; Mazumdar, Liu, Houck, & Reynolds III, 1999). In a pre-post design such as the present study, the LOCF method involves replacing non-completers missing T2 outcome values with T1 values, which assumes the null hypothesis that non-completers experienced no change from T1 to T2 (e.g., Abramowitz, Foa, & Franklin, 2003). This method is appropriate when it can be reasonably assumed that mean outcome values do not change following drop out (Mazumdar et al., 1999). For instance, the LOCF method may not be appropriate for long term follow up of a critically ill sample who were likely to continue to deteriorate after discontinuing an intervention (Bell, Kenward, Fairclough, & Horton, 2013). The LOCF method is also most appropriate when the rate and timing of withdrawal are similar among treatment groups (Mazumdar et al., 1999). The present is appropriate for LOCF ITT analyses based on use of data from an unselected (e.g., non-treatment seeking) nonpsychiatric sample, whose data can be reasonably assumed to remain stable following intervention discontinuation over the one week T1-T2 interval (i.e., one week re-test reliability for the BDI is  $r=.93-.96$ , Beck, Steer, & Brown, 1996; Sprinkle et al., 2001). In addition, rate of attrition were similar across groups in the present study (see diagram and above results). The timing of attrition was also similar for all non-completers across groups, with control and reminiscence non-completers showing similar number of practice days prior to attrition,  $M=.75$ ,  $SD=1.55$ ,  $F(1,178)=.007$ ,  $p=.931$ . This

method is considered very conservative for handling missing data, and would be more likely to dilute or underestimate treatment effects (Gupta, 2011; Heyting, Tolboom, & Essers, 1992) than overestimate. Following procedures used in prior studies (Arch et al., 2012; Geraghty et al., 2010a; McManus, Surawy, Muse, Vasquez-Montes, & Williams, 2012), hypotheses were tested separately in completer and ITT samples. Main hypotheses were thus tested as planned using a completer sample, then repeated in an ITT sample to validate findings.

Given one of the variables related to differential attrition, trait anxiety, was a key study variable hypothesized to influence group differences in intervention outcome, an additional analytical step was taken to investigate whether anxiety was differentially related to the key experimental manipulation in the reminiscence and control groups. Correlation analyses examined the relationship of trait anxiety to reported emotion during daily practice exercises among non-completers in each group. A differential relationship of trait anxiety to the experimental manipulation variable (i.e., positive emotion during practice exercise) between groups would indicate bias such that anxious non-completers experienced the experimental manipulation differently than their non-anxious counterparts, which led to their attrition. Among non-completers who completed at least one daily online practice session, trait anxiety was unrelated to reported emotion during daily practice exercises in both the reminiscence ( $n=57$ ;  $r=-.174$ ,  $p=.197$ ) and control groups ( $n=66$ ;  $r=-.086$ ,  $p=.491$ ). Although these findings cannot conclusively exclude the possibility that the manipulation differed for high versus low anxious non-completers, they lend some confidence that the higher likelihood of anxious participants to drop out of the control group versus the reminiscence group was not a function of the experimental manipulation operating differently for high anxious participants. Trait anxiety, a planned covariate a priori, was included as a covariate in main analyses. Exploratory analyses were performed examining group effects on emotion regulation difficulties.

**Follow up sample.** The follow up sample ( $n=49$ ) was also examined for T1 group differences. Reminiscence and control participants who participated in the one month follow up assessment did not differ on T1 assessments of depression symptoms [BDI,  $F(1,48)=.832$ ,  $p=.366$ ], trait anxiety [STAI,

$F(1,48)=1.611, p=.211$ ], positive affect [PANASW-PA,  $F(1,48)=.578, p=.451$ ], negative affect [PANASW-NA,  $F(1,48)=1.86, p=.179$ ], savoring beliefs [SBI,  $F(1,48)=.845, p=.363$ ], emotion regulation difficulties [DERS,  $F(1,48)=1.217, p=.276$ ], or perceived stress [PSS,  $F(1,48)=2.119, p=.152$ ].

### **Manipulation Check and Participant Perceptions**

Responses from the daily exercise questionnaires (EQ-R, EQ-M) and the T2 study feedback questionnaire were used to assess successful experimental manipulation and perceptions about study aims and participation. On a scale of 1 (very bad) to 7 (very good) assessing how participants felt each day while performing the exercise, participants in the reminiscence group had higher mean daily scores ( $M=6.03, SD=.77$ ) than controls ( $M=4.70, SD=.96$ ),  $F(1,156)=90.620, p<.001$ . These results indicate the reminiscence exercise elicited a more positive emotional state than the control exercise. Given the study aim to isolate the positive emotional element of the reminiscence exercise compared to a control exercise containing all other elements, this finding indicates successful experimental manipulation. Indeed, reminiscence participants reported success at recreating the feelings associated with the personal memory they were imagining during the exercise (How much were you able to immerse yourself in the memory and feel the way you felt back then?), indicated by a mean score of 5.56 ( $SD=.89$ ) on a scale of 1 (very little) to 7 (a great deal).

Reminiscence participants also had higher mean scores ( $M=5.67, SD=.92$ ) than controls ( $M=4.78, SD=1.14$ ) on daily reports of mental imagery vividness during the exercise (1=Not at all vivid, 7=Extremely vivid),  $F(1,156)=28.80, p<.001$ . Although the reminiscence group had higher scores ( $M=5.13, SD=1.11$ ) than controls ( $M=4.50, SD=1.18$ ) for mean daily perceived task difficulty (1=Extremely difficult, 7=Extremely easy),  $F(1,156)=11.546, p=.001$ ], they also reported being less distracted ( $M=3.08, SD=1.15$ ; 1=Very little, 7=A great deal) during the exercises than controls ( $M=3.73, SD=1.08$ ),  $F(1,156)=13.233, p<.001$ .

**Memory characteristics.** Participants in the reminiscence group recalled a total of 428 positive memories as part of the daily exercises. Reports of when the events remembered actually took place were

spread over the range of options, including during the last month (18%), 1-3 months ago (14%), 3-6 months ago (13%), 6-12 months ago (14%), 1-3 years ago (23%), and more than 3 years ago (18%). For the majority of memories recalled, participants reported using thinking only to trigger the memory (58%), followed by photos (21%), conversation (9%), music (4%), videos (4%), and other memorabilia (4%). On a scale of 1 (Very Little) to 7 (A Great Deal), participants reported the triggers they used were very helpful to them in recreating the good feelings associated with the memory ( $M=5.70$ ,  $SD=.93$ ).

**Perceptions of study aims.** Self-report assessments of mental focus (the purported intervention target) at T1 and T2 were included as a within subjects factor in a repeated measures ANOVA to test for changes in perceived mental focus over time and group differences. Reports of mental focus did not change over time for either group, indicated by no significant main effect of time,  $F(1,154)=.755$ ,  $p=.386$ , and no significant group by time interaction,  $F(1,154)=.399$ ,  $p=.528$ . Although the task had no actual effect on mental focus for either group, both groups reported believing at T2 the exercises were effective at improving mental focus and clarity, indicated by single sample t-tests comparing T2 ratings of perceived effectiveness to 1 (Not at all effective) [reminiscence  $M=2.83$ ,  $SD=.70$ ,  $t(76)=23.09$ ,  $p<.001$ ; control  $M=2.53$ ,  $SD=.85$ ,  $t(78)=16.11$ ,  $p<.001$ ]. These results suggest the study was successful in convincing participants in both groups that the aim of the exercise was to improve mental focus and clarity. Additionally, the effectiveness ratings of the reminiscence group were significantly higher than controls,  $F(1,155)=5.826$ ,  $p=.017$ . Responses to this item were included in ancillary covariate analyses to control for group differences in effort and investment.

**Effort and investment.** Mean duration of online exercise practice sessions was examined as a measure of study effort. Mean duration of online exercise practice sessions (in minutes) was longer for the reminiscence group ( $M=11.98$ ,  $SD=3.35$ ) than controls ( $M=10.04$ ,  $SD=3.40$ ),  $F(1,156)=13.04$ ,  $p<.001$ , which may reflect the 5 additional questions asked of the reminiscence group during online practice sessions. Single sample t-tests revealed duration means for both groups were significantly longer than the 8 minutes participants were instructed to do the exercise [reminiscence  $t(76)=10.439$ ,  $p<.001$ ; control  $t(79)=5.364$ ,  $p<.001$ ], indicating both groups had sufficient time to complete the practice exercise with

additional time for the corresponding questions. Groups did not differ in duration of T2 online assessment (overall  $M=27.11$ ,  $SD=9.51$ ),  $F(1,156)=1.450$ ,  $p=.230$ .

The reminiscence and control groups did not differ in their reports of how easy it was to incorporate the exercise into everyday life,  $F(1,155)=2.338$ ,  $p=.128$ . There were also no group differences in participant ratings of investment in doing the exercises and following study direction,  $F(1,155)=3.334$ ,  $p<.070$ . A single sample t test found the overall mean of 3.18 ( $SD=.723$ ) to be significantly higher than 1 (Not at all invested),  $t(155)=37.66$ ,  $p<.001$ , suggesting participants in both groups had some investment in the study. Although groups reported similar levels of study investment, the reminiscence group reported doing their best at the exercises ( $M=3.42$ ,  $SD=.59$ ; 1=Not at all, 4=Very much) to a greater extent than controls ( $M=3.19$ ,  $SD=.64$ ),  $F(1,154)=5.198$ ,  $p=.024$ . The reminiscence group also reported more frequently doing the exercises outside the allotted practice time during the week ( $M=2.08$ ,  $SD=.76$ ; 1=Never, 4=All the time) compared to controls ( $M=1.63$ ,  $SD=.72$ ),  $F(1,155)=14.176$ ,  $p<.001$ . Responses to these items (doing best, outside practice) were included in ancillary covariate analyses to control for group differences in study effort and investment.

