Mental Representations of Attachment Figures Facilitate Recovery Following Upsetting Autobiographical Memory Recall

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A growing literature shows that even the symbolic presence of an attachment figure facilitates the regulation of negative affect triggered by external stressors. Yet, in daily life, pernicious stressors are often internally generated—recalling an upsetting experience reliably increases negative affect, rumination, and susceptibility to physical and psychological health problems. The present research provides the first systematic examination of whether activating the mental representation of an attachment figure enhances the regulation of affect triggered by thinking about upsetting memories. Using 2 different techniques for priming attachment figure representations and 2 types of negative affect measures (explicit and implicit), activating the mental representation of an attachment figure (vs. an acquaintance or stranger) after recalling an upsetting memory enhanced recovery—eliminating the negative effects of the memory recall (Studies 1–3). In contrast, activating the mental representation of an attachment figure before recalling an upsetting memory had no such effect (Studies 1 and 2). Furthermore, activating the mental representation of an attachment figure after thinking about upsetting memories reduced negative thinking in a stream of consciousness task, and the magnitude of the attachment-induced affective recovery effects as assessed with explicit affect measures predicted mental and physical health in daily life (Study 3). Finally, a meta-analysis of the 3 studies (Study 4) showed that the regulatory benefits conferred by the mental representation of an attachment figure were weaker for individuals high on attachment avoidance. The implications of these findings for attachment, emotion regulation, and mental and physical health are discussed.

Keywords: attachment, affect regulation, stress, health, autobiographical memory

It has long been assumed that relationships with available and responsive attachment figures facilitate affect regulation and confer mental and physical health benefits (e.g., Bowlby, 1988; Diamond & Hicks, 2004; Harlow, 1958; Ryff & Singer, 2001). Supporting this view, extant research indicates that an attachment figure's actual or imagined presence down-regulates negative affective and physiological responses to external social stressors (e.g., giving a public speech; Grewen, Anderson, Girdler, & Light, 2003) and physical ones (e.g., receiving a mildly painful shock; Coan, Schaefer, & Davidson, 2006). But not all threats are external to the self. Some of the most pernicious threats are internally generated. Indeed, internally generated distressing cognitions characterize various physical and psychological disorders and are targets of various forms of therapy (e.g., Brewin, 2007; Brosschot, Gerin, & Thayer, 2006; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Surprisingly, to date, no work has directly examined whether the mental representation of an attachment figure facili-

tates the regulation of affect elicited by such internally generated stressors.

The current research addressed this issue, focusing specifically on the following four questions: Does imagining being supported by an attachment figure, or merely viewing a photograph of him or her, facilitate the regulation of affect triggered by thinking about an upsetting memory? Do such affect regulation benefits depend on whether the attachment figure representation is activated before or after thinking about the upsetting memory? Does activating the attachment figure representation also decrease the accessibility of negative thoughts in one's stream of consciousness following upsetting memory recall, and do the attachment-induced affect regulation benefits predict subsequent mental and physical well-being? Finally, do individual differences in adult attachment style amplify or dampen any affect regulation benefits conferred by activating the attachment figure representation?

Attachment and Affect Regulation

Whether a primary caregiver during infancy or a romantic partner during adulthood, attachment figures instill a sense of safety and protection (also referred to as *felt security*; Sroufe & Waters, 1977). A normative function of attachment figures involves affect regulation (e.g., Bowlby, 1982; Mikulincer & Shaver, 2007a). When an individual feels distressed—as a result of appraising the environment as threatening or the self as in need of help—she seeks proximity to her attachment figure. If the attach-

ment figure is available and responsive, the resulting contact alleviates distress. Restoration of felt security, in turn, enables the individual to resume exploration of the environment and other daily activities.

Numerous experimental and observational studies in both the child (e.g., Ainsworth, Blehar, Waters, & Wall, 1978; Larson, Gunnar, & Hertsgaard, 1991) and adult attachment literatures (e.g., Coan, 2008; Ditzen et al., 2007) provide support for the proposition that attachment figures enhance affect regulation (see Sbarra & Hazan, 2008; Selcuk, Zayas, & Hazan, 2010, for reviews). For instance, in adulthood, intimate and supportive interactions with a romantic partner, compared to nonsupportive interactions with a partner or being alone, lead to greater calmness while anticipating a stressor (e.g., Simpson, Rholes, & Nelligan, 1992), smaller elevations in self-reported anxiety and physiological reactivity (i.e., systolic blood pressure, diastolic blood pressure, heart rate, and cortisol level; e.g., Collins & Ford, 2010; Ditzen et al., 2007; Grewen et al., 2003) and attenuation of neural threat responses while experiencing a stressor (e.g., Coan et al., 2006), and faster emotional recovery following a stressor (e.g., Collins & Ford, 2010).

The regulatory benefits of attachment figures are realized not only through physical proximity and actual interactions with attachment figures but also through their symbolic presence (e.g., Hofer, 1984; Mikulincer & Shaver, 2007a). Over time, interactions with attachment figures are stored in memory as mental representations (also referred to as internal working models; e.g., Bowlby, 1973, 1982; Bretherton & Munholland, 2008; Collins, Guichard, Ford, & Feeney, 2004; Pietromonaco & Feldman Barrett, 2000). These representations consist of detailed memories of interactions with, and conscious and unconscious affective evaluations of, attachment figures (e.g., Günaydin, Zayas, Selcuk, & Hazan, 2012; Zayas & Shoda, 2005), as well as strategies to regulate negative affect (e.g., turning to attachment figures to alleviate negative affect or turning away from attachment figures and coping through other means; e.g., Baldwin, Fehr, Keedian, Seidel, & Thomson, 1993) in stressful and threatening situations (e.g., Collins et al., 2004; Pietromonaco, Feldman Barrett, & Powers, 2006). Repeated positive interactions with attachment figures during times of stress reinforce the association in long-term memory between bids for support and stress reduction (e.g., Beckes, Simpson, & Erickson, 2010; Mikulincer & Shaver, 2007a). As a result, it is hypothesized that mental representations of attachment figures become capable of activating psychological and physiological states of safety and calmness originally induced by actual interactions with them (e.g., Depue & Morrone-Strupinsky, 2005; Uvnäs-Moberg, 1998). In line with recent work showing that priming a social construct biases behavior (e.g., Ferguson & Zayas, 2009, for a discussion), this view suggests that merely calling to mind attachment figures in stressful situations confers regulatory benefits.

An extensive body of research has documented the effects of activating attachment-related representations on individuals' attitudes and behaviors (see Gillath, Selcuk, & Shaver, 2008; Mikulincer & Shaver, 2007b, for reviews). Yet, only a few of these studies have implications for affect regulation. Mikulincer, Hirschberger, Nachmias, and Gillath (2001) showed that in stressful contexts (after receiving negative feedback or being primed with a threat word), exposure to attachment-related stimuli elicited automatic positive reactions, whereas positive nonattachment stimuli did not. These findings suggest that the representation of an attachment figure is unique in its ability to restore positive affect after a stressful event. In addition, Eisenberger and colleagues (Eisenberger et al., 2011; Master et al., 2009) demonstrated that viewing a photograph of one's romantic partner (vs. a stranger or an object) reduced one's subjective experience of pain while receiving thermal stimulation at levels slightly higher than one's pain thresholds.

Do Mental Representations of Attachment Figures Facilitate Affect Regulation in Response to Internal Stressors?

Although existing findings provide evidence that activating mental representations of attachment figures confers affect regulatory benefits, past work has focused solely on external stressors. Yet, stressors are oftentimes internally generated. Memories of upsetting events spontaneously come to mind in individuals' daily life (e.g., Ayduk & Kross, 2010) and are associated with increased negative affect (Kross, Davidson, Weber, & Ochsner, 2009) and cognition (Kross & Ayduk, 2008). The negative thinking triggered by recalling an upsetting past event maintains and enhances the initially experienced negative affective response, increasing the likelihood that the individual will become entrapped in rumination—a state characterized by focusing repeatedly and passively on the events that cause negative affect (e.g., Nolen-Hoeksema et al., 2008). Not surprisingly, research has shown that difficulty in coping with upsetting autobiographical memories and resulting rumination increases susceptibility to psychological disorders such as depression and generalized anxiety disorder (e.g., Brewin, 2007; Mathews & MacLeod, 2005; Nolen-Hoeksema et al., 2008) and physical disorders such as cardiovascular disease (e.g., Brosschot et al., 2006; Schwartz et al., 2003).

To date, no study has investigated whether activating the mental representation of an attachment figure confers regulatory benefits in response to thinking about an upsetting memory. A related question, which has not received attention, is whether the affect regulation benefits depend on whether the representation is activated before or after exposure to the stressor. Answers to these questions have implications for both the attachment and emotion regulation literatures.

According to attachment theory, attachment figures should enhance the regulation of negative affect triggered by stressors regardless of whether they are external or internal and regardless of whether the representation is primed before or after the stressor. If the representation of an attachment figure is activated before the occurrence of a stressor, it would be expected to automatically activate positivity (e.g., Zayas & Shoda, 2005) and lead to feelings of calmness and safety. This, in turn, could decrease the extent to which the event is appraised as stressful, or a person's reactivity when recalling the event, and thus, decrease negative affect. Henceforth, this is referred to as the *buffering hypothesis*. Indeed, such a possibility is supported by studies showing that people are less physiologically reactive to an external stressor following an interaction with an attachment figure (e.g., Ditzen et al., 2007; Grewen et al., 2003; Kamarck, Manuck, & Jennings, 1990).

