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**Transforming or restraining rumination: The impact of compassionate reappraisal versus emotion suppression on empathy, forgiveness, and affective psychophysiology**

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### Abstract

We tested the effects of practicing compassionate reappraisal versus emotional suppression as direct coping responses to victims' ruminations about a past interpersonal offense. Participants (32 females, 32 males) were randomly assigned to learn one coping strategy which immediately followed three of six offense rumination trials (counterbalanced). For both strategy types, coping (vs. offense ruminating) reduced ratings of negative emotion, decreased the use of negative emotion language, and reduced tension at the brow muscle (*corrugator EMG*). Only compassionate reappraisal coping (vs. offense rumination) immediately prompted greater empathy and emotional forgiveness toward the offender. Empathy ratings for the first coping trial mediated the relationship between strategy type and empathy ratings for the final rumination trial. Compassionate reappraisal strategy participants increased their empathy toward the offender *while ruminating* at the end of the study. Compassionate reappraisal participants (vs. emotional suppression) described coping (vs. rumination) with more positive language, and also had calmer cardiac pre-ejection period responses.

146 words

Keywords: emotion regulation; empathy; forgiveness; reappraisal; suppression; Stroop; PEP.

**Transforming or restraining rumination: The impact of compassionate reappraisal versus emotion suppression on empathy, forgiveness, and affective psychophysiology**

Theoretical and empirical work in positive psychology has recently addressed how people respond to real-world interpersonal hurts, such as a betrayal or dishonesty, by exploring connections to the emotion regulation literature on suppression, reappraisal, and forgiveness (Witvliet & McCullough, 2007; Witvliet, N. DeYoung, Hofelich, & P. DeYoung, 2011). Our goal in the current experiment is to test effects of learning and practicing compassionate reappraisal for the offender versus suppressing one's experience and expression of negative emotions. Compassionate reappraisal considers the individual responsible for an interpersonal hurt as a *human being* who behaved unjustly, and genuinely wishes for his or her positive transformation in response. Conversely, emotional suppression entails the effort to not experience or express negative emotions while remembering the offender and offense. For example, an individual who experienced relationship betrayal might compassionately reappraise by thinking about that individual as a human whose act of betrayal shows that person's need to undergo a change that will equip him or her to show loyalty. Or, an individual coping through emotional suppression may strive to stifle the experience and expression of feelings of anger, sadness, or other negative emotions that arise when thinking about the person and the betrayal. The current study responds to recent work calling for the evaluation of compassionate reappraisal and emotion suppression as coping responses that immediately follow periods of ruminating about one's offense and offender (Witvliet et al., 2011). This work also responds to theorizing that repeated practice may strengthen the effects of strategies to regulate responses to interpersonal offenses (see Sandage & Worthington, 2010; Worthington & Sotoohi, 2009).

The current experiment tests the effects of practicing a single coping strategy in response to offense rumination, whereas prior research on both compassion and suppression in the forgiveness literature tested *both* strategies *within* individuals (Witvliet et al., 2011). The current study is designed to mimic what people do outside the lab, when only a *single* strategy may be known or available to them, or when an intervention is used in cognitive behavioral therapy. The between subjects methodology is important for testing compassionate reappraisal (unaffected by suppression) and emotional suppression (unchanged by compassion). This design allows us to see ways in which the strategies are similar in contrast to rumination about the offender and offense. It also allows us to evaluate differences between strategies that occur immediately and which emerge over time.

### ***Offense rumination, compassionate reappraisal, and emotional suppression***

Rumination about a past interpersonal offense has been found to increase negative self-reports and facial expressions, heighten skin conductance levels and blood pressure, and accelerate heart rate (Witvliet, Ludwig & Vander Laan, 2001). Additionally, McCullough, Orsulak, Brandon, and Akers (2007) found that salivary cortisol levels were higher when participants self-reported having ruminated more than usual about a real-life offense. Rumination about an anger-provoking laboratory event was also found to generate higher sympathetic nervous system activity and greater cognitive perseveration than reappraisal (Ray, Wilhelm, & Gross, 2008).