## Hypothesis Testing

*H1: In the completer sample, the experimental (reminiscence) group will report increases in positive emotion from T1 to T2 compared to the control group.*

A repeated-measures analyses of variance (ANOVA) with group (reminiscence, control) as the between subjects factor and time (T1, T2) as repeating within subjects factors was performed to test for effects of the reminiscence exercise on positive emotions, assessed by the PANAS-W-PA, in the completer sample. Trait anxiety and depression history were entered as covariates. There was a significant main effect of time,  $F(1,151)=19.488$ ,  $p<.001$ , with scores decreasing for both groups over time, qualified by an significant interaction of trait anxiety (STAIT scores) x time,  $F(1,151)=9.930$ ,  $p=.002$ . Contrary to hypotheses, there was no significant group by time interaction,  $F(1,151)=.889$ ,  $p=.347$ , indicating similar positive affect changes in the reminiscence and control groups. Depression history was not a significant

covariate in the model,  $F(1,151)=2.519, p=.115$ .<sup>1</sup> When effort and investment items on which the groups differed significantly (e.g., belief in effectiveness, doing best, additional practice) were included, results were unchanged. When analyses were repeated in the ITT sample, results were unchanged.

*H1a: Among high anxious completers, the experimental (reminiscence) group will report increases in positive emotion from T1 to T2 compared to the control group.*

Planned analyses were performed to follow up the significant effect of anxiety in the H1 analyses. The analysis was repeated including significant covariates and a group x anxiety interaction term. There was a main effect of time,  $F(1,151)=27.489, p<.001$ , qualified by a significant group x anxiety x time interaction,  $F(2,151) = 7.191, p=.001$ . Planned follow up analyses to decompose the interaction were performed repeating main analyses in subgroups of low and high anxious participants. Participants with STAI scores below the median (37) were classified as low anxious ( $n=78$ ), and those scoring greater than or equal to the median were classified as high anxious ( $n=77$ ). In the low anxious subsample, there was a significant main effect of time,  $F(1,76)=59.37, p<.001$ , and no significant group x time interaction,  $F(1,76)=.047, p=.829$ , indicating positive emotion scores decreased similarly over time for both groups. Contrary to hypothesis 1a, in the high anxious subsample, there was no significant effect of time,  $F(1,75)=2.516, p=.117$ , or group x time interaction,  $F(1,75)=.071, p=.790$ . The group x anxiety x time interaction in the main analyses was thus apparently driven by low anxious individuals in both groups reporting decreased positive affect from T1 to T2, while high anxious individuals showed no positive affect changes. See Table 3 for means.

**Daily emotion experience.** Similar analyses were planned to test for effects of reminiscence on other aspects of daily positive emotion experience, assessed daily during online practice sessions (i.e., PANAS-D-PA, percent happy, positive emotion frequency, duration, peak intensity). A univariate ANOVA found no group differences in mean daily positive emotion (average PANAS-D-PA scores for

<sup>1</sup> All models were run testing for a group x past depression x time interaction. This term did not emerge significant in any model and was dropped from analyses.

**Table 3. High Versus Low Anxious Completers (median split) by Condition**

Measure		T1		T2		T3	
		Mean (SD)		Mean (SD)		Mean (SD)	
		Low Anxious (n=79)	High Anxious (n=78)	Low Anxious (n=79)	High Anxious (n=78)	Low Anxious (n=26)	High Anxious (n=23)
BDI-II	Control	4.96 (4.09)	12.89 (8.04)	4.55 (4.98)	11.19 (7.95)	4.63 (3.91)	6.91 (8.23)
	Reminiscence	5.42 (4.25)	12.41 (8.34)	4.69 (6.44)	12.37 (8.25)	3.20 (4.37)	11.50 (8.92)
	Overall	5.16 (4.14)	14.22 (8.24)	4.61 (5.66)	11.81 (8.08)	4.08 (4.07)	9.30 (8.72)
STAI-T	Control	30.53 (3.99)	44.84 (5.78)	32.24 (7.21)	43.62 (8.05)	33.06 (6.50)	39.27 (9.49)
	Reminiscence	30.42 (4.66)	50.05 (9.00)	31.89 (7.09)	47.63 (9.53)	34.50 (7.95)	47.83 (9.49)
	Overall	30.48 (4.28)	8.04 (47.58)	32.08 (7.11)	45.73 (9.03)	33.62 (6.97)	43.74 (10.25)
PANAS-W-PA	Control	35.21 (5.45)	30.50 (8.34)	29.79 (5.88)	29.38 (27.80)	34.94 (7.58)	34.91 (7.38)
	Reminiscence	36.81 (5.94)	29.37 (6.37)	31.14 (8.15)	28.55 (8.18)	33.80 (7.45)	34.50 (8.04)
	Overall	35.94 (5.70)	29.90 (7.33)	30.41 (7.01)	28.55 (7.75)	34.50 (7.40)	34.70 (7.56)
PANAS-W-NA	Control	15.53 (4.19)	20.03 (5.52)	15.52 (5.27)	18.05 (5.35)	16.62 (5.70)	19.81 (10.08)
	Reminiscence	16.64 (3.80)	23.10 (6.08)	14.28 (4.08)	20.32 (7.10)	15.50 (5.10)	20.50 (6.65)
	Overall	16.04 (4.04)	21.64 (5.98)	14.95 (4.76)	19.24 (6.39)	16.19 (5.40)	20.17 (8.27)
SBI Total	Control	52.00 (9.92)	40.68 (14.39)	44.62 (17.51)	36.27 (19.95)	41.81 (19.32)	35.18 (40.91)
	Reminiscence	53.47 (13.16)	32.17 (18.58)	46.50 (25.01)	33.02 (22.80)	50.40 (24.13)	39.58 (18.07)
	Overall	52.67 (11.45)	36.21 (17.16)	45.49 (21.18)	34.56 (21.42)	45.11 (21.25)	37.48 (30.48)
DERS	Control	57.93 (12.07)	78.81 (19.63)	61.14 (17.19)	79.76 (20.31)	60.80 (13.81)	72.00 (18.20)
	Reminiscence	57.89 (9.66)	89.85 (24.01)	57.42 (13.57)	87.00 (24.45)	61.60 (14.86)	83.17 (29.36)
	Overall	57.91 (10.97)	84.54 (22.56)	59.42 (15.64)	83.56 (22.73)	61.12 (13.93)	77.83 (24.78)
PSS	Control	18.29 (4.89)	25.49 (6.09)	18.67 (5.94)	24.48 (5.57)	18.38 (5.14)	20.00 (7.95)
	Reminiscence	18.14 (5.29)	27.54 (5.77)	18.47 (6.48)	27.07 (5.25)	19.30 (6.00)	24.08 (6.17)
	Overall	18.22 (5.04)	26.56 (5.98)	18.58 (6.15)	25.85 (5.53)	18.73 (5.39)	22.13 (7.22)

all daily assessments),  $F(1,156)=.555, p=.457$ . Depression history was not significant in the model,  $F(1,156)=.020, p=.887^1$ , but anxiety was a significant covariate,  $F(1,156)=14.605, p<.001$ .

Planned analyses were performed to follow up the significant effect of anxiety in the above analyses. The analysis was repeated including significant covariates and a group x anxiety interaction term. There were no effects of group,  $F(1,156)=.264, p=.608$ , or group x anxiety,  $F(1,156)=.115, p=.735$ , but anxiety was a significant covariate,  $F(1,156)=13.342, p<.001$ . Follow up correlation analyses revealed a significant negative relationship between trait anxiety and mean daily positive affect ( $r= -.30, p<.01$ ). Given low positive affect is a depression symptom, and depression symptoms were highly correlated with trait anxiety in this sample (see Table 4), the correlation was performed again partially out the effect of depression symptoms on mean daily positive affect. This relationship remained significant after controlling for T1 depression symptoms ( $r= -.30, p<.01$ ). Thus, higher trait anxiety predicted lower daily positive emotion regardless of study group, and this effect was not explained by current depression symptoms.

**Table 4. Correlation Analyses of Baseline (T1) Measures Among Completers**

Measure	1.	2.	3.	4.	5.	6.	7.	8.
1. BDI-II	-							
2. STAIT	.776**	-						
3. PANASW-PA	-.369**	-.511**	-					
4. PANASW-NA	.651**	.650**	-.300**	-				
5. SBI	-.524**	-.610**	.408**	-.425**	-			
6. DERS	.756**	.808**	-.412**	.593**	-.527**	-		
7. PSS	.662**	.747**	-.585**	.518**	-.467**	.650**	-	
8. SLEQ	.537**	.382**	-.198*	.365**	-.152 <sup>†</sup>	.337**	.359**	-

<sup>†</sup>  $p<.06$ , \* $p<.05$ , \*\* $p<.01$

BDI-II: Beck Depression Inventory; STAIT: State-Trait Anxiety Inventory, Trait version; PANASW: Positive and Negative Affect Schedule; SBI: Savoring Beliefs Inventory; DERS: Difficulties in Emotion Regulation Scale; PSS: Perceived Stress Scale; SLEQ: Stressful Life Events Questionnaire.

**Percent happy.** There were no group differences in mean daily percent of time participants reported feeling happy,  $F(1,156)=.530, p=.468$ . Depression history was also not significant,  $F(1,156)=.558, p=.456^1$ , but anxiety was a significant covariate,  $F(1,156)=39.559, p<.001$ . Planned analyses were performed to follow up the significant effect of anxiety in the above analyses. The analysis was repeated including significant covariates and a group x anxiety interaction term. There were no effects of group,  $F(1,156)=2.637, p=.106$ , or group x anxiety,  $F(1,156)=2.301, p=.131$ , but anxiety was a significant covariate,  $F(1,156)=41.953, p<.001$ . Follow up correlation analyses revealed a significant negative relationship between trait anxiety and mean daily percent happy ( $r= -.46, p<.01$ ), which remained after controlling for T1 depression symptoms ( $r= -.39, p<.01$ ). In sum, regardless of group, higher trait anxiety predicted lower daily percentage of time spent happy independent of current depression symptoms.