If the representation of an attachment figure is activated after stress exposure, the positivity and feelings of calmness induced would be expected to promote recovery and help individuals return to their affective baseline. In line with this prediction, prior research shows that mental representations of attachment figures consist of "if–then" contingencies (e.g., Baldwin et al., 1993; Collins et al., 2004) that reflect expectations about interactions with attachment figures (e.g., "If I am upset, then my partner will comfort me"). This expectation of comfort when distressed suggests the possibility that following the recall of an upsetting memory a simple reminder of the attachment figure would provide relief. Hereafter, this is referred to as the *recovery hypothesis*. Indeed, when discussing personal worries, a partner's responsiveness has been shown to immediately improve mood (e.g., Collins & Feeney, 2000).

In contrast to the attachment perspective, research and theory on emotion regulation indicates that the effectiveness of affect regulation strategies depends on a number of factors, including whether the source of the affect is external or internal and the timing of the affect regulation strategy in relation to the stressor. Specifically, recent findings show that emotion induced by an internal versus external event is supported by partially distinct neural systems (Ochsner et al., 2009). One critical implication of this work is that whether the emotion is induced by an internal versus external event affects the effectiveness of particular affect regulation strategies. For example, McRae, Misra, Prasad, Pereira, and Gross (2012) have shown that reappraising a situation in nonemotional terms (vs. responding naturally) led to greater decrease in self-reported negative affect in response to an internally generated negative event compared to an external one. In addition, Gross's (1998, 2001) theory of antecedent- versus response-focused emotion regulation suggests that the timing of an affect regulation strategy relative to the stressor impacts its success. Although his work has focused on reappraisal and suppression, it highlights the importance of timing in the effectiveness of affect regulation strategies.

In sum, the attachment perspective suggests that both the buffering and recovery effects could serve to independently promote affect regulation in response to an internally generated stressor. However, given findings in the emotion regulation literature showing that the effectiveness of affect regulation strategies varies as a result of various factors (e.g., whether the stressor is external vs. internal, timing of stressor relative to the strategy), we believed that neither the buffering nor the recovery hypothesis could be assumed to occur for internal stressors. Testing both hypotheses empirically is necessary.

Individual Differences in Adult Attachment

According to attachment theory, the affect regulation benefits conferred by the presence of attachment figures are a normative process that characterizes attachment relationships in general (e.g., Bowlby, 1982; Selcuk et al., 2010). Nonetheless, these basic processes are expected to vary as a function of individual differences in a person's *attachment style*, that is, the characteristic ways a person feels, thinks, and behaves with an attachment figure. Specifically, individuals with different attachment styles possess representations of attachment figures that vary in valence and content. These differences, in turn, are expected to affect the

ability of individuals to obtain affect regulation benefits from the attachment representation.

With respect to individual differences in adult attachment styles, the two primary dimensions are *anxiety* (characterized by intense worries about abandonment) and *avoidance* (characterized by discomfort with depending on relationship partners; e.g., Fraley, Waller, & Brennan, 2000). Both high avoidance and high anxiety have been linked to problems in affect regulation (e.g., Mikulincer & Shaver, 2007b). However, they differ in that avoidance is expected to be more likely to modulate the extent to which individuals rely on and obtain affect regulation benefits from attachment figures in stressful contexts (e.g., Coan, 2008), whereas anxiety is expected to be more likely to modulate reactivity to separation from attachment figures (e.g., Diamond, Hicks, & Otter-Henderson, 2008). Consistent with this idea, avoidant individuals possess less positive automatic evaluations of attachment figures (e.g., Zayas & Shoda, 2005) and less positive interpersonal expectations (e.g., Baldwin et al., 1993) and prefer to cope with aversive situations by themselves versus relying on an attachment figure (e.g., Collins & Feeney, 2000; Pietromonaco & Feldman Barrett, 2006; Simpson et al., 1992). Moreover, studies have shown that in response to external stressors, avoidant individuals obtain fewer regulatory benefits from contact with attachment figures (e.g., Carpenter & Kirkpatrick, 1996; Coan, 2008; Ditzen et al., 2008).

Overview of the Present Studies

The present research investigated the effect of activating the mental representation of an attachment figure on affect regulation in response to an upsetting memory recall. Specifically, participants were asked to relive a personally upsetting autobiographical memory using a reliable and well-validated procedure for investigating the effects of internally generated stressors (Kross & Ayduk, 2011; Kross, Berman, Mischel, Smith, & Wager, 2011). The mental representation of the attachment figure (the mother in Studies 1 and 2 and the romantic partner in Study 3) was activated either before or after memory recall, affording empirical tests of both the buffering hypothesis (Studies 1 and 2) and the recovery hypothesis (Studies 1–3) using the same experimental paradigm. Study 1 investigated whether imagining being supported by an attachment figure leads to buffering or recovery effects as assessed by participants' explicit self-reported affect ratings. To extend the Study 1 findings, Studies 2 and 3 used a different priming technique (i.e., simply viewing the photograph of the attachment figure) and used an implicit measure of negative affect (Quirin, Kazén, & Kuhl, 2009) that is less susceptible to various biases including demand effects and self-presentational concerns. In addition, Study 3 investigated whether activating the mental representation of an attachment figure reduces negative thinking following an upsetting memory recall and whether the affect regulation benefits observed in the laboratory predict psychological and physical health assessed at least 1 month after the study. Finally, in Study 4, a meta-analysis was performed on the combined data from Studies 1–3 to obtain reliable estimates of the association between attachment style and the magnitude of regulatory effects.

Study 1

Method

Participants.   One hundred twenty-three undergraduate students (105 women) participated in the study for course credit. During a training session where participants practiced recalling an upsetting memory when presented with a cue (see the Procedure and materials section for details), one participant was not able to recall one of the memories in less than 20 s, the amount of time allotted for memory recall during the actual experiment, and was excluded from the sample. The mean age of the final sample was 20 years ($SD = 2.80$). The racial composition of the sample was 63% Caucasian, 25% Asian or Asian American, 3% African American, 3% Hispanic/Latino, and 6% other ethnicities.

Procedure and materials.

Overview.   The study consisted of an online survey and an experimental session that was held 1–2 days later. The online survey included a measure of attachment style (described in the Method section of Study 4) and a questionnaire prompting participants to generate upsetting autobiographical memories. The experiment had a mixed design with timing (recovery vs. buffering) as the between-participants factor and the prime (attachment figure vs. acquaintance) as the within-participant factor. At the start of the experimental session, participants completed a short training session to gain practice bringing to mind the upsetting memories they had generated in the online survey. After training, participants were randomly assigned to either the recovery condition ($n = 55$) or the buffering condition ($n = 67$) and completed the attachment affect regulation task (AART), a computer-based task specifically developed to test the effect of attachment figure representations on affect regulation in response to thinking about an upsetting memory. Upon completion of the experiment, participants were probed for suspicion and fully debriefed about the purposes of the study.

Generating upsetting autobiographical memories.   To ensure that participants would be able to recall an upsetting memory during the experiment, participants were asked to write in detail about two upsetting autobiographical memories prior to the experimental session using procedures adapted from Kross et al. (2009). They were told that these memories could refer to any type of negative experience as long as they did not involve participants' mother. Participants were first asked to describe the memory in detail (what happened, why it was a negative experience, where it took place, when it occurred, who else was present, etc.). They then constructed a "memory cue," which consisted of 1–3 words. It was to be used in the experimental session to help them recall the memory. After writing about each memory and providing a cue, participants rated the event's significance in their lives using the following eight-item scale developed for the present study: "When this event happened, how significant was the event in your life?"; "How significant is the event in your life currently?"; "When you recall this experience now, how bad do you feel?"; "When this event happened, how bad did you feel?"; "When you think about this experience, how vividly does it come to mind?"; "How frequently have you thought about this experience since it happened?"; "How frequently do you think about this experience currently?"; and "How frequently did you think about this event soon after it occurred?" Participants answered the questions using a 7-point scale (1 = *not very*, 4 = *somewhat*, 7 = *very*). Average

Cronbach's alpha was .86, and the average significance rating was 4.86, significantly above the midpoint, $t(121) = 10.23$, $p < .001$, across the two memories.

Memory recall training.   On the basis of previous studies (e.g., Kross et al., 2009), participants completed a memory recall training before performing the AART. This training ensured that they would be able to bring the memory to mind within the allotted time during the actual AART. First, participants were presented with the description of each memory along with the cue to recall it on a computer screen. They were given as much time as they needed to pair the cue with the memory so that they would be able to quickly recall the memory when they saw the corresponding cue during the AART. Participants obtained practice for both memories. Next, one of the two memory cues was randomly presented on the computer screen without the description of the memory, and participants were asked to press the space bar as soon as they were able to recall the specific memory to which the cue referred. Reaction time data were examined to ensure that participants recalled the memory in less than 20 s—the amount of time allotted during the AART for memory recall.

Nominating an acquaintance.   After completing the training, participants were asked to nominate an acquaintance, which was defined as someone "who has little impact on your life. This person may be someone you interact with on a regular basis on a superficial level or someone whom you have only met a few times" (McGowan, 2002). They were asked to think about this person whenever asked to think about an acquaintance when completing the AART.

Attachment affect regulation task (AART).   As shown in Figure 1A, each trial of the AART consisted of an upsetting memory recall and the prime manipulation. Participants indicated how they felt at the moment ("How bad do you feel at the moment?" and "How good do you feel at the moment?") on a 7-point scale (1 = *not at all*, 4 = *somewhat*, 7 = *extremely*) at the beginning of the trial (baseline), after recalling the upsetting memory (post-memory), and after the prime (post-prime). Because positive and negative affect were moderately to strongly correlated across Studies 1–3 (ranging from –.54 to –.81 in Study 1, –.48 to –.78 in Study 2, and –.49 to –.67 in Study 3) and the main tests of the buffering and recovery hypotheses led to similar conclusions when positive and negative affect were analyzed separately, a composite negative affect score was computed by averaging negative affect and reverse-scored positive affect. Average Cronbach's alphas across trials, for each negative affect assessment and as a function of prime condition in Study 1, ranged from .69 to .86.