Compassionate reappraisal has begun to be examined experimentally. The first study compared compassionate reappraisal to another positive reappraisal strategy focused on benefits (e.g., lessons learned, insight gained, or strengths shown), testing both in contrast to ruminating about an interpersonal offense (Witvliet et al., 2010). While both positive reappraisals increased

positive emotion and decreased negative emotion in comparison to offense rumination, compassionate reappraisal prompted the greatest use of forgiveness and social language in typed narratives, while calming heart rate.

The second experimental study directly compared compassionate reappraisal to emotional suppression and offense rumination (Witvliet et al., 2011), during which participants engaged in each response for two-minute trials. Only compassionate reappraisal increased positive emotions, forgiveness, social language, and facial EMG associated with smiling when compared to rumination about the offense. Compassionate reappraisal also quelled negative emotion ratings and negative word use in typed narratives, similar to the effects of emotional suppression. Indeed, for those engaging in emotional suppression, focusing on the offender and offense while not experiencing or expressing negative emotion effectively reduced negative emotion expressions in ratings, writing, and *corrugator* (brow) EMG, as well as heart rate (Witvliet et al., 2011). Consistent with Dunn et al.'s (2009) adaptive suppression hypothesis, emotional suppression did what it was supposed to do; it simply failed to induce forgiveness and positive emotion.

To summarize, no existing research has tested sympathetic nervous system and cognitive effects of rumination versus compassionate reappraisal and suppression in an offense context. Further, no studies have tested how the effects of ruminations change over time based on the type of coping strategy used. Finally, research has not empirically examined the use of a *single* one of these coping strategies in response to a transgression, which may often be the case in a real-world or intervention environment. Given the emerging literature on emotion regulation in relation to interpersonal transgressions and forgiveness, our aim was to implement an experimental design that would have implications for an intervention environment.

*Empathy and forgiveness*

In the forgiveness literature, empathy holds a central place. Empathy is a common thread from early empirical intervention studies (e.g., Hebl & Enright, 1993) to more recent intervention research (e.g., Sandage & Worthington, 2010). Empathy for the offender plays an essential role in promoting victim forgiveness as a moral response (see Enright, 2001; Enright & Fitzgibbons, 2000; Hargrave, 2001), particularly promoting emotional forgiveness beyond the decision to forgive (Worthington, 2009). In a landmark meta-analysis, state empathy emerged as a strong predictor of forgiveness toward an offender (Fehr, Gelfand, & Nag, 2010).

Building empathy, or compassion, for a transgressor is pivotal for cultivating forgiveness, but it also poses a critical obstacle. Forgiveness is a moral response that needs to address both justice and compassion. In forgiving, people need to tell the truth about the offender and the injustice while transforming unforgiving and retributive responses so they are constructive, prosocial, and can genuinely promote flourishing (Witvliet, 2012). Concerns for victim safety (Gordon, Burton, & Porter, 2004; McNulty, 2010), self-differentiation (Sandage & Jankowski, 2010), self-concept clarity and self-respect (Luchies, Finkel, McNulty, & Kumashiro, 2010) are important for setting the boundary conditions of a *just forgiveness* that is morally grounded, promotes responsible healing, and does not excuse, minimize, or tolerate injustice (Worthington, 2009). Empathy and compassion are responses that are typically directed toward others who are victims deserving of help when one has the resources to assist, according to the appraisal model of Goetz, Keltner, and Simon-Thomas (2010). By contrast, when the victim is oneself, responses are more likely to include sadness, anger, and shame (Goetz et al., 2010). Empirically, rumination about being the victim of an interpersonal offense activated sadness and anger that was significantly decreased by empathic perspective-taking (Witvliet et al., 2001) and

compassion for the human being (the transgressor) whose offense gave evidence of his or her need to experience positive transformation (Witvliet et al., 2011).