**Frequency.** There were no group differences in participant reports of daily positive emotion frequency,  $F(1,156)=.032, p=.858$ , and no significant effects of past depression,  $F(1,156) = .142, p=.707^1$ . Anxiety was a significant covariate,  $F(1,156)=37.824, p<.001$ . Planned analyses were performed to follow up the significant effect of anxiety in the above analyses. The analysis was repeated including significant covariates and a group x anxiety interaction term. There were no effects of group,  $F(1,156)=.140, p=.709$ , or group x anxiety,  $F(1,156)=2.301, p=.131$ , but anxiety was a significant covariate,  $F(1,156)=41.953, p<.001$ . Follow up correlation analyses found higher anxiety scores predicted less frequent daily positive emotions ( $r= -.453, p<.01$ ), and this effect remained after controlling for current depression symptoms ( $r= -.33, p<.01$ ).

**Intensity.** There were no group differences in mean daily reports of peak positive emotion intensity,  $F(1,156)=.001, p=.980$ , and depression history was not significant in the model,  $F(1,156)=.524, p=.470^1$ . Anxiety was a significant covariate,  $F(1,156)=13.853, p<.001$ . Planned analyses were performed to follow up the significant effect of anxiety in the above analyses. The analysis was repeated including significant covariates and a group x anxiety interaction term. There were no effects of group,  $F(1,156)=.513, p=.475$ , or group x anxiety,  $F(1,156)=.586, p=.445$ , but anxiety was a significant

covariate,  $F(1,156)=13.758, p<.001$ . Follow up correlation analyses found higher trait anxiety predicted lower daily peak positive emotion intensity ( $r= -.286, p<.01$ ), and this effect remained after controlling for current depression symptoms ( $r= -.274, p=.001$ ).

**Duration.** There were no group differences in the average daily reported duration of positive emotions,  $F(1,156)=.554, p=.458$ . Depression history was not significant in the model,  $F(1,156)=1.396, p=.239$ . Anxiety was a significant covariate,  $F(1,156)=7.002, p=.009$ . Planned analyses were performed to follow up the significant effect of anxiety in the above analyses. The analysis was repeated including significant covariates and a group x anxiety interaction term. There were no effects of group,  $F(1,156)=2.174, p=.142$ , or group x anxiety,  $F(1,156)=1.898, p=.170$ , but anxiety was a significant covariate,  $F(1,156)=7.584, p=.007$ . Follow up correlation analyses found higher trait anxiety predicted shorter duration of daily positive emotions ( $r= -.203, p=.011$ ), and this effect remained after controlling for current depression symptoms ( $r= -.178, p=.026$ ).

These analyses show no evidence that the reminiscence exercise was associated with increasing positive emotions from T1 to T2, nor evidence for this effect in a high anxious subsample. Hypotheses 1 and 1a were thus not supported. In both groups, individuals with higher trait anxiety reported lower positive affect, lower percentages of the day spent feeling happy, less frequent positive emotions, lower peak positive emotion intensity, and shorter positive emotion duration assessed by daily reports throughout the study week (see Table 5 for means).

*H2: In the completer sample, the experimental (reminiscence) group will report decreases in depression symptoms from T1 to T2 compared to the control group.*

A repeated-measures analyses of variance (ANOVA) with group (reminiscence, control) as the between subjects factor and time (T1, T2) as repeating within subjects factors was performed to test for effects of the reminiscence exercise on depression symptoms, assessed by the BDI, in the completer sample. A significant main effect of time emerged,  $F(1,152)=4.277, p=.040$ , qualified by a significant anxiety x time interaction  $F(1,152)=8.257, p=.005$ . The group x time interaction was not significant,

**Table 5. Means for Daily Assessments of Emotion Among Completers**

Measure	Mean (SD)
Mean Daily PANAS-D-PA	28.05 (6.57)
Mean Daily Percent Happy (0-100%)	69.35% (20)
Mean Daily Positive Emotion Frequency <i>1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=All the time</i>	3.56 (.60)
Mean Positive Emotion Intensity <i>(1=None or very low, 10=Extremely positive)</i>	7.16 (1.36)
Mean Daily Positive Emotion Duration <i>(1=&lt;1 min., 2=1 to 5 min., 3=5 to 15 min., 4=15 to 30 min., 5=30 to 60 min., 6=1 to 3 hrs, 7=&gt;3 hrs)</i>	4.42 (1.46)

$F(1,152)=.124, p=.725$ , with an overall decreasing pattern of depression scores for both groups.

Depression history was not significant in the model,  $F(1,152)=.042, p=.838^1$ . When effort and investment were statistically controlled, the main effect of time was no longer significant,  $F(1,148)=.519, p=.472$ . All other results were unchanged, and none of the effort and investment items emerged as significant covariates. When analyses were repeated in the ITT sample, results were unchanged. Hypothesis 2 was not supported; although depression scores decreased over time according to prediction, this effect was present in both groups.

*H2a: Among high anxious completers, the experimental (reminiscence) group will report decreases in depression symptoms from T1 to T2 compared to the control group.*

Planned analyses were performed to follow up the significant effect of anxiety in the H2 analyses. The analysis was repeated including significant covariates and a group x anxiety interaction term. There was a near significant effect of time,  $F(1,152)=3.438, p=.066$ , qualified by a significant group x anxiety x time interaction,  $F(2,151) = 4.461, p=.013$ . Planned follow up analyses to decompose the interaction were performed repeating main analyses in subgroups of low and high anxious participants. In the low anxious

subsample, there was no main effect of time,  $F(1,76)=1.001, p=.320$ , or group x time interaction,  $F(1,76)=.065, p=.799$ . In the high anxious subsample, there was a significant main effect of time,  $F(1,76)=5.880, p=.018$ , with depression symptom scores decreasing over time. There was no significant group x time interaction,  $F(1,76)=.472, p=.494$ .

Hypothesis 2a was not supported. While low anxious participants in both groups maintained similar depression scores from T1 to T2, high anxious participants showed decreased depression symptoms scores regardless of whether they participated in the reminiscence or control intervention.

*H3: In the completer sample, the experimental (reminiscence) group will report increases in savoring from T1 to T2 compared to the control group.*

A repeated-measures analysis of variance (ANOVA) with group (reminiscence, control) as the between subjects factor and time (T1, T2) as repeating within subjects factors was performed to test for effects of the reminiscence exercise on savoring, assessed by the SBI, in the completer sample. A significant main effect of time emerged,  $F(1,152)=7.592, p=.007$ , with scores decreasing for both groups, qualified by a significant anxiety x time interaction,  $F(1,152)=4.161, p=.043$ . Contrary to prediction, the group x time interaction was not significant,  $F(1,152)=.682, p=.410$ . Depression history was not significant in the model,  $F(1,152)=.012, p=.913^1$ . When effort and investment items were included as covariates, results were unchanged except for a significant interaction of time with the item assessing time spent practicing outside of the allotted study time,  $F(1,148) = 4.112, p=.044$ . When analyses were repeated in the ITT sample, results were unchanged. Hypothesis 3 was not supported. There was no evidence of increasing savoring scores in the reminiscence group; savoring scores decreased over time in both groups.

*H3a: Among high anxious completers, the experimental (reminiscence) group will report increases in savoring from T1 to T2 compared to controls.*

Planned analyses were performed following up the significant effect of anxiety in the H3 analyses. The analysis was repeated including significant covariates and a group x anxiety interaction

term. There was a significant effect of time,  $F(1,152)=7.035, p=.009$ , but no significant group x anxiety x time interaction,  $F(2,152) = 2.222, p=.112$ . Correlation analyses revealed higher trait anxiety predicted lower savoring scores at T2 ( $r=-.328, p<.001$ ), but this relationship disappeared after controlling for initial savoring ( $r=.109, p=.178$ ). Hypothesis 3a was not supported. There was no evidence for anxiety levels influencing group effects on savoring.

*H4: Group differences in positive emotions will be maintained at a one month follow up assessment. In the completer sample, the experimental (reminiscence) group will report increases in positive emotion from T1 to T3 compared to the control group.*

A repeated-measures analyses of variance (ANOVA) with group (reminiscence, control) as the between subjects factor and time (T1, T3) as repeating within subjects factors was performed to test for long term effects of the reminiscence exercise on positive emotions, assessed by the PANAS-W-PA, in the completer sample. A significant group by time interaction emerged,  $F(1,45)=8.151, p=.006$ , along with a significant anxiety x time interaction,  $F(1,45)=4.109, p=.049$ , and a significant past depression x time interaction,  $F(1,45)=9.244, p=.004^1$ .

To decompose the group x time interaction, analyses were re-run separately for each group, including significant covariates. In the control group, there was no main effect of time,  $F(1,24)=.038, p=.846$ , suggesting no overall changes in positive affect from T1 to T3 in the control group. A significant past depression x time interaction emerged,  $F(1,24)=4.394, p=.047$ . The anxiety x time interaction was not significant,  $F(1,24)=1.737, p=.20$ , but there was a main effect of anxiety,  $F(1,24)=6.150, p=.021$ . To decompose the significant past depression x time interaction, univariate ANOVAs were performed to compare controls with and without past depression on PANASW-PA scores at T1 and T3. At T1, there were no significant differences between controls with past depression ( $M=31.00, SD=5.00$ ) and without past depression ( $M=32.28, SD=6.24$ ),  $F(1,26)=.103, p=.751$ . At T3, however, controls with a history of depression ( $n=3$ ) had significantly higher reported positive affect ( $M=43.67, SD=33.83$ ) than controls with no depression history ( $n=24, M=33.83, SD=7.06$ ),  $F(1,26)=5.605, p=.026$ . A paired samples t-test

found positive affect scores did not change significantly from T1 to T3 among controls without past depression,  $t(23)=-1.170, p=.254$ . The small subsample ( $n=3$ ) of controls with past depression showed a marginal increase in positive affect scores from T1 to T3,  $t(2)=-3.640, p=.068$ . This modest effect should be interpreted with caution due to extremely small cell sizes.