The AART was the same in both the recovery and buffering conditions except for the placement of the prime manipulation in relation to the memory recall. In the recovery condition, the mother (or acquaintance) prime was presented after the memory recall. In the buffering condition, the mother (or acquaintance) prime was presented before the memory recall.

During the upsetting memory recall, the memory cue appeared on the screen, and participants were asked to recall the experience to which the cue referred as fully as possible. Specifically, participants were told that "as you recall the experience, please let your deepest thoughts and emotions about this experience run through your mind." Previous studies (e.g., Kross et al., 2011) showed that a memory recall as short as 15 s is sufficient to induce subjective negative affect and increase activation of neural regions involved
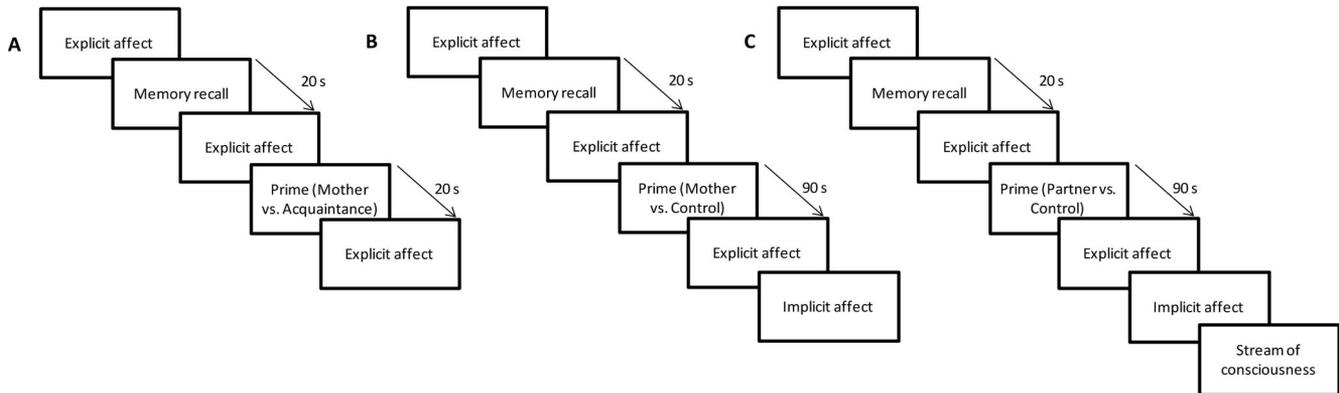
Figure 1. Schematic representation of an attachment affect regulation task (AART) trial in the recovery condition in (A) Study 1, (B) Study 2, and (C) Study 3. The structure of the trial in the buffering condition (Studies 1 and 2) was the same except that the prime preceded memory recall.

in affective processing. Accordingly, in the current study, the memory recall lasted 20 s, during which the memory cue remained on the screen.

The prime manipulation consisted of a mental imagery task designed to activate the representation of one's mother or an acquaintance. Participants were asked to imagine as vividly as possible that they were supported and comforted by their mother (mother condition) or the acquaintance (acquaintance condition). This task lasted 20 s as well.

The AART consisted of two blocks (the mother block and the acquaintance block). Participants completed two trials in each block (one with each upsetting memory) for a total of four trials. To provide a mental cleanse in between trials, participants completed a distracter task consisting of a series of simple one- or two-digit addition questions (e.g., 22 + 55 = ?) before starting the next trial (average time to complete the distracter task = 21 s, $SD = 4.7$). The order in which the two blocks were presented (mother block first and acquaintance block second or vice versa) was counterbalanced across participants.

Data analytic strategy. The goal of the data analytic strategy was to quantify the extent to which the attachment figure prime helped maintain baseline levels of affect in the face of an upsetting memory recall (buffering hypothesis) or restore affect to baseline levels following memory recall (recovery hypothesis). Thus, change in negative affect relative to baseline level was the focus of assessment. Accordingly, for each trial, baseline negative affect was subtracted from post-memory negative affect and from post-prime negative affect. For simplicity, these change scores are referred to as *post-memory NA*$_\Delta$ and *post-prime NA*$_\Delta$, respectively. For both post-memory and post-prime NA$_\Delta$, a score of zero reflects no change in negative affect compared to baseline, a positive NA$_\Delta$ score reflects increased negative affect compared to baseline, and a negative NA$_\Delta$ score reflects decreased negative affect compared to baseline. By correcting for baseline negative affect, on a trial-by-trial basis within each participant, we could rule out the possibility that differences in negative affect may arise over time in the prime conditions (e.g., increasing negative affect in the control prime condition). After performing the baseline correction, we averaged the NA$_\Delta$ scores across trials in the same block. The recovery and buffering hypotheses were tested via

separate repeated-measures analyses of variance (ANOVAs) with prime (mother vs. acquaintance) as the within-participant factor. The dependent variables were post-prime NA$_\Delta$ in the recovery condition and post-memory NA$_\Delta$ in the buffering condition.[1]

Results and Discussion

Effect of upsetting memory recall on negative affect. Consistent with previous work (Kross et al., 2009), the upsetting memory recall induced negative affect. This was reflected by post-memory NA$_\Delta$ scores that were significantly above zero in both the buffering and recovery conditions (Ms > 0.85, ts > 8.41, ps < .001, Cohen's ds > 1.03). Participants reported significantly greater negative affect in response to the memory recall in the first block of the AART than the second block (ps < .01), suggesting habituation to the effects of memory recall. Nevertheless, recalling the same upsetting memories the second time still induced negative affect (Ms > 0.65, ts > 5.58, ps < .001, ds > 0.68).

Recovery hypothesis. Supporting the recovery hypothesis, participants showed significantly lower negative affect, as reflected by lower post-prime NA$_\Delta$, after the mother prime than the acquaintance prime, $F(1, 54) = 15.39$, $p < .001$, $\eta_p^2 = .22$ (see Figure 2). These results indicate that imagining being supported and comforted by one's mother (vs. an acquaintance) following an upsetting memory recall leads to greater affective recovery.

Buffering hypothesis. Priming one's mother (vs. an acquaintance) before recalling an upsetting memory led to lower negative affect in response to the upsetting memory recall as reflected by

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[1] In Studies 1–3, we performed supplemental analyses to test whether the effect of the prime (attachment vs. control) on each variable of interest was moderated by order of the AART blocks (attachment figure block first vs. control block first) and significance of the upsetting event. There were no statistically significant main effects of or interactions with significance of the upsetting event. However, four (out of nine) analyses revealed an unpredicted, statistically significant, order by prime interaction. Follow-up tests using data from only the first block of the AART and treating prime type (attachment figure vs. control) as the between-participants variable produced similar results and conclusions to those reported in the text. Thus, for simplicity, order and significance were not included in the final model.
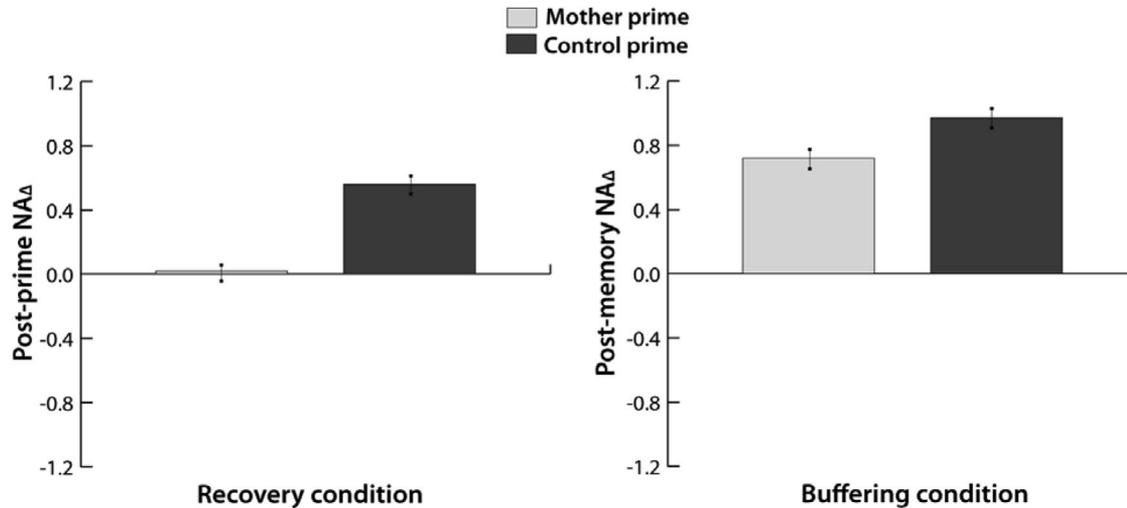
Figure 2. Bars represent post-prime NA_Δ in the recovery condition (left panel) and post-memory NA_Δ in the buffering condition (right panel) as a function of prime (mother vs. control) in Study 1. Error bars represent 1 *SE* above and below the mean. A NA_Δ score of zero reflects no change in negative affect compared to baseline, a positive NA_Δ score reflects increased negative affect compared to baseline, and a negative NA_Δ score reflects decreased negative affect compared to baseline. NA = negative affect.

lower post-memory NA_Δ. However, this effect did not reach conventional levels of significance, $F(1, 66) = 3.22$, $p = .077$, $\eta_p^2 = .05$.[2]

In sum, Study 1 provides the first evidence that activating the mental representation of an attachment figure facilitates recovery from negative affect triggered by an upsetting autobiographical memory recall—essentially facilitating the restoration of mood to baseline levels and supporting the recovery hypothesis. Interestingly, although priming an attachment representation buffered against negative affect in response to the memory recall, the effect was only marginally significant (at $p < .10$). Therefore, the buffering and recovery hypotheses were tested again in Study 2 using a different priming manipulation.