Because compassion is more understandably directed toward others who are victims (Goetz et al., 2010), compassion for an offender likely takes practice (Sandage & Worthington, 2010). By contrast, people may more often implement emotional suppression in everyday coping (e.g., stifling one's sadness or anger about an offense in order to comport oneself professionally in a meeting or while teaching). If so, in prior research, suppression may have accrued its benefits in a single trial measure of it (even though compassionate reappraisal still had more forgiveness, positive, and prosocial benefits; Witvliet et al., 2011). The goal of the current study was to test the effects of multiple trials of emotion suppression versus compassionate reappraisal in direct response to rumination, measuring participants' rated, written, embodied, and cognitive responses.

***Do compassionate reappraisal and emotional suppression have cognitive costs?***

While both suppression and reappraisal have been shown to decrease negative emotion associated with an interpersonal offense (Witvliet et al., 2010, 2011), each coping strategy may come with cognitive costs. Suppression often is considered a response-focused coping strategy (Gross, 2007) because it involves trying to dampen down the experience and expression of emotion once it is noticed. Reappraisal often is conceptualized as an antecedent-focused strategy because it involves changing the way one thinks about a situation before an emotional reaction surfaces. Research has shown that suppression, but not reappraisal, impairs memory (Gross, 2007) and leads to depletion of regulatory control compared to free expression of emotion (Inzlicht & Gutsell, 2007).

However, reappraisal does not always occur as an antecedent to the experience of

negative emotions. In real-life experiences, people often employ regulatory strategies like suppression or reappraisal *after* noticing they have had an emotional response they want to change. Similarly, in the current paradigm, participants first ruminate about an interpersonal offense before engaging in a coping strategy. Studies that have measured cognitive costs of reappraising in response to an emotion find that this strategy requires cognitive control and depletes self-control resources more than suppression (Sheppes, Catran, & Meiran, 2009; Sheppes & Meiran, 2008).

Cognitive impairment and depletion can be measured with the Stroop task (Stroop, 1935), which requires the use of selective attention and executive control to override the automatic response of reading a word in an effort to identify the color of the font in which it is printed. Unlike emotional or clinical versions of the Stroop task, which assess general slow-downs that occur when identifying the color of salient emotional or clinical words (i.e., attentional capture), the original color Stroop task requires executive control to resolve conflict that occurs when the word meaning and color are mapped to the same response. Increased Stroop interference (a longer reaction time to name the font color when the word itself is the name of a different color, than when the word names the same color as the font) is seen after cognitively depleting events (e.g., Vohs, Baumeister, & Ciarocco, 2005) and depleting social interactions (e.g., Salvatore and Shelton, 2007). Studies have found increased Stroop interference after engaging in suppression (Inzlicht & Gutsell, 2007) and reappraisal (Sheppes & Meiran, 2008). In the present study, we used the Stroop task to measure cognitive demand after repeated practice of suppression or reappraisal in comparison to rumination about an interpersonal offense.

In addition to measuring Stroop interference, we assessed accuracy rates for the different conditions, as well as reaction times for accurate trials. This allowed us to assess subtle

differences between conditions (such as general speed and accuracy effects or tradeoffs) that may exist even if no difference in the Stroop effect occurred.

***Summary, hypotheses, and analysis plan***

In summary, the aims of this study were to test the effects of learning and practicing either compassionate reappraisal or emotional suppression multiple times as direct responses to offense rumination. Taking seriously the importance of replication, we used ratings, linguistic narratives, facial EMG, and heart rate to build on programmatic research (Witvliet et al., 2010, 2011). To extend what is known, we developed a paradigm to test the practice of implementing a single coping strategy directly after offense rumination, while adding new cardiac and cognitive measures. Participants completed a total of six trials, with three rumination-only trials interspersed with three rumination-then-coping trials (orders counterbalanced). Because cardiac pre-ejection periods (PEP) are measurable within 45 s trials, PEP was assessed as an indicator of sympathetic nervous system activity. This approach provides a new measure that extends what was assessed in previous research using 120 s trials, which were long enough to conduct spectral analysis of heart rate variability to assess parasympathetic activity (Witvliet et al., 2010, 2011). We also extended the literature by testing cognitive effects of rumination, reappraisal, and suppression with the Stroop (1935). We used the color Stroop, rather than other versions of the task (e.g., to measure attentional capture to emotionally salient words), because our goal in this study was to assess whether rumination and coping deplete executive functions (e.g., resulting in decreased ability to resolve response conflict).