When analyses were performed for the reminiscence group, there was no significant main effect of time,  $F(1,19)=1.780, p=.198$ . This finding was similar to controls, suggesting no evidence of an overall group effect on positive affect changes from T1 to T3. A past depression x time interaction emerged,  $F(1,19)=4.78, p=.042$ , with no significant interaction for anxiety x time,  $F(1,19)=2.33, p=.143$ , or anxiety main effect,  $F(1,19)=.773, p=.390$ . When the past depression x time interaction was decomposed using univariate ANOVAs, reminiscence participants with past depression had significantly lower positive affect scores at T1 ( $M=29.72, SD=6.13$ ) than those with no depression history ( $M=37.27, SD=6.03$ ),  $F(1,21)=8.46, p=.009$ . At T3, positive affect scores did not differ between reminiscence participants with past depression ( $M=34.91, SD=7.60$ ) and no depression history ( $M=33.45, SD=9.59$ ),  $F(1,21)=.194, p=.665$ . A paired samples t-test showed no significant change in positive affect scores for those with no depression history,  $t(10)=1.743, p=.112$ . Those with past depression showed significant increases in positive affect scores from T1 to T3,  $t(41)=-2.746, p=.021$ .

Results in the completer sample seem to offer partial support for H4. While the control group exhibited no changes in positive affect from T1 to T3, a subsample of past depressed participants in the reminiscence group showed increases in positive affect from T1 to T3. This pattern was not evident in reminiscence participants with no history of depression. There was also a very modest finding suggesting that the control condition may have also have produced increases in positive affect among past depressed individuals, although this effect is interpreted with caution because of the small cell size ( $n=3$ ).

Importantly, when H4 analyses were repeated in the ITT sample, the group x time interaction was no longer significant,  $F(1,331)=1.975, p=.161$ . Significant effects remained for anxiety x time,  $F(1,331)=5.820, p=.016$ , and past depression x time,  $F(1,331)=4.141, p=.043$ . This suggests the group

effect seen in the completer sample should be interpreted with caution due to potential self-selection bias.

Hypothesis 4 is thus considered not supported by these data.

*H4a: Among high anxious completers, group differences in positive emotions will be maintained at a one month follow up assessment. Among high anxious individuals, the experimental (reminiscence) group will report increases in positive emotion from T1 to T3 compared to the control group.*

Planned analyses were performed to follow up the significant effect of anxiety in the H4 analyses.

The analysis was repeated including significant covariates and a group x anxiety interaction term. There was no effect of time,  $F(1,44)=1.148, p=.290$ , no group x time interaction,  $F(1,44)=.256, p=.616$ . The past depression x time interaction remained significant,  $F(1,44)=9.149, p=.004$ . There group x anxiety x time interaction was not significant,  $F(2,44) = 2.067, p=.139$ , although observed power for this test was only .40. A marginal between subjects effect of group x anxiety emerged,  $F(2,44)=2.411, p=.102$ , which also had low power (.46)<sup>2</sup>. Hypothesis 4a was not supported. Anxiety levels were unrelated to the effect of group on positive affect changes over the follow up period.

*H5: The effects of the experimental (reminiscence) condition on depression will be mediated by changes in positive emotions.*

Mediation analyses using the Preacher and Hayes (Preacher & Hayes, 2004) bootstrapping method were planned to test for potential mediation of the relationship between group (X) and T2 depression symptoms (Y) by T2 positive emotions (M). Given the lack of support for a relationship between group and depression symptoms (see H2 above), these analyses were not warranted.

### **Exploratory Mediation Analyses**

Moderated mediation analyses using the bootstrapping method discussed above (Preacher, et al., 2007) were planned to test whether stress moderates the mediation relationship of positive emotions and depression symptoms. As in H5, these analyses were also contingent upon there being a significant

relationship between group and depression symptoms. As there was no support for this relationship (see H2), exploratory moderated mediation analyses were not warranted. Additional planned exploratory mediation analyses, examining savoring, negative emotion and emotion regulation difficulties as potential alternative mediators of the relationship between group and depression symptoms, were likewise not warranted.

Moderated mediation analyses using the bootstrapping method discussed above (Preacher, et al., 2007) were also planned to test whether stress moderates the mediation relationship of positive emotions and depression symptoms in the high anxious subsample. These analyses were not warranted in light of no evidence supporting a relationship between group and depression in the high anxious subsample.

### **Exploratory Analyses of Alternate Outcome Variables**

Unplanned exploratory analyses were performed to test for main effects of group on alternative outcome variables: negative emotion and emotion regulation difficulties.

**Negative emotion.** A repeated-measures analyses of variance (ANOVA) with group (reminiscence, control) as the between subjects factor and time (T1, T2) as repeating within subjects

<sup>2</sup>Given low power to detect the 3 way interaction of group x anxiety x time due to the small follow up sample ( $n=49$ ) as well as the marginal group x anxiety effect, exploratory follow up analyses were performed in subsamples of low and high anxious participants. In the low anxious subsample ( $n=26$ ), there was no effect of time,  $F(1,23)=.252, p=.620$ , no significant group x time interaction,  $F(1,23)=3.005, p=.096$ , and no effects of past depression,  $F(1,23)=2.392, p=.136$ , indicating positive emotion scores did not change significantly among low anxious participants in either the control or reminiscence groups.

In the high anxious subsample ( $n=23$ ), there was a significant main effect of time,  $F(1,20)=16.27, p=.001$ , qualified by a significant group x time interaction,  $F(1,20)=4.307, p=.051$ , and a significant past depression x time interaction,  $F(1,20)=9.907, p=.005$ . To decompose the group x time interaction, analyses were repeated separately for reminiscence and controls. When high anxious controls ( $n=11$ ) were considered separately, there was a main effect of time,  $F(1,9)=10.740, p=.010$ , and no effect for past depression,  $F(1,9)=2.779, p=.130$ . High anxious controls showed significant increases in positive affect from T1 ( $M=28.45, SD=6.56$ ) to T3 ( $M=34.90, SD=7.38$ ).

Among high anxious reminiscence participants ( $n=12$ ), the main effect of time was not significant,  $F(1,10)=2.271, p=.163$ , but there was a significant past depression by time interaction,  $F(1,10)=7.899, p=.018$ . For high anxious reminiscence participants with no history of depression ( $n=5$ ), there was no significant change in positive affect from T1 ( $M=35.60, SD=7.02$ ) to T3 ( $M=33.40, SD=11.84$ ),  $t(4)=.701, p=.522$ . For those with past depression ( $n=7$ ), however, positive affect scores increased significantly from T1 ( $M=28.00, SD=6.98$ ) to T3 ( $M=35.29, SD=4.82$ ),  $t(6)=-4.057, p=.007$ .

factors was performed to test for effects of the reminiscence exercise on negative emotions, assessed by the PANAS-W-NA, in the completer sample. There was no significant main effect of time,  $F(1,152)=1.539, p=.217$ , nor was there a significant group x time interaction,  $F(1,152)=.859, p=.356$ . Depression history was not significant in the model,  $F(1,152)=2.499, p=.116^1$ . A significant anxiety x time interaction emerged in the model,  $F(1,152)=5.675, p=.018$ . When effort and investment were statistically controlled, results were unchanged and none of the effort and investment items emerged as significant covariates. Results were unchanged when repeated in the ITT sample.

Analyses were performed following up the significant anxiety effect. The analysis was repeated including significant covariates and a group x anxiety interaction term. A main effect of time emerged,  $F(1,152)=4.155, p=.043$ , qualified by a significant group x anxiety x time interaction,  $F(2,152)=4.643, p=.011$ . Follow up analyses were performed to decompose the interaction, repeating main analyses in subgroups of low and high anxious participants. In the low anxious subsample there was a marginal effect of time,  $F(1,76)=3.455, p=.067$ , qualified by a near significant group x time interaction,  $F(1,76)=3.745, p=.057$ . Follow up univariate tests in the low anxious subsample found no group differences in PANAS-W-NA scores at T1,  $F(1,78)=1.475, p=.228$ , or T2,  $F(1,77) = 1.332, p=.252$ .

In the high anxious subsample, the reminiscence group had significantly higher negative emotion scores at T1 ( $M=23.10, SD=6.08$ ) than controls ( $M=20.03, SD=5.52$ ),  $F(1,77)=5.413, p=.023$ . By T2, negative emotion scores were similar for high anxious reminiscence ( $M=20.32, SD=7.10$ ) and controls ( $M=18.05, SD=5.35$ ),  $F(1,77)=2.483, p=.119$ . In high anxious controls, there was a near significant decrease in negative emotion from T1 to T2,  $t(36) = 1.90, p=.063$ . In the high anxious reminiscence group, the decrease in negative emotion from T1 to T2 was significant,  $t(40)=2.317, p=.026$ . In sum, high anxious reminiscence had higher negative emotion than high anxious controls at T1, but this difference disappeared by T2, apparently driven by greater decreases in negative affect among high anxious reminiscence participants compared to high anxious controls. This pattern was not present in low anxious participants, who showed no evidence of group effects on negative emotion.

**Daily emotion experience.** Analyses were performed to test for effects of reminiscence on other aspects of daily negative emotion experience (e.g., frequency, duration, peak intensity). A univariate ANOVA found no group differences in mean daily negative emotion (PANAS-D-NA) scores,  $F(1,156)=1.806, p=.181$ . Depression history was not a significant covariate,  $F(1,156)=2.090, p=.150^1$ , but anxiety was significant in the model,  $F(1,156)=50.777, p<.001$ . Exploratory follow up analyses were performed to examine the significant effect of anxiety in the above analyses. The analysis was repeated including significant covariates and a group x anxiety interaction term. There were no effects of group,  $F(1,156)=1.888, p=.171$ , or group x anxiety,  $F(1,156)=1.269, p=.262$ , but anxiety was a significant covariate,  $F(1,156)=48.478, p<.001$ . Follow up correlation analyses revealed a significant positive relationship between trait anxiety and mean daily negative affect ( $r=.504, p<.001$ ). This relationship remained significant after controlling for T1 depression symptoms, ( $r=.392, p<.001$ ).