One alternative explanation for the recovery effect is that it may have been caused by differences in distraction elicited by the prime stimuli rather than the mental representation of the mother facilitating recovery. Mental representations of attachment figures are more complex, rich, and detailed than those of acquaintances (e.g., Andersen & Cole, 1990; Collins et al., 2004). When asked to imagine being supported and comforted by their mother, participants may have recalled or imagined a very detailed scene, and thus may have been more distracted, compared to when they were asked to imagine being supported by an acquaintance. The priming technique used in Study 2 was designed to assess the extent to which participants were distracted and thus provides a test of this alternative explanation.

Study 2

Study 2 had three aims. The first was to conceptually replicate the findings of Study 1, especially given the inconclusive evidence for the buffering hypothesis. The second aim was to test the recovery and buffering hypotheses using a different priming manipulation. The effectiveness of the prime manipulation used in

Study 1 depends on a number of factors, including the relative accessibility of memories in which one's mother provided support and comfort as well as participants' effort and willingness to imagine such an interaction, and one's metacognition of the ease and speed of the recall process (e.g., Schwarz et al., 1991). Thus, based on prior research showing that the regulatory benefits of attachment figures can be realized spontaneously, automatically, and effortlessly (e.g., Coan, 2008; Coan et al., 2006; Sbarra & Hazan, 2008), Study 2 primed the attachment representation by simply exposing participants to a photograph of their mother, without requiring any explicit recollection of a supportive interaction.

Study 2 also afforded a test of an alternative explanation. Namely, in Study 1, the prime manipulation of recalling a supportive interaction involving one's mother, versus an acquaintance, may have elicited a richer, more detailed memory, which may have led to greater distraction. Thus the greater recovery observed in the mother (vs. acquaintance) condition could have been the result of manipulating distraction, rather than the attachment representation per se. To investigate this possibility, during the photograph priming manipulation used in Study 2, participants

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[2] In Studies 1 and 2, we compared the magnitude of the recovery versus buffering effects by entering buffering versus recovery as a between-participants factor in the model. In Study 1, the main effect of prime was significant, $F(1, 120) = 16.21$, $p < .001$, $\eta_p^2 = .12$. The Prime $\times$ Timing interaction was not statistically significant at conventional levels, $F(1, 120) = 2.35$, $p = .13$, $\eta_p^2 = .02$. In Study 2, for explicit negative affect, the main effect of prime, $F(1, 136) = 27.71$, $p < .001$, $\eta_p^2 = .17$, was qualified by a Prime $\times$ Timing interaction, $F(1, 136) = 10.50$, $p = .002$, $\eta_p^2 = .07$. For implicit negative affect, there was a marginally significant effect of prime, $F(1, 136) = 2.94$, $p = .09$, $\eta_p^2 = .02$, and the Prime $\times$ Timing interaction was at the trend level, $F(1, 136) = 2.29$, $p = .13$, $\eta_p^2 = .02$.

were asked to locate randomly occurring visual stimuli on a computer screen. We reasoned that if the attachment prime leads to greater distraction compared to the control prime, then participants should be slower at indicating the location of the stimuli in the attachment prime condition (see Master et al., 2009, for a similar approach).

The third aim of Study 2 was to complement the Study 1 findings by using an implicit measure of negative affect. Although self-reports provide reliable and valid assessments of affect (e.g., Diener, 2000), they are susceptible to a variety of biases such as self-presentational concerns, demand effects, and individuals' beliefs about emotions (how one *should* feel in a particular situation; e.g., Robinson & Clore, 2002). Implicit measures provide an index of affect in a manner that is less overt, and thus less susceptible to conscious control. Support for the regulatory effects with an implicit measure would further increase confidence in the effects obtained in Study 1.

Method

Participants. One hundred thirty-nine undergraduate students (105 women) participated in the study in exchange for course credit ($ns = 70$ and 69 in the recovery and buffering conditions, respectively). During the memory recall training, one participant in the buffering condition did not recall a memory in less than 20 s, which was a prerequisite for performing the AART, and was removed from the sample. The mean age of the final sample was 20 years ($SD = 1.59$). The racial composition was 62% Caucasian, 19% Asian or Asian American, 7% African American, 5% Hispanic/Latino, and 7% from other ethnic backgrounds.

Procedure and materials.

Overview. The materials and procedure were exactly the same as those described in Study 1 except that the prime manipulation in Study 2 involved participants viewing a photograph of their mother (instead of imagining a supportive interaction) and a measure of implicit negative affect was administered at the end of each AART trial (Figure 1B).

Prime manipulation. In the prime manipulation phase of the AART, the photograph of the participant's mother or another participant's mother appeared in the center of the screen. To ensure that participants attended to the photograph and to assess whether they were more distracted in one prime condition than the other, a yellow equilateral triangle (0.3 in. [0.76 cm]) was randomly presented for 300 ms (interstimulus interval of 3,000 ms) at one of six possible locations (i.e., upper left, mid-left, lower left, upper right, mid-right, and lower right side of the photograph). Participants indicated the position of the triangle by pressing the *d* (for left) or *k* (for right) buttons on the keyboard. Thirty triangle stimuli were presented (five flashes at each location), ensuring a 90-s prime exposure. The accuracy rate was high (>98%) and did not differ across condition ($p = .56$). Mean latency to locate stimuli in each condition was computed by averaging reaction times for correctly classified trials.

To obtain stimuli for the prime manipulation, participants submitted a digital photograph of their mother's face in which she is directly facing the camera and not wearing any items that obscure her face (e.g., sunglasses). A research assistant confirmed that the photograph adhered to the instructions and standardized it by replacing the background with a gray fill and resizing the photograph to 5×5 in. (12.7 $\times$ 12.7 cm).

Implicit negative affect. Implicit negative affect was assessed using a modified version of the Implicit Positive and Negative Affect Test (IPANAT; Quirin, Kazén, & Kuhl, 2009). Participants saw letter strings (e.g., *LINTE*) that were supposedly from an artificial language and indicated "how well each artificial word expresses different moods" on a 4-point Likert scale (*does not fit at all* to *fits very well*). Previous studies have shown that the IPANAT is sensitive to state variations in affect induced by negative stimuli (Quirin, Kazén, & Kuhl, 2009) and that greater negative affect as assessed by the IPANAT is associated with higher cortisol responses to a laboratory stressor (Quirin, Kazén, Rohrmann, & Kuhl, 2009), providing empirical support for the construct validity of the instrument as an implicit measure of negative affect. The original version of the IPANAT uses six adjectives: *happy*, *energetic*, *cheerful*, *tense*, *helpless*, and *inhibited*. To more adequately capture negative affect triggered by the memory recall, we replaced these adjectives with *distressed*, *anxious*, *threatened*, *upset*, *secure*, *relaxed*, and *calm* (with the last three adjectives reverse scored). Given the length of the measure, we could not assess implicit affect repeatedly within each trial. Instead, participants completed the measure once at the end of each trial (see Figure 1B). That is, at the end of each trial, participants were shown one (of four) artificial word and were asked to indicate how well each of the seven adjectives fits the word. Participants saw a different artificial word each time they completed the measure. Average Cronbach's alphas across trials and for each prime condition separately were high, ranging from .81 to .84.

Data analytic strategy. The data analytic strategy was the same as in Study 1.

Results and Discussion

Effect of upsetting memory recall on negative affect. As in Study 1, the upsetting memory recall induced negative affect, as reflected by post-memory NA_Δ scores significantly above zero in both the buffering and recovery conditions ($Ms > 0.78$, $ts > 8.30$, $ps < .001$, $ds > 1.01$). Participants reported significantly greater negative affect in response to the memory recall in the first block of the AART than the second block ($ps < .001$). Nevertheless, recalling the same upsetting memories the second time continued to induce negative affect ($Ms > 0.57$, $ts > 5.60$, $ps < .001$, $ds > 0.68$).

Effect of prime on distraction. Inspection of reaction times to locate the stimuli during the priming task revealed no evidence that the attachment figure prime was more distracting than the control prime in either the recovery condition, $F(1, 69) = 2.86$, $p = .10$, $\eta_p^2 = .04$, or the buffering condition, $F(1, 67) = 3.52$, $p = .07$, $\eta_p^2 = .05$. In fact, the trend was in the opposite direction, with participants being slower during the control prime task than the mother prime task (recovery condition: $M = 384.67$, $SE = 9.15$ vs. $M = 377.73$, $SE = 8.64$; buffering condition: $M = 387.71$, $SE = 11.62$ vs. $M = 372.43$, $SE = 8.87$).