The first set of analyses focused on ratings of empathy, forgiveness, and subjective emotion for the first trial of rumination versus coping (with order counterbalanced). We hypothesized that compassion would induce empathy and emotional forgiveness immediately,

within its first 45 s trial (vs. the rumination trial). We hypothesized that both coping response types would immediately subdue negative emotion compared to rumination. The second set of analyses tested emotional changes from the first to the third coping trial by strategy type; we hypothesized that both strategies would continue to move emotion from the negative end of the valence spectrum to neutral, and that arousal ratings would decrease. The third set of analyses addressed changes in emotions associated with early versus late rumination periods by strategy type. We hypothesized that both strategy types would be associated with reduced negativity and arousal over time. Although this has not previously been tested, we predicted that participants who learned to engage in compassionate reappraisal of the offender (versus emotional suppression of their responses to the offender) would be more likely to increase their empathic perspective-taking of the offender while ruminating later in the study.

The fourth set of analyses assessed the descriptions participants wrote about their experiences while ruminating or coping. Participants described their thoughts, feelings, physical responses, and what they wanted to say or do to their offender. We predicted that for both strategy types, coping would be associated with fewer negative emotion words. However, we predicted that compassionate reappraisal coping (versus suppression coping) would prompt larger increases in positive emotion word use compared to offense rumination (Witvliet et al., 2010, 2011).

The fifth major set of analyses examined psychophysiological variables and drew on findings from the subjective emotion analyses. If rumination emotions were found to change significantly from the beginning to the end of the study differently for the two groups, then physiological analyses would assess reactivity for the purest rumination trial participants experienced (i.e., before the introduction of a coping strategy). The design allowed us to capture

pure rumination reactivity by measuring physiological data continuously. All physiology reactivity measures subtract out the particular trial's baseline responses, which reduces the risk of overall habituation effects. Based on Witvliet et al. (2011), we predicted that coping would decrease *corrugator* reactivity (i.e., brow muscle tension) and heart rate versus rumination, and we tested whether suppression would show a stronger effect (Witvliet et al., 2011) when repeatedly practiced as the only strategy. We predicted that PEP would also be slower for coping, testing whether one strategy type was associated with a calmer sympathetic nervous system response.

The sixth set of analyses assessed Stroop interference as an executive functioning indicator, while also examining accuracy rates and speed of responses as subtle indicators of cognitive demand. The experiment was designed to assess these responses for rumination early in the study—before any significant changes to rumination ratings—in comparison to the learned coping strategy. Against the backdrop of mixed cognitive effects in a range of paradigms, some evidence found reappraisal to be more cognitively taxing than suppression (Sheppes et al., 2009; Sheppes & Meiran, 2008), leading us to predict similar patterns.

## **Methods**

### ***Participants***

Sixty-four introductory psychology students (32 men, 32 women) completed the experiment as one way to meet a research requirement. Participants were an average of 19.24 years old ( $SD = 3.57$ ). Of the participants, 54 were European-American, 3 were Asian-American, 2 were African-American, 1 was multi-ethnic, and 2 had missing data.

### ***Design***

This study used a mixed experimental design, in which participants were randomly assigned to

learn and practice one of two possible coping strategies (between subjects treatment conditions), each of which was contrasted with offense rumination-only trials using repeated measures. Specifically, participants were randomly assigned either to learn how to compassionately reappraise their offender or to suppress their experience and expression of negative emotions about the offense and offender. We did not use a control group, such as participants who ruminated for the same number of trials without any coping.

Unlike other repeated measures research in which every participant ruminated, reappraised, and emotionally suppressed with regard to an interpersonal offense (Witvliet et al., 2011), the current participants ruminated and coped using one strategy: either compassionate reappraisal or emotional suppression. Furthermore, whereas participants in earlier research were assessed during their single use of each coping strategy, with relaxation periods between rumination and coping (Witvliet et al., 2011), the current study's participants had three coping trials that immediately followed half of the rumination trials. This allowed us to assess the effect of practiced coping.