**Emotion regulation difficulties.** A repeated-measures analyses of variance (ANOVA) with group (reminiscence, control) as the between subjects factor and time (T1, T2) as repeating within subjects factors was performed to test for effects of the reminiscence exercise on emotion regulation difficulties, assessed by the DERS, in the completer sample. There was a significant main effect of time,  $F(1,151)=3.968, p=.048$ , qualified by a significant anxiety x time interaction,  $F(1,151)=3.870, p=.051$ , and no significant group x time interaction,  $F(1,151)=2.065, p=.153$ . Depression history was not significant in the model,  $F(1,151)=.228, p=.634$ . When effort and investment were statistically controlled, the group x time interaction was significant,  $F(1,151)=5.001, p=.027$  as well as a significant interaction of time with the covariate item assessing additional practice time outside of study allotment,  $F(1,151)=10.224, p=.002$ . Results were unchanged when analyses were repeated in the ITT sample.

Follow up analyses, including significant covariates, were performed to decompose the group x time interaction. Among controls, there was no main effect for time,  $F(1,76)=.002, p=.963$ , but anxiety remained a significant covariate,  $F(1,76)=71.898, p<.001$ . In the reminiscence group, there was also no significant time effect,  $F(1,73)=.000, p=.985$ , but there remained a significant covariate effect of anxiety,  $F(1,73) = 160.683, p<.001$ .

Analyses were performed following up the significant anxiety effect. The analysis was repeated including significant covariates and a group x anxiety interaction term. The group x anxiety x time effect was not significant,  $F(2,150)=2.24, p=.110$ , but a significant group x anxiety interaction emerged,  $F(2,148) = 114.874, p<.001$ . Follow up univariate analyses in the low anxious subsample, including covariates, showed no group differences in DERS scores at T1,  $F(1,77)=.225, p=.637$ , or T2,  $F(1,77)=2.595, p=.111$ . In the high anxious subsample, the reminiscence group had significantly higher T1 DERS scores ( $M=89.85, SD=24.01$ ) than controls ( $M=78.81, SD=19.63$ ),  $F(1,77)=5.608, p=.020$ . By T2, there were no longer differences in emotion regulation difficulties among high anxious participants in the reminiscence ( $M=87.00, SD=24.45$ ) and control ( $M=79.76, SD=20.31$ ),  $F(1,77)=2.011, p=.160$ , although this test was limited by low power (.28). Paired samples t-test found no significant change from T1 to T2 among high anxious controls,  $t(36)=-.423, p=.675$  or high anxious reminiscence participants,  $t(39)=1.020, p=.314$ . In sum, high anxious reminiscence group participants had higher emotion regulation difficulty than high anxious controls at T1, but these differences disappeared by T2, apparently due to chance changes in means in opposite directions between groups. There was, thus, no evidence that anxiety influenced group effects on changes in emotion regulation difficulties.

### **Exploratory Longitudinal Analyses in the Follow Up Sample**

**Depression.** A repeated-measures analyses of variance (ANOVA) with group (reminiscence, control) as the between subjects factor and time (T1, T3) as repeating within subjects factors was performed to test for long term effects of the reminiscence exercise on depression symptoms, assessed by the BDI-II, in the completer sample. There were no effects for time,  $F(1,45)=.292, p=.592$ , group x time,  $F(1,45)=.576, p=.452$ , or past depression,  $F(1,45)=1.230, p=.273$ . There was no significant anxiety x time interaction,  $F(1,45)=2,186, p=.146$ , but there was a main effect of anxiety,  $F(1,45)=42.046, p<.001$ . Correlation analyses revealed, regardless of group, higher trait anxiety predicted higher T3 depression scores ( $r=.465, p=.001$ ), and this effect remain even after controlling for T1 depression scores ( $r=.418, p=.003$ ).

**Savoring.** A repeated-measures analyses of variance (ANOVA) with group (reminiscence, control) as the between subjects factor and time (T1, T3) as repeating within subjects factors was performed to test for long term effects of the reminiscence exercise on savoring, assessed by the SBI, in the full sample. There were no effects of time,  $F(1,45)=.506, p=.481$ , group x time,  $F(1,45)=3.084, p=.086$ , or past depression,  $F(1,45)=1.290, p=.262$ . There was a main effect of anxiety,  $F(1,45) = 8.527, p=.005$ . Correlation analyses found, regardless of group higher trait anxiety predicted lower T3 savoring scores ( $r=-.308, p=.032$ ), but this effect disappeared after controlling for T1 savoring ( $r=-.074, p=.619$ ).

**Negative emotion.** A repeated-measures analyses of variance (ANOVA) with group (reminiscence, control) as the between subjects factor and time (T1, T3) as repeating within subjects factors was performed to test for long term effects of the reminiscence exercise on negative, assessed by the PANASW-NA, in the full sample. There were no effects for time,  $F(1,45)=.511, p=.478$ , group x time,  $F(1,45)=.476, p=.494$ , or past depression,  $F(1,45)=.041, p=.841$ . There was a main effect of anxiety,  $F(1,45)=32.740, p<.001$ . Correlation analyses revealed, regardless of group, higher trait anxiety predicted higher T3 negative affect ( $r=.371, p=.009$ ), and this effect remained after controlling for T1 negative affect ( $r=.358, p=.012$ ).

**Emotion regulation difficulties.** There was no significant effect of time,  $F(1,44)=2.275, p=.139$ , group x time,  $F(1,44)=.659, p=.421$ , or past depression,  $F(1,44)=.463, p=.500$  on DERS scores. There was a significant anxiety x time interaction,  $F(1,44)=3.977, p=.052$ . Analyses were repeated including a group x anxiety x time interaction term. The group x anxiety x time interaction term was near significant,  $F(2,44)=3.102, p=.055$ , and the group x anxiety interaction was significant,  $F(2,44)=29.988, p<.001$ . When low anxious participants were considered separately, there were no effects of time,  $F(1,23)=1.048, p=.317$ , group x time,  $F(1,23)=.454, p=.507$ . When high anxious participants were analyzed separately, there was a near significant main effect of time,  $F(1,21)=4.126, p=.055$ , no group x time interaction,  $F(1,21)=.002, p=.961$ . High anxious participants in both groups showed significant decreases in difficulties regulating emotions from T1 ( $M=84.57, SD=27.11$ ) to T3 ( $M=77.83, SD=24.78$ ),  $t(22)=2.079, p=.05$ .

## Exploratory Analyses in a Clinically Anxious Subsample

A subsample of participants with the highest anxiety scores was formed using percentile scores to form a cutoff at the 66<sup>th</sup> percentile of scores within the full sample. This subsample ( $n=50$ ; 30 reminiscence, 20 controls) had a mean STAI score of 51.96 ( $SD=6.74$ ), which is within the range of scores reported in studies of patients with anxiety disorders such as OCD ( $M=54.38$ ,  $SD=11.55$ ; Abramowitz & Deacon, 2006) and GAD ( $M=55.7$ ,  $SD=10.01$ ; Stanley, Novy, Bourland, Beck, & Averill, 2001), indicating clinically significant levels of anxiety. Main analyses were repeated in this subsample to explore whether effects differed in those at the higher end of the anxiety spectrum. Repeated-measures analyses of variance (ANOVAs) with group (reminiscence, control) as the between subjects factor and time (T1, T2) as repeating within subjects factors was performed to test for effects of the reminiscence exercise on outcome variables. Covariates were included as in main analyses. Statistics are presented when results differ from what was found previously in the anxious subsample based on median split.

**Positive emotion.** Results were similar to those in the median split anxious subsample (H1a). There were no time effects, group effects, or group x time interaction for PANAS-W-PA scores, or other indicators of positive emotions (i.e., percent of time feeling happy, positive emotion frequency, intensity, and duration of positive emotions).

**Depression symptoms.** Results differed from the median split sample, which found decreasing scores over time (H2a). In the clinically anxious subsample, there was no significant time effect,  $F(1,43)=1.468$ ,  $p=.232$ , or group x time interaction,  $F(1,43)=.343$ ,  $p=.561$  for BDI-II scores.

**Savoring.** Results from H3a analyses did not warrant comparison of median split anxious groups, precluding comparison here. In the clinically anxious subsample, a significant group x time interaction,  $F(1,43)=11.258$ ,  $p=.002$ , along with a significant time x past depression interaction,  $F(1,43)=6.768$ ,  $p=.013$ , emerged for SBI scores. Follow up analyses in controls found a main effect of time,  $F(1,18)=10.309$ ,  $p=.005$ , with savoring scores decreasing over time. Among controls, savoring scores significantly decreased from T1 to T2,  $t(19)=2.927$ ,  $p=.009$ . In the reminiscence group, the time effect

was not significant,  $F(1,28)=1.393$ ,  $p=.248$ , with savoring scores remaining constant from T1 to T2,  $t(29)=.778$ ,  $p=.443$ .

**Negative emotion.** Results diverged from findings in the median split sample, where high anxious reminiscence had higher negative emotion than high controls at T1, but not T2. In the clinically anxious subsample, there were no significant time effect,  $F(1,43)=.160$ ,  $p=.692$ , group x time interaction,  $F(1,43)=.021$ ,  $p=.887$ , or covariate interactions for PANAS-W-NA scores.

**Emotion regulation difficulties.** Results diverged from findings in the median split sample, where high anxious reminiscence group participants had higher emotion regulation difficulty than high anxious controls at T1, but not T2. In the clinically anxious subsample, there emerged no significant time effect,  $F(1,43)=1.225$ ,  $p=.275$ , group x time interaction,  $F(1,43)=2.079$ ,  $p=.157$ , or covariate interactions emerged for DERS scores.

**Exploratory longitudinal analyses.** Main longitudinal analyses were repeated in the clinically anxious subsample to explore whether effects differed in those at the higher end of the anxiety spectrum. Repeated-measures analyses of variance (ANOVAs) with group (reminiscence, control) as the between subjects factor and time (T1, T3) as repeating within subjects factors was performed to test for effects of the reminiscence exercise on outcome variables. Covariates were included as in main analyses.