Recovery hypothesis. As in Study 1, participants in the recovery condition showed greater recovery from an upsetting memory recall, as assessed by post-prime NA_Δ, after being exposed to a photograph of their mother versus a photograph of another participant's mother, $F(1, 69) = 40.80$, $p < .001$, $\eta_p^2 = .37$
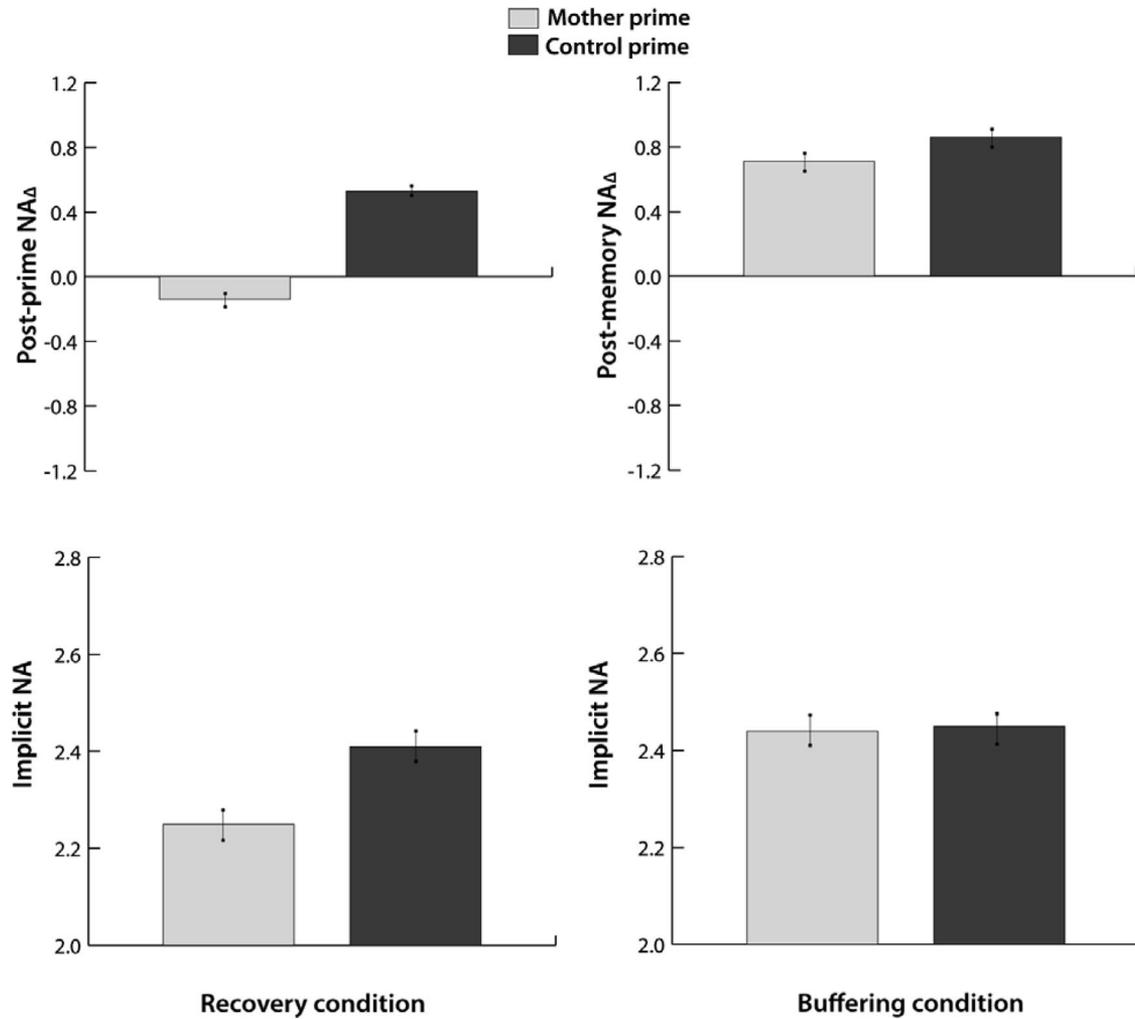
Figure 3. Bars represent post-prime NA_Δ in the recovery condition (top left panel), post-memory NA_Δ in the buffering condition (top right panel), implicit negative affect in the recovery condition (bottom left panel), and implicit negative affect in the buffering condition (bottom right panel) as a function of prime (mother vs. control) in Study 2. Error bars represent 1 *SE* above and below the mean. A NA_Δ score of zero reflects no change in negative affect compared to baseline, a positive NA_Δ score reflects increased negative affect compared to baseline, and a negative NA_Δ score reflects decreased negative affect compared to baseline. NA = negative affect.

(see Figure 3). Furthermore, after the upsetting memory recall, viewing the photograph of one's mother led to lower implicit negative affect than viewing the photograph of another participant's mother, $F(1, 69) = 4.44$, $p = .039$, $\eta_p^2 = .06$.[3]

Buffering hypothesis. As was the case in Study 1, there was no empirical support for the buffering hypothesis. Viewing the photograph of one's mother (vs. another participant's mother) before an upsetting memory recall did not lead to significantly lower negative affect, as assessed by explicit post-memory NA_Δ, $F(1, 67) = 1.83$, $p = .18$, $\eta_p^2 = .03$. Furthermore, there was no statistically significant difference between the mother and control conditions in participants' implicit negative affect in response to upsetting memory recall, $F(1, 67) = 0.025$, $p = .87$, $\eta_p^2 = .00$.

In sum, Study 2 showed that simply viewing the photograph of one's mother (vs. another participant's mother)—in the absence of

explicit instructions to imagine or recall an interaction—enhanced recovery following an upsetting memory recall as assessed by both explicit and implicit measures of negative affect. Because the manipulation in Study 2 did not involve explicit instructions to recall supportive interactions, these findings support the proposition that attachment figures confer regulatory benefits automati-

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[3] Nineteen participants in Study 2 (10 in the buffering condition and nine in the recovery condition) and one participant in Study 3 correctly guessed the purpose of the implicit negative affect measure during debriefing. When the analyses were repeated after removing these participants, the findings remained the same in both Study 2, $F(1, 60) = 3.45$, $p = .068$, $\eta_p^2 = .054$ (recovery condition), and $F(1, 57) = 0.04$, $p = .85$, $\eta_p^2 = .00$ (buffering condition), and Study 3, $F(1, 110) = 2.89$, $p = .092$, $d = 0.32$.

cally, without any conscious effort (Coan, 2008; Sbarra & Hazan, 2008) and suggest that attachment figure reminders, such as simply viewing a photograph of an attachment figure, can be a relatively effortless and efficient way of coping with negative events.

Study 2 also investigated the possibility that recovery effects are due to differential distraction caused by the attachment figure prime. There was no evidence that the attachment prime was more distracting than the control prime as reflected by the latency to respond to unrelated visual stimuli during the priming task. These findings further support the conclusion that the observed effects are due to the attachment representations enhancing affective recovery.

With regards to the buffering hypothesis, Study 2 showed that viewing the photograph of one's mother (vs. another participant's mother) before recalling an upsetting memory did not lead to appreciably lower explicit or implicit negative affect in response to memory recall. Taken together with the Study 1 findings, we found no clear support for the buffering hypothesis using two distinct methods for activating the mental representation of an attachment figure and two distinct instruments for measuring affect. Because the buffering manipulation failed to reliably lessen negative affect elicited by the upsetting memory recall, Study 3 focused only on the recovery hypothesis. (Possible explanations for the absence of support for the buffering hypothesis are explored in the General Discussion.)

Study 3

Study 3 aimed to further investigate the recovery effects induced by activating the mental representation of an attachment figure in a number of ways. Given theory and empirical evidence that romantic partners not only serve attachment functions but also are the prototypical attachment figure in adulthood (e.g., Hazan & Shaver, 1987; Zeifman & Hazan, 2008), Study 3 assessed whether activating partner representations promotes affective recovery following an upsetting memory recall. Because Study 3 required the recruitment of romantic couples, it also ensured an approximately equal number of men and women. Given that past work has sometimes found gender differences in attachment processes (e.g., Del Giudice, 2011; Diamond et al., 2008), Study 3 aimed to test whether the recovery effects, obtained in Studies 1 and 2, whose samples consisted disproportionately of women, occur for both men and women and whether there is a gender difference.

Moreover, a central aim of Study 3 was to examine whether activating the mental representation of one's romantic partner would lessen the tendency to engage in negative thinking. Although research increasingly has investigated the cognitive strategies (e.g., reframing, distancing; Kross & Ayduk, 2011; Ochsner & Gross, 2008) that might reduce negative thinking following a negative event, to date, no study has directly examined the role of attachment figure representations on reducing tendencies for negative thinking. Indirect evidence for this proposition comes from previous research from the terror management theory perspective (Cox et al., 2008) showing that reminding participants of their parent after a mortality salience manipulation leads to lower accessibility of death-related words. Thus, Study 3 investigated whether activating the mental representation of a romantic partner (vs. an unknown other) following an upsetting memory recall

would also reduce subsequent negative thinking in a stream of consciousness task (Kelly & Kahn, 1994).

Finally, Study 3 examined whether the magnitude of recovery elicited by simply viewing the photograph of one's romantic partner would predict mental and physical well-being. It has long been recognized that forming and maintaining close positive and supportive relationships confers protective health benefits (e.g., Diamond & Hicks, 2004; House, Landis, & Umberson, 1988; Ryff & Singer, 2001). One possible way through which attachment relationships contribute to health is by enhancing individuals' ability to cope with upsetting memories. Indeed, prior research suggests that asking people to relive negative autobiographical memories in the laboratory has long-lasting effects, leading to increases in negative thinking and rumination and negative affect even 7 days after the laboratory manipulation (Kross & Ayduk, 2008). Moreover, such rumination and negative thinking in daily life is associated with increased cardiovascular reactivity (Kross & Ayduk, 2008; Ottaviani, Shapiro, & Fitzgerald, 2011) and heightened susceptibility for developing various psychological disorders such as depression and generalized anxiety disorder (e.g., Brewin, 2007; Mathews & MacLeod, 2005; Nolen-Hoeksema et al., 2008) and physical disorders such as cardiovascular disease (e.g., Brosschot et al., 2006; Schwartz et al., 2003). Thus, to the extent that the processes assessed in the laboratory using the AART reflect processes that occur in day-to-day life, individuals who obtain greater recovery effects from the mental representations of their romantic partner should also report better mental and physical health outcomes in daily life. In other words, it was predicted that individual differences in recovery from viewing one's partner's photograph would be prospectively associated with health problems in daily life, with individuals who show the greatest recovery effects in the lab subsequently experiencing fewer health problems.