Participants completed six trials. Each trial was comprised of a pre-trial baseline followed by a period in which participants ruminated about a past real-life offense. On three of the six trials, offense rumination led directly into a 45 s period of coping. Coping was always preceded by offense rumination periods so that these strategies would be engaged as a response to rumination, reflecting how these coping strategies are employed outside the laboratory.

Each pretrial baseline served to relax the participant and clear his or her mind before the subsequent rumination or rumination-then-coping induction. The pretrial baseline was also important for determining the physiological effects of each experimental condition; we calculated changes that occurred as participants went from pretrial baseline to rumination or

rumination-then-coping. (We did not measure self-reports after each pretrial baseline period because this would induce movement-related physiological reactivity that could decrease the accuracy of experimental condition effects).

Trial orders were counterbalanced across participants. Half of the participants (including equal numbers of men and women) were randomly assigned to proceed through six trials in the following order: ruminate, ruminate-cope, ruminate-cope, ruminate, ruminate-cope, and ruminate. The other half were assigned to proceed in this order: ruminate-cope, ruminate, ruminate, ruminate-cope, ruminate, and ruminate-cope. The first two trials in each order included an *early rumination* trial (first instance of rumination) or *early coping* trial (first instance of ruminate-cope). Coping that occurred in the last two trials comprised the third use of the coping strategy and is thus referred to as *practiced coping*.

In order to accommodate repeated trials within a 90-minute paradigm, we set the duration of pretrial relaxation periods to 60 s of measurement, and we set each rumination period and each coping period to 45 s of measurement. This duration is too short to measure heart rate variability (HRV) to assess parasympathetic responding (Witvliet et al., 2010, 2011). Rather, cardiac pre-ejection periods were measured to assess sympathetic nervous system activity.

### ***Procedure***

Procedures adapted Witvliet et al.'s (2010, 2011) paradigm in order to create multiple trials and to incorporate additional cardiology and Stroop measures. Participants individually gave informed consent and were tested. The participant sat in a stationary recliner in front of a flat screen monitor as electrodes and physiological recording devices were applied using standard methods. Each physiology variable was monitored from an adjacent room and tested for clear and reliable signals before beginning a period of baseline relaxation and a practice Stroop task.

Subsequently, the participant completed a questionnaire, identifying and describing a particular offense in which another person hurt and offended him or her in real-life. This interpersonal offense was the basis for all subsequent rumination and coping conditions. Upon study completion, physiological devices were removed, and participants were debriefed.

### *Stimulus materials*

We used published stimulus materials (Witvliet et al., 2011). A tone signaled participants to open their eyes and read the relevant 30 s computer screen display of instructions for the pre-trial baseline relaxation, offense rumination, compassionate reappraisal, or emotional suppression. Participants were instructed to close their eyes for all relaxation, rumination, and coping trials.

Pretrial relaxation baseline instructions guided participants to quietly rest in the chair and keep their arms, legs, and body still as they sat, relaxed, and thought the word “one” whenever they naturally breathed out.

Offense rumination instructions guided participants to think about the person who hurt them and all the ways that this offense was hurtful to them. They were instructed to remember what happened, and the thoughts, feelings, and physical reactions they had. They also thought of all the ways that they were affected by the hurtful experience.

Compassionate reappraisal instructions guided participants to think of the offender as a *human being* whose offense behavior was bad. Even if the relationship could not be restored, participants were to try to genuinely wish that this person would undergo a positive transformation or healing experience. Even if it was difficult, participants were encouraged to focus their thoughts and feelings on giving a genuine gift of mercy or compassion.

Emotional suppression instructions were to think about the offender and the offense. At the same time, participants were to try not to become emotional about the experience and to try

not to show any outward expression of feelings they might have. As they thought about the offender and offense, if they noticed any negative emotions, they were encouraged to try not to feel or show them.

### ***Self-reports***

#### *Empathy, Forgiveness, and Emotion Ratings*

Each participant privately recorded his or her ratings via a computer after giving informed consent and then after completing each rumination or rumination-then-coping trial. SuperLab software was used to present ratings in random orders. Participants used a Biopac RB-730 response-pad with a seven-point scale, rating their emotional valence (1 = negative to 7 = very positive) and the degree to which they experienced arousal, empathy, and heartfelt forgiveness toward the offender (1 = not at all to 7 = completely).