**Positive emotion.** Results from H4a analyses did not warrant separate examination of the high anxious median split subsample, precluding comparison here. In the clinically anxious subsample, A significant main effect of time emerged,  $F(1,13)=8.720$ ,  $p=.011$ , qualified by a significant group x time interaction,  $F(1,13)=4.519$ ,  $p=.053$ , and a significant past depression x time interaction,  $F(1,13)=5.263$ ,  $p=.039$ . To decompose the group x time interaction, groups were analyzed separately. In controls ( $n=8$ ), there was a significant time effect,  $F(1,6)=6.252$ ,  $p=.047$ , with positive affect scores increasing from T1 ( $M=28.75$ ,  $SD=7.74$ ) to T3 ( $M=35.75$ ,  $SD=6.36$ ). Past depression was not significant in the model,  $F(1,6)=.283$ ,  $p=.614$ . In the reminiscence group ( $n=8$ ), there was no main effect of time,  $F(1,6)=.077$ ,  $p=.791$ , but the past depression x time interaction was significant,  $F(1,6)=12.467$ ,  $p=.012$ . Reminiscence participants with no past depression ( $n=2$ ) showed no significant changes from T1 ( $M=31.50$ ,  $SD=6.36$ ) to

T3 ( $M=23.50$ ,  $SD=.70$ ), although the small cell size precludes a powerful test  $t(1)=2.00$ ,  $p=.295$ .

Reminiscence participants with past depression ( $n=6$ ) showed a significant increase in positive affect scores from T1 ( $M=29.50$ ,  $SD=6.28$ ) to T3 ( $M=36.33$ ,  $SD=4.32$ ),  $t(5)=-3.323$ ,  $p=.021$ . In sum, in a subsample with clinically significant trait anxiety, the control condition was associated with increased positive affect over the follow up period. The reminiscence condition was also associated with increased positive affect, but only in those with a history of past depression.

**Depression symptoms.** Results from exploratory longitudinal depression analyses did not warrant separate examination of the high anxious median split subsample, precluding comparison here. There were no significant longitudinal effects of time,  $F(1,13)=3.038$ ,  $p=.105$ , group x time,  $F(1,13)=.030$ ,  $p=.866$ , or past depression,  $F(1,13)=.286$ ,  $p=.602$ .

**Savoring.** Results from exploratory longitudinal savoring analyses did not warrant separate examination of the high anxious median split subsample, precluding comparison here. In the clinically anxious subsample, there was no significant effect of time,  $F(1,13)=.396$ ,  $p=.540$ , or past depression,  $F(1,13)=2.893$ ,  $p=.113$ , but there was a near significant group x time effect,  $F(1,13)=4.392$ ,  $p=.056$ . Among controls ( $n=8$ ), there was a marginal effect of time,  $F(1,6)=4.502$ ,  $p=.078$ , a marginal past depression x time effect,  $F(1,6)=4.502$ ,  $p=.078$ , and a main effect of past depression,  $F(1,6)=8.859$ ,  $p=.025$ . At T1, controls with and without past depression had no significant differences in savoring scores,  $F(1,7)=.401$ ,  $p=.550$ . At T3, controls with past depression had significantly lower savoring scores than those with no depression history,  $F(1,7)=8.068$ ,  $p=.030$ . Findings for past depression analyses should be interpreted with caution due to very small cell sizes. In the reminiscence group, there were no effects of time,  $F(1,6)=1.218$ ,  $p=.312$ , or past depression,  $F(1,6)=.105$ ,  $p=.757$ .

**Negative emotion.** Results from exploratory longitudinal analyses of negative affect did not warrant separate examination of a high anxious median split subsample precluding comparison here. There were no significant longitudinal effects of time,  $F(1,13)=.209$ ,  $p=.655$ , group x time,  $F(1,13)=.081$ ,  $p=.781$ , or past depression,  $F(1,13)=.002$ ,  $p=.968$ , on negative affect in the clinically anxious subsample.

***Emotion regulation difficulties.*** Results diverged from exploratory longitudinal analyses of emotion regulation difficulties, which found participants above the anxiety median split in both groups showed significant decreases in difficulties regulating emotions from T1 to T3. In the clinically anxious subsample, there were no significant longitudinal effects of time,  $F(1,13)=2.488, p=.139$ , group x time,  $F(1,13)=.054, p=.820$ , or past depression,  $F(1,13)=.770, p=.396$ , on emotion regulation difficulties in the clinically anxious subsample.

## **Discussion**

The primary aim of the study was to investigate whether increasing positive emotions mitigates depression risk, and whether this effect was present in a group of at-risk anxious individuals. Previous studies have shown that interventions aimed at increasing positive emotions can reduce depression risk (Sin & Lyubomirsky, 2009), but it is unclear whether changes in positive emotion are responsible for this effect. The present study sought to determine whether manipulating positive emotions using a controlled design, under limited demand, would reduce depression risk. To manipulate positive emotions, this study utilized reminiscence, a method of savoring positive emotional experiences. The ability to savor positive emotional experiences has been posited as a fundamental process to bolster the benefits of positive emotions (Garland et al., 2010), including low depression (Bryant, 2003; Feldman, et al., 2008; see Tugade & Fredrickson, 2007). Previous studies have found reminiscence to increase positive emotions in unselected samples (Bryant et al., 2005; Lyubomirsky et al., 2006), but this study is the first to examine whether reminiscence exercises increase savoring using gold-standard assessments. The present study is the first to examine the effects of savoring exercises among those at high depression risk, including anxious individuals, who tend to dampen positive emotional experiences rather than savor them (Eisner et al., 2009). A stress resilience view of depression development in anxious individuals suggests that increasing positive emotions in anxious individuals may reduce depression risk (Morris, 2012).

### **Reminiscence Exercises Produce Immediate Increases in State Positive Emotion**

As intended, the reminiscence exercise elicited a more positive emotional state than the control exercise. The successful manipulation of positive emotions is particularly notable given the study's active control condition, which included mental imagery of a neutral memory of oneself in the past, allowing isolation of the positive emotional element of the reminiscence exercise. In addition, the group difference

is also notable given the study's limited demand characteristics, due to participants in both groups believing that the aim of the exercise was to improve mental focus and clarity. These results are in line with prior work documenting immediate positive emotion increases associated with writing about past positive experiences. Burton and King (2004) found a group who wrote about a positive experience in the laboratory on 3 consecutive days had higher average post-exercise positive mood ratings, but no differences in negative mood ratings, compared to a group who completed a descriptive writing exercise. Wildschut, Sedikides, Arndt, and Routledge (2006) found similar results in participants who wrote about a past nostalgic experience versus a control group who wrote about an ordinary event in their life. Participants in the nostalgia condition reported more positive affect, but not less negative affect, than controls. Our results add to these findings and suggest that these results can be obtained outside the laboratory and with imagery rather than writing.

#### **No Differences Between Conditions for Post-Intervention Positive Emotion**

Contrary to main hypotheses, there was no evidence that the reminiscence condition was associated with increased positive affect during or at the end of the intervention week compared to the control condition. This effect was replicated in the ITT sample ( $n=336$ ), which precludes constrained power as an explanation for lack of group effects. One prior study also failed to find positive affect differences between a laboratory reminiscence group and a no manipulation control group (Lyubomirsky et al., 2006). Lyubomirsky et al. (2006) found that students thinking about their happiest life experiences during 3 consecutive daily lab visits showed no greater changes in current moment positive affect or life satisfaction from day 1 to one month later compared controls. Similarly, the current study failed to find group differences in positive affect over a one month follow up, nor any group differences over a shorter duration covering only the intervention period (one week).

The current study findings are contrary to two prior studies finding daily reminiscence exercises increased reports of positive emotions. Bryant et al. (2005) found practicing daily reminiscence exercises at home, using either cognitive imagery or nostalgic memorabilia, for one week increased percentage of

time spent feeling happy compared to a control group who spent time thinking about current daily concerns. Lyubomirsky et al. (2006) found students practicing a “think and replay” version of reminiscence in the laboratory for 8 minutes on 3 consecutive days reported significantly higher positive affect scores (3 month version) at one month follow up than students who wrote about or analyzed their positive experience. There are several possible explanations for the present study failing to replicate the findings in Bryant et al. (2005) and Lyubomirsky et al. (2006).

At first glance, the most obvious explanation is that participants in the Bryant et al. (2005) study spent more time practicing reminiscence than in the present study. Indeed, the Bryant et al. (2005) participants were required to practice 10 minutes twice per day, whereas the present study only required 8 minutes once per day. However, because Bryant et al (2005) does not report on compliance or attrition, it is impossible to know how many days and times participants actually practiced. Given the high rate of noncompliance and attrition in the present study, one might predict similar if not higher rates of noncompliance and attrition in a similar student sample doing similar exercises with a greater time commitment. The current study used online, time-stamped assessments that were only available for 24 hours that fortunately allowed for data collection about when and if participants logged into complete online assessment. These time-stamped assessments do not afford conclusions about participant exercise compliance (i.e., participants might have been doing another activity while logged in for 8 minutes and merely complied with the questions before and afterward), but they do afford some conclusions about non-compliance. Notwithstanding any undocumented non-compliance where participants may have complied with assessments but not with the exercise itself, the present study documented over half of the sample as non-compliant. In the Bryant et al. (2005) study, participants received a packet at the beginning of the week, including instructions for daily exercises and questions to answer after each, and outcome measures, that was turned in at the end of the week. Paper and pencil diaries do not afford certainty about completion times and can introduce demand such that participants are compelled to complete all items even if they are not completed “on time” (Bolger, Davis, & Rafaeli, 2003). Thus, it cannot be confidently

concluded that the lack of effect of reminiscence exercises on positive affect in the current study was due to less time spent practicing because no compliance data is available in the Bryant et al. (2005) study.