Method

Participants.   Thirty heterosexual couples who were in a romantic relationship for at least 1 year (range = 12 to 132 months) participated in the study in exchange for monetary compensation. Given findings that "clear-cut" attachment behaviors develop in romantic relationships around a year or so (Zeifman & Hazan, 2008), couples were required to be together for at least 1 year. One couple was excluded from the sample because they withdrew from the study, and one male participant was excluded because his memory cue was not displayed correctly due to an experimenter error, leaving 57 participants in the sample. The mean age of the final sample was 21 years ($SD = 2.84$). The racial composition was 79% Caucasian, 18% Asian or Asian American, and 3% from other ethnic backgrounds.

Procedure and materials.

Overview.   The study consisted of three sessions. In Session 1, participants generated upsetting autobiographical memories and had their photographs taken.[4] Approximately 1 week later participants returned to the lab for Session 2, during which they com-

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[4] In Session 1, participants also completed the short form of the Perceived Relationship Quality Components Inventory (Fletcher, Simpson, & Thomas, 2000; possible range = 1–7; $M = 6.16$, $SD = 0.65$ for females; $M = 6.04$, $SD = 0.64$ for males). Relationship quality did not significantly moderate the effect of prime on outcomes of interest.

pleted the experimental task. Given the increased length of each AART trial due to the addition of the stream of consciousness task (Figure 1C), participants completed one trial in the partner block and one trial in the control block. Finally, approximately 1 to 6 months after completing the experimental task ($M = 14$ weeks, $SD = 8.43$), they completed the health outcome measures.[5] Couple members participated in the sessions independently.

All materials were the same as in Study 2 except for the procedures to obtain the photographs used as prime stimuli in the AART, the specific items of the implicit negative affect measure, and the stream of consciousness task.

Prime manipulation. Participants' photographs were taken at the lab, which offered greater control and standardization over the stimuli used as primes in the AART. Participants posed for a headshot in front of a white background, facing forward to the camera with a neutral expression. To create stimuli used in the AART, we paired couples and created yoked pairs between same-sex participants. Because each yoked pair saw the same faces (i.e., the photograph used as the partner prime for one participant was used as the control prime for the yoked participant), peculiarities in the stimuli were controlled entirely. The priming task was the same as in Study 2.

Implicit negative affect. The implicit negative affect measure consisted of the adjectives used in Study 2 and the adjectives used in the original IPANAT (i.e., *tense*, *helpless*, *inhibited*, *happy*, *energetic*, and *cheerful*, with the latter three items reverse scored). Given that the two measures were moderately to strongly correlated within each gender and priming condition (ranging from .43 to .74) and that the same pattern of findings emerged when they were analyzed separately, a composite implicit negative affect score was computed by averaging across all adjectives. Average Cronbach's alpha across the trials was .83. Participants completed the implicit negative affect measure once in each trial, after the last explicit affect rating.

Stream of consciousness task. After completing the implicit negative affect measure, participants completed a stream of consciousness task (Kelly & Kahn, 1994) as an index of the extent to which negative (vs. positive) thoughts were consciously available. They were asked to write down whatever information was present in their awareness from moment to moment for 5 min. Their transcripts were analyzed using the Linguistic Inquiry and Word Count software (LIWC2007; Pennebaker, Chung, Ireland, Gonzales, & Booth, 2007). LIWC analyzes transcripts with a dictionary-based approach in which each word is coded on various linguistic dimensions. Transcripts were coded for the presence of positive affect and negative affect words. Following Pennebaker, Mayne, and Francis (1997), we computed an affect difference score by subtracting the percentage of positive affect words used in the stream of consciousness task from the percentage of negative affect words. Thus, higher scores indicate greater use of negative relative to positive affect words (referred to hereafter simply as *negative thinking*).

Health problems. Thirty-nine (21 women) of the 57 participants (68%) agreed to complete the health problems measures. Both members of 14 couples completed the measures. For the remaining couples, only one or neither of the members agreed to complete the measures. One couple reported that they had broken up and consequently were excluded from the analyses, reducing the sample size for health problem analyses to 37. This final

sample did not differ from the remainder of the sample on attachment style to their partner or the affective recovery in the partner condition as assessed by post-prime NA_Δ (ps > .34).

The health problem questions were adapted from previous health status inventories (e.g., Veit & Ware, 1983). Participants indicated how many times within the last month they had visited a doctor or other health professional for a physical or emotional health concern ($M = 2.00$, $SD = 3.28$) and how many days within the last month they had missed school or work due to a health problem ($M = 0.76$, $SD = 1.23$). They also indicated whether they currently had any of a total of 14 physical (e.g., persistent pain) or psychological (e.g., persistent anxiety) symptoms ($M = 1$, $SD = 0.91$). Finally, they rated the extent to which physical health or emotional problems interfered with their school/work life or other daily activities (three items; 1 = *all of the time* to 5 = *none of the time*; e.g., "Cut down on the amount of time you spent on work or other activities," reverse scored; $M = 3.77$, $SD = 0.92$) and social activities with family, friends, neighbors, and groups (one item; 1 = *not at all* to 5 = *extremely*; $M = 1.59$, $SD = 0.72$) within the last month. All variables except days missed at school or work had a loading of at least 0.40 on a primary health problems factor. Therefore, a composite health problems score was computed by standardizing and averaging the remaining variables (i.e., number of doctor visits, symptoms, interference with work/school, and interference with social life; $\alpha = .81$).[6]

Data analytic strategy. To account for the interdependency among data points due to participants being nested within couples and couples being nested in yoked pairs, linear mixed models (LMM) were performed in SPSS. First, to test whether the upsetting memory recall induced negative affect, an LMM was performed with explicit post-memory NA_Δ as the dependent variable and couple and yoked couple pair as random variables. In this analysis, the intercept of the equation corresponds to mean post-memory NA_Δ and thus, a test of whether the intercept is significantly different than zero addresses the question of whether the memory recall induced negative affect. Next, to test for the presence of recovery effects, an LMM was performed for each of the main dependent variables, including explicit negative affect (i.e., explicit post-prime NA_Δ), implicit negative affect, and negative thinking. In each of these models, prime (0 = control, 1 = partner,), gender (0 = female, 1 = male), and the prime by gender interaction were entered as fixed variables, and couple and yoked couple pair were entered as random variables. Unless otherwise noted, gender or gender by prime interaction did not reach conventional levels of statistical significance ($p < .05$). The variance component for the yoked couple pair was estimated to be zero for implicit negative affect and negative thinking and .002 ($p = .97$) for explicit negative affect. Hence, this variable was dropped from the final models.

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[5] Neither the main effect of time lag (i.e., time between completing the AART and completing the health problems measures) nor the time lag by recovery interaction was significantly associated with health problems.

[6] Participants also completed a two-item measure assessing how they perceived their overall mental and physical health in the last month (1 = *poor* to 5 = *excellent*). Analyses showed that the perceived health score was not significantly correlated with the health problems score ($r = -.29$, $p = .085$). Thus, we did not include the perceived health measure in the analyses.

Finally, to test whether the magnitude of recovery in the partner condition predicts subsequent health problems, an LMM was performed with health problems as the outcome variable, post-prime NA_Δ in the partner condition as the predictor of interest, and couple as the random variable. Because attachment dimensions and gender have been shown to predict health outcomes (e.g., Kafetsios & Sideridis, 2006; Kiecolt-Glaser & Newton, 2001), these variables were included as covariates in the model.

There is no established method of calculating effect sizes for complex nonindependent designs such as the LMMs used in the present study (Kline, 2004). However, to give the reader a general sense of the magnitude of the effect of the prime on outcomes of interest, we calculated the effect size in units of residual variation, estimated by the full model (see Günaydin et al., 2012). Our estimate of effect size is equivalent to Cohen's *d*, except that we used the residual standard deviation. Specifically, we estimated the effect size using the following formula: $d = $ (estimated $mean_{[partner]}$ − estimated $mean_{[control]}$)/SD_{res}, where SD_{res} is the residual standard deviation—that is, the square root of the error variance.

Results and Discussion

Effect of memory recall on negative affect.   Consistent with Studies 1 and 2, the upsetting memory recall induced negative affect as reflected by a mean post-memory NA_Δ score significantly above zero ($M = 1.06$), $t(28.31) = 7.86$, $p < .001$, $d = 1.08$.[7] Moreover, participants reported greater negative affect in response to the memory recall in the first block of the AART than the second block ($p < .001$). Nevertheless, recalling the same upsetting memory the second time still induced negative affect ($M = 0.74$), $t(28.24) = 5.85$, $p < .001$, $d = 0.83$.

Effect of prime on distraction.   As in Study 2, there was no evidence that the attachment figure prime was more distracting than the control prime as measured by the latency to locate unrelated stimuli during the priming task ($M = 381.13$, $SE = 9.93$ vs. $M = 383.81$, $SE = 9.92$), $F(1, 82.42) = 0.05$, $p = .82$, $d = 0.04$.

Recovery hypothesis.   Supporting the recovery hypothesis, viewing the photograph of one's romantic partner (vs. a yoked participant's romantic partner) after recalling an upsetting memory enhanced recovery from the memory recall as reflected by lower post-prime NA_Δ, $F(1, 82.69) = 41.52$, $p < .001$, $d = 1.21$ (see Table 1). The prime interacted with gender as well, $F(1, 82.69) = $

7.90, $p = .006$. Planned comparisons focusing on the effect of prime type for each gender separately revealed that viewing the partner's photograph (vs. the control photograph) enhanced recovery for men ($M = -0.05$, $SE = 0.18$ vs. $M = 0.59$, $SE = 0.18$; $d = 0.68$) and women ($M = -0.64$, $SE = 0.18$ vs. $M = 1.00$, $SE = 0.18$; $d = 1.73$). However, the partner prime led to lower post-prime NA_Δ for women than men ($p = .02$). Viewing the photograph of the partner (vs. yoked participant's partner) also led to lower implicit negative affect, $F(1, 110) = 2.79$, $p = .098$, $d = 0.31$ (see Table 1), although this effect was not statistically significant at the conventional two-tailed $p < .05$.[8]

Negative thinking.   After recalling an upsetting memory, participants showed lower negative thinking in the stream of consciousness task after viewing the photograph of their romantic partner compared to viewing the photograph of a yoked participant's partner, $F(1, 82.66) = 7.59$, $p = .007$, $d = 0.52$ (see Table 1).