#### *Analyses of written responses: Linguistic Inquiry and Word Count (LIWC)*

Written responses were measured for the middle trials of rumination and rumination-then-coping conditions (which were in the opposite order for half of the participants). Participants typed into a laptop their responses to four questions about what they were *thinking*, what they were *feeling*, their *physical reactions* during imagery, and *what they would do or say to their real-life offender* (Witvliet et al., 2010, 2011).

Linguistic Inquiry and Word Count software (LIWC2007 Windows v 1.12; Pennebaker, Booth, & Francis, 2007) counted the number of words in submitted texts that matched pre-defined dictionaries. We used the standard LIWC2007 English dictionary containing categories for positive emotion and negative emotion.

### ***Physiology<sup>1</sup>***

Throughout all pretrial relaxation baselines, rumination, and coping trials, we continuously

measured physiological responses with standard methods (Biopac MP150 and Acqknowledge 3.9 software for the Macintosh). We measured covert facial muscle activity relevant to emotion using standard electromyography (EMG) methods at the *corrugator supercilii* (brow) muscle responsive to valence (Witvliet & Vrana, 1995). We used electrocardiography (ECG) to obtain R-R (beat-to-beat) interval data and calculate heart rate. We also measured impedance cardiography in order to determine pre-ejection period (PEP) data. PEP is calculated through the measurement of cardiac bioimpedance, comparing the timing of locations on the derivative of that curve to their counterparts on a measurement of ECG. PEP was assessed as a cardiac indicator of sympathetic nervous system activity, associated with the fight or flight response.

Physiological reactivity data for each condition were calculated as change from each condition's pretrial baseline to the subsequent imagery trial (Witvliet & Vrana, 1995; Witvliet et al., 2001, 2010, 2011). The physiological data were calculated for the last 45 s of the pre-trial relaxation baseline, and for every 45 s offense rumination or coping strategy imagery trial. Pre-trial baseline values were based on the final 45 s of each pre-trial baseline to equalize durations and to ensure a calm pre-trial baseline comparison. To determine change from pre-trial baseline, physiological values from this 45 s period were subtracted from the raw physiological values for the 45 s offense rumination and 45 s coping strategy trials. This standard procedure enables the reader to see whether increases or decreases from baseline occurred. The *Explore* function of SPSS 15.0 was used to identify and remove statistical outliers that may have been caused by technological difficulties with the apparatus, electrical noise, or movement artifacts.

### ***Stroop***

The Stroop task we used was selected as a partial replication of the Stroop used in related research by Gehring, Himle, & Nisenson (2000). It consisted of 72 trials of randomly presented

words in red or blue ink. Words had an equal probability of being congruent (“red” appeared in red ink), incongruent (“blue” appeared in red ink), or neutral (“brown” or “green” appeared in a blue or red font). Because red and blue were the only font response options, neutral words would not be facilitated by the word name and font color matching (as on congruent trials), nor would they cause interference from the word name and font color describing conflicting response options (as on incongruent trials). Words were presented for 175 ms, followed by a fixation period for at least 1500 ms between words. Responses were made with the right (dominant) index and middle finger using a response pad. A practice Stroop occurred prior to the start of the experiment session so that participants could learn the task, and so that we could ensure the groups both showed expected Stroop interference and had similar accuracy rates. The Stroop task was presented four times in the experiment, after both early and late rumination and coping periods (the first two blocks and the last two blocks of the study).

Percent accuracy was calculated for each imagery period. Reaction time (RT) was calculated after removing incorrect trials. Stroop interference (referred to as the Stroop effect) was assessed for each imagery period by subtracting each participant’s median RT for congruent trials from their median RT for incongruent trials. Longer RTs on incongruent trials reflect the increased difficulty of selectively attending and responding to the font color when the word does not match it, because readers have to override the prepotent tendency to read the color named by the word in order to respond correctly in identifying the color of the font.