Other methodological differences may have influenced the divergent study findings in other ways. For instance, the present study offered course credit compensation immediately for each daily exercise as participants progressed through the study, with no requirements that participants complete a certain number of assessments before receiving compensation. Bryant et al (2005) also offered course credit, although it is unclear what participants were told about completion requirements. It is possible that participants were offered credit after turning in completed packets at the end of the week. Prior work examining the validity of paper and pencil diary methods has revealed high rates of falsified entries “to give the appearance of good compliance” (Stone, Shiffman, Schwartz, Broderick, & Hufford, 2003, p. 183). Given lack of data collection as to when exercises were completed and lack of incentive to complete them on time, this leaves open the possibility that some participants in the Bryant et al. (2005) study completed the exercises and assessments all at once just before completing the outcome measures in the packet. If this was the case, reports of increased time spent feeling happy at post-test in the Bryant et al. (2005) study may be more comparable to our findings that reminiscence exercises increases positive emotions immediately, but not over the longer term. The differences in methodology between the present study and Bryant et al. (2005) thus preclude confident comparisons of the dosing of reminiscence exercises.

It is important to note also that the present study findings were consistent across measurements of various aspects of positive emotional functioning, assessed at both the daily and weekly levels, including the single assessment used in the Bryant et al. (2005) study, percentage of time spent feeling happy. The Bryant et al. (2005) sample completed retrospective assessments of time spent feeling happy during the past week at pre- and post- test and reported mean percentages of time spent feeling happy as changing from 51% to 53% over the course of the week. The present study sample reported feeling happy 69% of the time when daily assessments were averaged for the week. This difference presents the possibility that the present study sample was already at a higher level of positive emotional functioning, perhaps

constraining the range of possible positive emotion increases. Indeed, both groups in our study showed decreases, rather than increases, in reported positive affect at the end of the study week.

Possible explanations for the present study failing to replicate findings in Lyubomirsky et al. (2006) are somewhat different. The Lyubomirsky study involved reminiscence exercises of the same length (8 minutes per day) of the present study, and although paper and pencil instructional packets were used, compliance could be monitored as participants completed the exercise in a controlled laboratory environment. Attrition was very low (3%,  $n=4$ ) and participants were required to complete all study assessments. Even with fewer practice days (3) than the present study (4+), the Lyubomirsky et al. (2006) study found higher long term positive affect at a one month follow up than comparison groups. One consideration in interpreting the divergence between Lyubomirsky and the present study is the use of more stringent statistical analytical procedures (e.g., two tailed tests, .05 significance level) in the present study. Lyubomirsky reports one tailed tests and the significance level reported for long term positive affect was .07. An additional consideration involves consistency of findings across indices of positive affect and emotional functioning and across time points in the present study, while Lyubomirsky et al. (2006) did not report similar group differences on other measures relevant to positive affect, including psychological well-being. Interestingly, on one subscale of the psychological well-being scale, Environment Mastery, the effect was in the opposite direction. While participants in the think-replay condition showed increased long term PA, they also report decreased scores on the Environmental Mastery subscale of the psychological well-being scale, which assesses feelings of mastery (i.e., scores on items such as “I am quite good at managing the many responsibilities of my daily life”), which would be expected to positively correlate with PA (Lyubomirsky et al., 2006, p. 702). In sum, the more rigorous statistical conventions and consistent findings across measures in the present study may help explain why the effect on long term positive affect reported in the Lyubomirsky et al. (2006) failed to replicate.

Another consideration in comparing findings of the present study to both Bryant et al. (2005) and Lyubomirsky et al. (2006) is the difference in control conditions. Although both prior studies utilize comparison conditions that involve personally referential material as in the present study (i.e., similar to

reminiscence condition, comparison participants are thinking about their own lives), there is no data about the affective nature of the task in either study. Lyubomirsky et al. (2006) lacked a control group and instead utilized comparison groups that wrote about or analyzed past positive events. The Bryant study's control condition involved thinking about "current concerns" (p. 240), and according to the authors the thought content reported by control participants "primarily focused on the present and the future, and encompassed a wide range of concerns, including academic, romantic, family, health, financial, and job-related issues" (pg. 244). Prior studies have used similar instructions to induce worry (Oathes, Ray, Yamasaki, Borkovec, Castonaguay & Newman, 2008). Whereas the current study's control condition was demonstrably neutral in affective tone, the same cannot be confidently said for the control condition in the Bryant et al. (2005) or Lyubomirsky et al. (2006) studies. Though the lack of data documenting the immediate affective impact of each condition preclude strong conclusions about prior findings, a control condition with a negative affective tone could have the effect of inflating group differences, ultimately producing results that represent the differences between groups practicing a positive-emotion-inducing exercise and a negative-emotion-inducing exercise on time spent feeling happy at the end of the week.

A final consideration is that both the Bryant et al. (2005) and the Lyubomirsky et al. (2006) samples were mixed-sex, whereas the current study included only females. Our exclusion of males was based on prior studies of savoring and reminiscence reporting gender differences (Bryant, 2003; see Bryant, et al., 2011; Bryant, et al., 2005), with females reporting higher levels of savoring than males (Bryant, 2003; Bryant et al., 2011), as well as reminiscing more frequently and about different topics than males (Bryant et al., 2005). Additionally, the Bryant et al. (2005) study reported females in the reminiscence and control conditions had higher percentages of time spent feeling happy at pre- and post-test. Whether differences in the gender makeup of the samples were partially responsible for the divergent findings between the present study and the Bryant et al. (2005) and the Lyubomirsky et al. (2006) cannot be known; however, if this were the case one might hypothesize that males would show greater effects of reminiscence on positive affect due to lower initial savoring and reminiscence scores.

### **No Differences Between Conditions for Prospective Positive Emotion**

The present study's unexpected finding of decreasing positive affect scores from pre- to post-intervention was not maintained at one month follow up. That is, positive affect scores essentially returned to baseline in the follow up sample. Some prior work examining other self-administered interventions aimed at increasing positive emotions had delayed effects. Seligman et al. (2005) found that the two interventions with the strongest overall effects for happiness and depression symptoms (writing down "3 Good Things" daily and using "Signature strengths" of character in a new way each day) produced no differences from an active control condition at the one week post-intervention, but group differences in happiness began to emerge at one month and were maintained at 6 month follow up. It may be that the one month follow up sample was not large enough to detect group differences in positive affect that were just beginning to emerge.

Another potential explanation is that longer, more intensive interventions may be necessary to make lasting changes in positive emotional functioning in at-risk groups. One recent study examined an 8 week course of Mindfulness Based Cognitive Therapy (MBCT) for reducing depression relapse risk in those with a prior episode and found increased daily positive emotions and decreased depressive symptoms compared to a waitlist control group (Geschwind et al., 2011). Although the study did not examine whether positive emotion changes mediated the group differences in depression outcomes, results supported a does-response relationship between increased positive emotions and decreased residual symptoms in the MBCT group (Geschwind et al., 2011). Future studies assessing the impact of interventions on emotional functioning and the relationship of emotional changes to risk reduction efficacy are crucial to understanding affective mechanisms of resilience in groups at risk for depression.

### **No Differences Between Conditions for Depression Symptoms**

The present study found no support for the hypothesized decreases in depression symptoms in the reminiscence group versus controls; both groups showed decreasing depression symptoms from pre- to post-intervention, but these differences were not maintained for either group in a smaller sample who

completed the one month follow up assessment. Prior work examining the effects of positive emotion interventions on depression symptoms has documented similar depression decreases and happiness increases among intervention and active control conditions at one week post-test (Seligman et al., 2005). In particular, Seligman et al. (2005) found that the “3 Good Things” and “Signature strengths” interventions produced depression decreases at one week post-test that were maintained at follow up time points up to 6 months later. While active control condition also produced decreased depression at one week post-test, a return to baseline levels was documented for follow up assessments (Seligman et al., 2005). One hypothesis is that the present study lacked power to test for group differences (maintenance versus return to baseline) at the one month follow up, when group differences may be more evident.

#### **No Evidence that Reminiscence Exercises Increased Savoring**

Present study findings were contrary to hypotheses for savoring, where no evidence suggested that the reminiscence condition increased savoring from pre-to post-intervention based on a self-report assessment of participants’ beliefs about their ability to enjoy positive events through savoring. Findings from prior studies are preliminary given the dearth of studies with strong experimental control (no control condition, Schueller, 2010) and no prior studies examining savoring as a dependent variable. Hurley and Kwon (2012) found a savoring intervention consisting of psychoeducation and daily logging of savoring behaviors produced decreased depression symptoms, but no changes in positive emotions after 2 weeks compared to a no manipulation control condition. Quoidbach et al. (2009) found a daily savoring intervention involving anticipating positive events increased positive emotions after 2 weeks compared to an active control condition, which involved anticipating neutral or routine events. Neither Hurley and Kwon (2012) or Quoidbach et al. (2009) assessed savoring itself as an outcome. Without prior studies, interpretation of the present results is preliminary. It may be that practicing reminiscence, which is a method of savoring, does not impact one’s perceptions of his/her savoring ability, but rather increases the frequency with which savoring occurs.

### **Divergent Effects for Positive Emotion and Depression Symptoms**

The present study found that for both groups positive emotions and depression symptoms decreased. Given these measures are expected to be inversely related, and were strongly negatively correlated in the present study, the finding of decrease on both positive emotions and depression symptoms was unexpected. Reports from previous studies of positive emotion interventions frequently report effects on one and not the other. For instance, while some have found effects for depression symptoms or negative affect but not positive affect (Hurley & Kwon, 2012), others have found effects for positive emotion but not anxiety (Quoidbach et al., 2009). Still others have found effects of increasing one aspect of positive emotional functioning and decreasing another (Lyubomirsky et al., 2006). As noted above, even when effects are noted for both positive emotion and depression, they often emerge at different time points. Additionally, the finding of decreasing depression scores in both groups in the present study appears driven by high anxious individuals, whereas low anxious individuals showed stable depression scores from pre-to post intervention. Indeed, the present study found trait anxiety was a strong predictor of depression outcomes. High trait anxiety, in both groups, predicted higher depression symptoms at one month, even after controlling for initial depression scores. The present study adds to findings that interventions aimed at positive emotions can have differential effects on various aspects of emotional functioning. Future studies aimed at understanding the emotional impact of reminiscence and other positive emotion interventions are needed before the implications of this impact can be fully gauged.