Health problems.   Individuals who experienced greater recovery in negative affect in response to viewing their partner's photograph following an upsetting memory recall reported fewer psychological and physical health problems ($b = 0.26$, $SE = 0.12$, $p = .03$). The effects of gender, attachment anxiety, and avoidance were not statistically significant ($ps \geq .10$).[9] The magnitude of recovery in the control condition was not significantly associated with health problems ($b = 0.09$, $SE = 0.10$, $p = .40$), indicating that the health benefits observed in the partner condition were not simply due to individual differences in the ability to recover from negative affect but due to differences in the effect of partner representations in enhancing recovery.

Overall, Study 3 provided further support for the recovery hypothesis by extending the findings of Studies 1 and 2 to romantic partners. Study 3 also enabled us to test for gender differences in the recovery effect. For explicit affect, although viewing the photograph of the romantic partner enhanced recovery among both men and women, the partner photograph led to greater recovery for women than men. This finding is in line with research showing that women, compared to men, are more sensitive to facial (e.g., McBain, Norton, & Chen, 2009) and relational cues (e.g., Cross & Madson, 1997). Nevertheless, this gender difference should be interpreted cautiously given that there was not support for a similar gender difference with the implicit affect measure. In addition, Study 3 showed, for the first time, that activating the romantic partner representation after an upsetting memory recall led to lower negative thinking and that greater decreases in negative affect in response to viewing the photograph of the partner prospectively predicted experiencing fewer psychological and physical health problems.

Table 1
Mean Explicit and Implicit Negative Affect and Negative Thinking as a Function of Prime (Partner vs. Control) in Study 3

Measure	Condition	
	Partner	Control
Explicit negative affect	−0.35 (0.13)	0.80 (0.13)
Implicit negative affect	2.28 (0.07)	2.45 (0.07)
Negative thinking	−2.77 (0.34)	−1.51 (0.34)

Note.   Standard errors are in parentheses. Explicit negative affect was computed by subtracting baseline negative affect from post-prime negative affect. Negative thinking was computed by subtracting percentage of positive affect words from percentage of negative affect words. For all three measures, higher scores indicate greater negative outcomes.

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[7] SPSS's linear mixed models use Satterthwaite's (1946) approximation to estimate the degrees of freedom associated with the intercept and slopes, resulting in noninteger degrees of freedom.

[8] The degrees of freedom for mean implicit negative affect were larger than the degrees of freedom for explicit negative affect because for implicit negative affect, the variance component for the couple variable was estimated to be zero, and hence was dropped from the model.

[9] When covariates were removed from the model, the results were highly similar, although not significant at $p < .05$ ($b = 0.16$, $SE = 0.11$, $p = .14$).

Study 4

Adult attachment style is expected to relate to the ability of individuals to obtain affect and distress regulation benefits from attachment figures. Thus, Study 4 examined whether the psychological benefits of activating the mental representation of an attachment figure vary as a function of a person's attachment style. Because the statistical power for each of the individual studies to test the interaction between the manipulated variable (prime) and nonmanipulated variable (attachment style) was low (and much lower than the statistical power to test each main effect; see Smith, 2000), a meta-analysis was conducted on the combined data from Studies 1–3. This approach increased the power of the tests and hence provided more reliable estimates of the association between attachment style and the magnitude of recovery effects elicited by the mental representation of an attachment figure.

Method

Procedure and materials.

Adult attachment style. In all three studies, participants completed a 10-item short version of the Experiences in Close Relationships Inventory—Revised (ECR–R; Fraley et al., 2000) developed and validated by Zayas, Mischel, Shoda, and Aber (2011). Participants completed the measure either as part of the online survey (Studies 1 and 2) or at the first laboratory session (Study 3). They were instructed to respond to the items in terms of their relationship with their mother in Studies 1 and 2 and romantic partner in Study 3, and accordingly, the items were modified so that they were appropriate for the particular attachment relationship. Participants responded to five items assessing attachment anxiety (e.g., "I often worry that my mother [partner] does not really love me") and five items assessing attachment avoidance (e.g., "I find it difficult to allow myself to depend on my mother [partner]") on a 7-point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*). The scales showed strong internal reliability (see Table 2 for alphas). Anxiety and avoidance scales were positively correlated (*r*s ranged from .32 to .68, *p*s < .02), in line with previous studies (e.g., Zayas et al., 2011).

Data analytic strategy. To obtain effect sizes for each study, we first computed the difference in negative affect between the prime conditions. For explicit negative affect, post-prime NA_Δ in the attachment figure (mother in Studies 1 and 2 and partner in Study 3) condition was subtracted from post-prime NA_Δ in the

control condition. Thus, higher difference scores reflect greater recovery benefits conferred by the mental representation of the attachment figure compared to the control condition. Similarly, for implicit negative affect, negative affect in the attachment figure condition was subtracted from negative affect in the control condition. Next, for Studies 1 and 2, the correlations between these difference scores and attachment dimensions were computed. Given the nested structure of the data in Study 3, the effect size was estimated by performing two LMMs, one for each attachment dimension, with the standardized difference scores as the dependent variable, standardized attachment anxiety or avoidance score as the fixed factor, and couple as the random factor. By standardizing all variables before entering them into the LMMs, the coefficients produced by the model are akin to standardized coefficients and comparable to the zero-order correlation coefficients computed in Studies 1 and 2. Next, all effect sizes were transformed to *z* scores using Fisher's *r*-to-*z* transformation (Field, 2001; Lipsey & Wilson, 2001; see Table 2 for the transformed effect sizes within each study). Finally, the transformed effect sizes were weighted as a function of the accuracy of the effect size (based on the sample size), and mean effect sizes were estimated using random effects models (Rosenthal & DiMatteo, 2001). Preliminary analyses revealed that in none of the individual studies was the two-way interaction between attachment anxiety and avoidance appreciably associated with the magnitude of the recovery effect (*p*s > .17). Therefore, this two-way interaction term was not included in the meta-analyses.

Results and Discussion

As predicted by attachment theory, the meta-analysis revealed that individuals high on attachment avoidance showed less affective recovery as a result of priming the mental representation of an attachment figure. This inverse association between avoidance and affective recovery was observed for both the explicit (mean effect size = −.18, *p* = .02, 95% CI [−.32, −.03]) and implicit affect measures (mean effect size = −.20, *p* = .03, 95% CI [−.38, −.02]), and it was evident in all studies included in the meta-analyses (Studies 1–3 for explicit affect, and Studies 2 and 3 for implicit affect; see Table 2).

With respect to the association between attachment anxiety and the magnitude of recovery effects, the mean effect sizes did not reach statistical significance (mean effect size = −.10 for explicit

Table 2

Effect Sizes (r) Representing the Associations Between Each Attachment Dimension and Recovery Effects for Studies 1–3

Study		Attachment avoidance					Attachment anxiety				
	n	*M*	*SD*	α	Effect size (explicit NA)	Effect size (implicit NA)	*M*	*SD*	α	Effect size (explicit NA)	Effect size (implicit NA)
Study 1	55	3.12	1.43	.86	−.17		1.88	1.07	.85	−.14	
Study 2	70	2.91	1.41	.88	−.21	−.27	1.84	1.06	.83	−.17	−.41
Study 3	57	2.26	1.02	.76	−.13	−.15	2.32	1.02	.74	.03	.04

Note. Effect sizes refer to Fisher's *r*-to-*z* transformed correlations between attachment dimensions and the magnitude of recovery effect within each study. For explicit affect, recovery effects were computed by subtracting post-prime NA_Δ (negative affect) in the attachment figure condition from post-prime NA_Δ in the control condition. For implicit affect, recovery effects were computed by subtracting implicit negative affect in the attachment figure condition from implicit negative affect in the control condition.

and −.20 for implicit negative affect, $ps > .20$). Post hoc, a meta-analysis on the combined data from Studies 1 and 2, focusing on representations of one's mother, showed a trend in which higher attachment anxiety toward one's mother was associated with smaller recovery effects (mean effect size = −.16, $p = .09$, 95% CI [−.34, .02]). This negative association between attachment anxiety and recovery effect was most clearly evident for implicit negative affect assessed in Study 2.[10]

General Discussion

The inability to effectively regulate negative affect triggered by thinking about distressing experiences has been linked with a variety of emotional and physical health disturbances. Although a growing body of research indicates that attachment figures dampen psychological and physiological distress in response to external stressors, extant research has not examined whether attachment relationships similarly help people cope with internally generated distress. The current research demonstrates, for the first time, that activating the mental representation of an attachment figure enhances affective recovery following an upsetting autobiographical memory recall. Across three studies, simply imagining a supportive interaction with, or viewing a photograph of, an attachment figure (vs. an acquaintance or a stranger) after recalling an upsetting memory enhanced recovery. Affective recovery was reflected by lower negative affect, assessed by explicit measures of phenomenological experience as well as implicit measures of affect that are less susceptible to self-presentation biases, and by lower negative thinking in a stream of consciousness task.