### *Statistical analysis*

The first three sets of analyses on subjective ratings were conducted using mixed ANOVAs for coping and rumination within participants  $\times$  Strategy Type (compassionate reappraisal vs. suppression coping) between participants. The fourth set of analyses assessed LIWC emotion

word counts using mixed ANOVAs testing the Coping Effect (rumination vs. coping) within participants  $\times$  two Coping Strategy Groups (compassionate reappraisal vs. suppression) between participants. Emotion ratings are reported below and in Table 1 and in Figures 1, 2, and 3. LIWC results are reported below and in Figure 4.

Ratings results indicated that rumination changed differently across coping strategy types. Thus, we conducted the fifth set of analyses using physiological reactivity for the pure rumination trial (before learning a coping strategy) and compared this to reactivity for the learned coping trial. Data were analyzed with mixed ANOVAs for coping and rumination within participants  $\times$  Strategy Type (compassionate reappraisal vs. suppression coping) between participants. The sixth set of analyses for Stroop data similarly used a mixed ANOVA for coping and rumination within participants  $\times$  Strategy Type (compassionate reappraisal vs. suppression coping) between participants. We conducted analyses which ensured that baseline practice trials showed equivalent Stroop interference effects and accuracy using between group tests.

The physiological and Stroop means (standard deviations),  $p$  values,  $F$  values, and partial  $\eta^2$  values are reported in Table 2.

## Results

### *Ratings of empathy, forgiveness, and emotion*

We conducted analyses to answer three questions about the ratings (Table 1 reports the means and SDs). First, *at the earliest measurement periods, did coping strategies differ compared to rumination?* To investigate this, we used mixed ANOVAs for Condition (early coping and rumination) within participants  $\times$  Strategy Type (compassionate reappraisal vs. suppression coping) between participants. After only 45 s of compassionate reappraisal, participants showed significant Condition  $\times$  Strategy Type interactions for both empathy,  $F(1,$

62) = 8.33,  $p = .005$ , partial  $\eta^2 = .12$ , and emotional forgiveness,  $F(1, 62) = 4.58$ ,  $p = .036$ , partial  $\eta^2 = .07$ . Only compassionate reappraisal learners showed significantly higher empathy and emotional forgiveness while coping versus ruminating on the first trial, empathy Condition  $F(1, 31) = 14.56$ ,  $p < .001$ , partial  $\eta^2 = .32$ ; emotional forgiveness Condition  $F(1, 31) = 4.77$ ,  $p = .037$ , partial  $\eta^2 = .13$ . The early empathy effect is evident in Figure 1, whereas emotional forgiveness is depicted in Figure 3. A main effect showed that compared to rumination, early coping shifted valence ratings from negative to neutral emotion, Condition  $F(1, 62) = 5.22$ ,  $p = .026$ , partial  $\eta^2 = .08$ . Arousal tests were not significant,  $F_s(1, 62) \leq 2.30$ ,  $p_s \geq .14$ , partial  $\eta^2_s \leq .04$ .

Second, *did ratings for the coping trials change from the earliest to the latest measurement period?* We used mixed ANOVAs to investigate Coping Practice (early vs. late coping) within participants  $\times$  Strategy Type (compassionate reappraisal vs. suppression coping) between participants. We found a main effect of Strategy Type, in which compassionate reappraisal (vs. suppression) learners gave higher empathy ratings,  $F(1, 62) = 5.41$ ,  $p = .023$ , partial  $\eta^2 = .08$ . The significant effects on empathy and emotional forgiveness reported for early trial coping reported above remained constant, with no change over time, Coping Practice and Coping Practice  $\times$  Strategy Type  $F_s(1, 62) \leq 0.19$ ,  $p_s \geq .67$ , partial  $\eta^2_s \leq .003$ . However, both strategies showed Coping Practice main effects, shifting emotional valence ratings from negative to neutral,  $F(1, 62) = 6.92$ ,  $p = .011$ , partial  $\eta^2 = .10$ ; and reducing arousal ratings  $F(1, 62) = 21.29$ ,  $p = .000$ , partial  $\eta^2 = .26$ .