### **Anxiety predicted positive emotion outcomes regardless of group**

Anxiety was assessed and sub-hypotheses were tested to determine if results for reminiscence would differ between subsamples of high and low (median split) anxious individuals. These results represent the first to investigate reminiscence or any savoring intervention in anxious persons, who are at increased risk for depression development. There was no evidence that the reminiscence condition had stronger effects on positive affect, depression symptoms, or savoring in a high anxious subsample.

Overall, however, anxiety was a strong predictor of positive emotion outcomes regardless of group. In both the control and reminiscence groups higher trait anxiety predicted lower positive emotion across all daily indicators, and these effects were not explained by comorbid depression symptoms. The low positive affect reported by high anxious individuals upon study entry was maintained throughout the intervention week. This finding adds to a small but compelling literature that suggests anxiety may have a blunting effect on positive emotional functioning. Previous findings in anxiety disordered samples suggests that daily variations in anxiety are linked to variations in positive emotions. For instance, there is evidence of diminished positive emotions during peak anxiety times such as exposure to trauma cues in PTSD (Litz, Orsillo, Kaloupek, & Weathers, 2000), days of high social anxiety (Kashdan & Steger, 2006) and during worry episodes (McLaughlin et al., 2007). This may be the result of the tendency of anxious individuals across the disorder spectrum to focus attention away from positively valenced stimuli in the environment (Frewen et al., 2008; Taylor et al., 2010) or interpret positive stimuli in a negative way (e.g., Alden et al., 2008; Frewen et al., 2010; Laposa et al., 2010).

Importantly, our finding that anxiety predicted low positive emotion after accounting for depression symptoms supports the notion that the effects of anxiety on positive emotional functioning are independent of depression. Several prior studies have found positive emotions deficits in anxious individuals hold after accounting for co-occurring depression, which is known to blunt positive emotions. In a study of patients with GAD, Power and Tarsia (2007) found low positive emotion predicted anxiety symptoms independently of sadness, which suggests that co-occurring depression symptoms are not fully responsible for relationship between low positive emotion and GAD. However, others have not found deficits in positive emotion reported by those with GAD (Brown, Chorpita, & Barlow, 1998). A one-day diary study of veterans with PTSD found lower reported positive affect ratings than non-PTSD veterans, even after controlling for depression history (Beckham, et al., 2000). In a one day experience sampling study of women with PTSD, Newton (2008) found that higher PTSD symptoms were related to fewer occurrences and more within- individual variability of positive emotion, even after controlling for depression diagnosis. Anxiety symptoms in general are related to the self-reported tendency to

downregulate (dampen) and to not upregulate (savor) positive emotions, even after controlling for current depression symptoms (Eisner, 2009).

The current study adds to this literature by extending previous findings from cross-sectional and one day studies to establish prospective evidence of the blunting impact of trait anxiety on positive emotion over the course of a week. Importantly, our findings were consistent across all daily indicators of positive emotional functioning, with higher trait anxiety predicting lower percentages of time spent feeling happy, less frequent positive emotions, lower peak positive emotion intensity, and shorter positive emotion duration assessed by daily reports throughout the study week. Taken together with previous cross sectional work, these findings provide evidence that anxiety has a unique blunting effect on positive emotional functioning. This effect has been hypothesized as a mechanism by which anxiety may increase risk for depression development (Morris, 2012). The current study lays the groundwork for future prospective studies to examine the relationship of positive emotional blunting in anxiety to depression development.

### **Study Limitations**

The findings of the present study must be interpreted taking several limitations into account. First, the present study is unable to speak to potential gender differences in the effects of reminiscence due to an all female sample. Second, the sample was unselected and thus cannot be generalized to treatment seekers. This is an important difference between the present study and some previous work finding effects of various self-administered positive emotion interventions on positive emotions and depression symptoms in individuals self-selecting to participate in a study to increase happiness (e.g., Seligman et al., 2005). Future studies examining the effects of reminiscence in treatment seekers may yield different results. Third, the present study had a high attrition rate and some evidence of differential attrition. The high attrition rate was similar to previous savoring studies involving daily online participation such as Quoidbach et al. (2009) which reported a 50% attrition rate (104 dropouts out of 210). It is notable that identical to our study Quoidbach et al. (2009) found no group differences in attrition rates and no

differences in anxiety between completers and non-completers. However, there is no report of group main effects for initial anxiety and the study did not assess negative emotion or emotion regulation difficulties, which revealed differential attrition in the present study. While means are not reported, from graphs it appears that participants in the neutral and control conditions had the highest T1 anxiety symptoms and showed the least changes in happiness, while the positive emotion intervention group had the lowest anxiety and evidenced the greatest increases in positive emotions. The lack of means reporting and ITT analyses precludes conclusions about whether the reported effects of the positive emotion intervention on positive emotions may have been influenced by differential attrition.

Our attrition findings are also in line with Geraghty et al. (2010a) who compared two self-directed interventions for reducing body dissatisfaction and found that a gratitude intervention focusing on positive thought content led to higher completion rates than a negative thought restructuring intervention although both were efficacious. The authors posit this was because the gratitude intervention produced higher positive emotions than the negative intervention and was thus as effective but less aversive and thus led to lower attrition rates (70% versus 81%). In the present study, individuals high in trait anxiety and emotion regulation difficulties were more likely to complete the reminiscence intervention, which produced greater positive emotion increases than the control condition. It may be that these more symptomatic individuals might be more likely to self select for an intervention aimed at decreasing depression and improving positive emotion, which would map onto the Geraghty et al. (2010a) findings that treatment seeking individuals were more likely to complete an intervention that increased positive emotions.

Fourth, our study was underpowered to detect 4-way interactions involving potential effects of past depression. Analyses revealed several effects that suggested past depression status may influence the effect of reminiscence. For instance, longitudinal analyses found increased positive affect in a subsample of past depressed reminiscence participants versus controls. In exploratory analyses in a clinically anxious subsample, high anxious controls exhibited increases in positive affect over the one month follow up period, while high anxious reminiscence participants only had increased positive affect at one month if

they had a history of past depression. Given extremely small cell sizes and lack of ITT replication, these findings are quite preliminary. However, prior work has found past depression interacts with anxiety to influence reward functioning (Morris & Rottenberg, in press), suggesting future studies may benefit from including past depression as a factor.

### **Summary**

The present study was the first to document that reminiscence exercises produce immediate increases on positive emotions even when compared to an active mental imagery control condition. However, contrary to prediction, these immediate positive emotion increases did not generalize to positive affect assessed at the daily, weekly, or one month follow up period. These findings thus cast doubt on the utility of reminiscence interventions to improve positive emotional functioning in unselected samples beyond active control interventions. Future work examining reminiscence or other savoring interventions in treatment seekers would benefit from strong attention to experimental control and attrition effects. The present findings of trait anxiety as a strong predictor of positive emotional outcomes regardless of group add to a growing literature suggesting anxiety has a unique blunting effect on positive emotions, which may leave anxious individuals at greater risk of depression development.

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## Appendix A: IRB Approval Letter



DIVISION OF RESEARCH INTEGRITY AND COMPLIANCE  
Institutional Review Boards, FWA No. 00001669  
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799  
(813) 974-5638 • FAX (813) 974-5618

January 31, 2013

Bethany Morris, M.A.  
Psychology, PCD4118G  
4202 E. Fowler Ave.  
Tampa, FL 33602

RE: Expedited Approval for Initial Review  
IRB#: Pro00010751  
Title: Savor the Memory: A Reminiscence Exercise to Increase Positive Emotions and Reduce Depression Risk in Anxious Individuals

Dear Ms. Morris:

On 1/31/2013 the Institutional Review Board (IRB) reviewed and APPROVED the above referenced protocol. Please note that your approval for this study will expire on 1/31/2014.

Approved Items:  
Protocol Document:  
[Dissertation 1-30-13](#)

Consent Document:  
[IMF Consent-version3.pdf.pdf](#)

Please use only the official, IRB- stamped consent document(s) found under the "Attachment Tab" in the recruitment of participants. Please note that these documents are only valid during the approval period indicated on the stamped document.

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history,

focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval by an amendment.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,



Lora M. A. Thompson, Ph.D., Chairperson Designee  
USF Institutional Review Board

## Appendix B: IRB Continuing Review Approval Letter



RESEARCH INTEGRITY AND COMPLIANCE  
Institutional Review Boards, FWA No. 00001669  
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799  
(813) 974-5638 • FAX (813) 974-7091

1/8/2014

Bethany Morris, M.A.  
Psychology  
4202 E. Fowler Ave.  
PCD4118G  
Tampa, FL 33602

**RE: Expedited Approval for Continuing Review**

IRB#: CR1\_Pro00010751

Title: Savor the Memory: A Reminiscence Exercise to Increase Positive Emotions and Reduce Depression Risk in Anxious Individuals

**Study Approval Period: 1/31/2014 to 1/31/2015**

Dear Ms. Morris:

On 1/8/2014, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents outlined below.

**Approved Item(s):**

**Protocol Document(s):**

[Dissertation 5-13-13 tracked changes](#)

**Consent/Assent Document(s)\*:**

[IMF Consent-version3\\_clean.pdf.pdf](#)

\*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab on the main study's workspace. Please note, these consent/assent document(s) are only valid during the approval period indicated at the top of the form(s) and replace the previously approved versions.

The IRB determined that your study qualified for expedited review based on federal expedited category number(s):

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval by an amendment.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,



John Schinka, Ph.D., Chairperson  
USF Institutional Review Board

### **About the Author**

Bethany Morris earned a Bachelor of Science in Psychology from the University of Tennessee Chattanooga in 2001. Training under the mentorship of Dr. Jonathan Rottenberg, she earned a Master of Arts and a Doctor of Philosophy in Clinical Psychology from the University of South Florida in 2010 and 2014, respectively. She completed her pre-doctoral clinical psychology internship training at the Oklahoma Health Sciences Center in 2014 and will continue her training as a postdoctoral fellow in combat stress at the Oklahoma City Veteran's Affairs Medical Center.