Moreover, individual differences in attachment avoidance (but not attachment anxiety) were associated with less affective recovery effects as observed on both the explicit and implicit affect measures. Given that the meta-analysis afforded high statistical power (e.g., power was .99 to detect a medium-sized association of 0.3), the findings suggest that if anxiety is associated with affect regulation, the effect is small, and a larger sample size would be required to empirically detect it. Overall, these findings are highly consistent with the proposition that individuals with an avoidant attachment style possess mental representations of attachment figures that are less positive (e.g., Baldwin et al., 1993; Zayas & Shoda, 2005) and obtain fewer regulatory benefits from physical contact with attachment figures in stressful situations (e.g., Carpenter & Kirkpatrick, 1996; Coan, 2008). They are also consistent with the idea that attachment avoidance and anxiety are related to affect dysregulation in different ways. Whereas avoidance is more likely to modulate the affect regulation benefits of attachment figures in stressful contexts, anxiety is more likely to modulate affective responses to separation from attachment figures (e.g., Diamond et al., 2008).

Most important, individuals who experienced the greatest recovery after being primed with their romantic partner in the AART subsequently experienced fewer psychological and physical health problems. Most of the work investigating attachment-induced regulation in laboratory tasks has not linked individual differences in these effects to emotional or physical well-being. Thus, the present finding is novel in being the first to show links between a computer-based laboratory task (the AART) designed to assess recovery effects triggered by simply viewing a photograph of one's partner, on the one hand, and reports of actual psychological and physical ailments, on the other.

Implications for Adult Attachment

Attachment theory (e.g., Bowlby, 1982; Mikulincer & Shaver, 2007a) predicts that attachment figures enhance regulation of negative affect triggered by both external and internal stressors. Yet, experimental work has exclusively focused on external stressors. In light of findings from the emotion regulation literature indicating important differences in the regulation of internal (vs. external) stressors (McRae et al., 2012; Ochsner et al., 2009), it is unwarranted to assume that the regulatory benefits of attachment figures would extend to internal stressors. The present work provides the first empirical support for the hypothesis that simply calling to mind an attachment figure is sufficient to reproduce regulatory benefits in response to an internal stressor, thereby addressing an important gap in the attachment literature.

Moreover, the current research has implications for identifying a social cognitive mechanism for the well-documented link between supportive, positive interactions with close others and positive health outcomes in daily life (e.g., Barth, Schneider, & von Kanel, 2010; Diamond & Hicks, 2004; House et al., 1988). The inability to regulate one's affect in response to upsetting memories has been implicated in the development of rumination and various psychological and physical disorders (e.g., Brosschot et al., 2006; Mathews & MacLeod, 2005; Nolen-Hoeksema et al., 2008; Schwartz et al., 2003). Not surprising, then, is the finding that individual differences in the ability to obtain regulatory benefits from activating the attachment figure mental representation predicted emotional and physical health at least 1 month after the experiment. In sum, the present findings aid in understanding the protective health benefits of attachment relationships. Nonetheless, because the current prospective evidence does not show causality, future experimental work building on the present findings is needed.

An important question regarding the generalizability of the current findings is whether the attachment-induced recovery effects are simply due to mental representations of attachment figures being more positive, compared to representations of acquaintances or unknown others. Research shows that mental representations of attachment figures are heavily imbued with positivity (Zayas & Shoda, 2005) and are highly rewarding (Acevedo, Aron, Fisher, & Brown, 2012). Nonetheless, on the basis of the present findings, as well as drawing from past research and theorizing, we believe that the present findings are due to activating attachment representations, rather than simply positivity. Across all three studies, the magnitude of the affect regulation benefits triggered by the attachment figure representation was meaningfully related to adult attachment avoidance within the specific attachment relationship. If the attachment-induced affect regulation benefits were entirely reflecting positivity, the specific associations with avoidance to the attachment figure would not have been observed.

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[10] Meta-analyses were performed to also test whether attachment style was associated with explicit negative affect in the buffering condition (Studies 1 and 2). No significant associations were found (all $ps > .13$).

Moreover, our interpretation is consistent with past theory and research. A body of research across various subdisciplines within psychology using both nonhuman animals and humans (e.g., see Hennessy, Kaiser, & Sachser, 2009; Sbarra & Hazan, 2008, for reviews) points to the affect regulation benefits of attachment figures. For example, in the social cognitive literature, research by Mikulincer and colleagues (Mikulincer et al., 2001) has shown that in stressful contexts exposure to attachment security-related representations restores positive affect, whereas positive, nonattachment stimuli (e.g., a smiling face) do not. In studies investigating the physiological correlates of daily interactions, time spent with romantic partners is associated with down-regulation of the autonomic nervous system and hypothalamic–pituitary–adrenocortical axis activity (e.g., Gump, Polk, Kamarck, & Shiffman, 2001). In the social cognitive neuroscience literature, recent work suggests that interactions with attachment figures are likely to activate oxytocin and opioid neurotransmission (e.g., Coan, 2008; Eisenberger et al., 2011), which is also known to reduce stress reactivity. Critically, such neurophysiological responses are assumed to be easily conditioned to cues associated with the attachment figure (e.g., Depue & Morrone-Strupinsky, 2005; Uvnäs-Moberg, 1998).

Collectively, the present as well as prior findings and theorizing support the conclusion that the regulatory benefits associated with attachment figures are not merely due to positivity. Nonetheless, given research showing that individuals form attachments to inanimate objects (e.g., Van IJzendoorn, Goossens, Tavecchio, Vergeer, & Hubbard, 1983), it would be informative to investigate to what extent other stimuli would also facilitate recovery from negative memories.

Implications for Emotion Regulation

Although the present studies were based on an adult attachment perspective, they also inform the emotion regulation literature in two important ways. First, previous research on affect regulation in response to negative memories has focused on effortful strategies such as reflecting on the event from a self-distanced or observer perspective (Kross & Ayduk, 2011) or reappraising an emotional experience (Gross, 1998). The current findings offer a novel route to facilitating affect regulation in response to an internally generated stressor. That is, simply being reminded of an attachment figure enhanced affect regulation in a fairly effortless, automatic, and spontaneous fashion. As such, this type of affect regulation may be particularly useful for individuals with difficulty in implementing effortful strategies.

Second, some research (e.g., Gross, 1998, 2001) suggests that antecedent-focused strategies, which are implemented preemptively before the emotional response is fully developed, are more effective than response-focused strategies, which are implemented after an emotional response is fully developed and more intense (Sheppes & Gross, 2011; Sheppes & Meiran, 2007). The present work shows that this may not always be the case. In some situations, such as when the stressor is internally generated, activating the mental representation of an attachment figure can facilitate recovery after (but not before) affect has been generated. These findings are consistent with theory and research in emotion regulation showing that a relatively less effortful, more automatic process—such as activating attachment representations by simply viewing the photograph of a loved one—has a greater chance to

down-regulate negative affect after the emotion has been activated (see also Sheppes & Meiran, 2007). As such, the current findings complement the existing work by Gross and colleagues suggesting a process that can be implemented after an emotional response is fully developed. This is important because in daily life people do not always get a chance to regulate their emotions early on as they experience an emotional event, but oftentimes they need to modulate their responses after an emotion is experienced (Gross, Richards, & John, 2006).

The Role of Buffering

One of the aims of the present work was to investigate whether the timing of activating the mental representation of an adult attachment figure affected the ability to regulate negative affect. Whereas activating the attachment figure representation after recalling an upsetting memory consistently led to enhanced affective recovery, activating the mental representation of an attachment figure before recalling an upsetting memory did not appreciably buffer against negative affect. Thus, at least with respect to regulating affect triggered by an internally generated stressor, the timing of activation appears to be crucially important.

One possible reason for the lack of a buffering effect in the present work is that in daily life buffering effects may be manifested in terms of the *frequency* and *manner* with which individuals recall upsetting memories, rather than in lessening the intensity of affective response when the memory is fully relived. That is, in daily life, activating the mental representation of an attachment figure may buffer individuals by minimizing the tendency to recall upsetting memories in the first place. A related possibility is that, when recalled spontaneously in day-to-day life, attachment figure representations may influence how individuals reflect on these events, perhaps affecting whether they adopt a more adaptive perspective (e.g., a self-distanced perspective instead of an immersed perspective; e.g., Kross & Ayduk, 2011).

The present work does not address these possibilities because all participants were explicitly instructed to deeply focus on their feelings and thoughts about the past event. Thus, the frequency of recall was completely controlled. Moreover, the upsetting memory recall task was a very powerful and mentally engaging stressor, thereby reducing potential variation in how individuals may spontaneously reflect on these events. Indeed, affective and cognitive responses to such strong situational cues are difficult to modulate (Meyer & Dalal, 2009), whereas responses to weaker situational cues are influenced by subtle manipulations of temporary mental states as well as chronic individual differences in reappraisal and other strategies. Future work might investigate whether activating the mental representation of an attachment figure would reduce the tendency to think of an upsetting memory and influence the manner in which the memory is recalled.

General Summary and Conclusions

The present research investigated whether mental representations of attachment figures help individuals regulate affect in response to an internally generated stressor such as reliving an upsetting autobiographical memory. Specifically, activating the mental representation of an attachment figure, whether it is one's mother or one's partner, by either thinking about a supportive

interaction with them or simply viewing a photograph of them, helps individuals restore affect to levels experienced prior to the upsetting memory recall and decreases the tendency to engage in negative thinking. These psychological processes captured in the laboratory with the AART, an experimental task designed to assess attachment-related regulation, also appear to be at play in individuals' day-to-day lives. Those individuals who showed the greatest affective recovery were also the ones who reported fewer psychological and physical health problems. Finally, attachment avoidance was associated with weaker recovery effects. Collectively, these findings are the first to document the effect of attachment figures on enhancing recovery following internally generated stressors as well as the short- (i.e., reducing negative thinking) and long-term (i.e., protecting against health problems) consequences of these effects.

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