Third, *how did ratings for the ruminating trials change from the earliest to the latest measurement period?* To answer this, we used mixed ANOVAs with Repetition (early offense rumination, late offense rumination) within participants  $\times$  Strategy Type (compassionate reappraisal vs. suppression coping) between participants. Main effects of repetition showed that

late rumination was associated with emotional change, which included lower arousal,  $F(1, 62) = 25.19, p \leq .001$ , partial  $\eta^2 = .29$ , and valence that became less negative,  $F(1, 62) = 15.20, p = .000$ , partial  $\eta^2 = .20$ .

Figure 1 shows the significant Rumination Repetition  $\times$  Strategy Type interaction,  $F(1, 62) = 12.56, p = .001$ , partial  $\eta^2 = .17$  for empathy ratings. Specifically, participants who learned the compassionate reappraisal strategy (vs. the emotion suppression strategy) reported increased empathy for their offender *during late versus early offense rumination*,  $F(1, 31) = 20.04, p \leq .001$ , partial  $\eta^2 = .39$ . [Indeed for compassionate reappraisal learners, the final rumination versus final coping trial prompted statistically equivalent empathy levels,  $F_s = 0.01, p = .92$ , partial  $\eta^2 = .00$ .]

As shown in Figure 2, an auxiliary mediation analysis was conducted using bootstrapping analysis with PROCESS (Hayes, 2012) to examine the indirect effect of strategy type on final rumination trial empathy ratings via the initial coping trial empathy ratings. This model was conducted with 5000 bootstraps and yielded a bootstrap estimate of the indirect effect through the mediator of 0.12. The 95% confidence interval did not include 0 [.01, .28]. Further, the significant direct effect between coping strategy used and empathy at the final rumination trial was no longer statistically significant with inclusion of the mediator (initial coping trial levels of empathy) in the analysis. Thus, this analysis suggests that empathy ratings for the first coping trial mediated the relationship between strategy type and empathy ratings for the final rumination trial.

### ***Linguistic inquiry and word count (LIWC2007)***

To assess emotion through written responses, participants typed descriptions of what they were thinking, feeling emotionally and physically, and what they wanted to say or do to their offender,

both after offense rumination and after coping mid-study. The responses participants typed in this study were an average of 36 words long, substantially fewer words than in other studies that requested responses to longer imagery periods (51.4 words in Witvliet et al., 2011; 61.8 words in Witvliet et al., 2010).

As shown in Figure 4, written responses showed that participants used fewer negative emotion words after coping than ruminating, Coping  $F(1, 61) = 15.81, p \leq .001$ , partial  $\eta^2 = .21$ . Positive emotion word counts, however, showed a Coping  $\times$  Strategy Type interaction,  $F(1, 61) = 8.07, p = .006$ , partial  $\eta^2 = .12$ . Only compassionate reappraisal coping increased positive emotion language use,  $F(1, 31) = 21.77, p = .001$ , partial  $\eta^2 = .41$ . [Suppression coping did not differ from rumination in the number of positive emotion words,  $F(1, 31) = 2.05, p = .16$ , partial  $\eta^2 = .06$ .]

### ***Physiology***

Analyses addressed the research question of how learning a coping strategy influenced physiological reactivity compared to offense rumination. Because ruminations changed over time, showing unique compassion effects, we compared physiological reactivity from pretrial baseline for pure rumination trials to reactivity for learned coping trials.<sup>2</sup> We did not hypothesize that the two randomly assigned groups would differ when conditions were collapsed, and no significant effects occurred for any of physiological measures (all  $F_s \leq 2.39, p_s \geq .13$ , and partial  $\eta^2 \leq .05$ ).

Table 2 shows a general Coping Effect, such that coping trials were associated with significantly less reactivity for both *corrugator* EMG and heart rate. However, cardiac pre-ejection period (PEP) data showed a significant Coping  $\times$  Strategy Type interaction. Specifically, compassionate reappraisal (vs. rumination) tended to show less reactivity on this indicator of

sympathetic nervous system innervation of the heart,  $F(1, 21) = 3.32, p = .08$ , partial  $\eta^2 = .14$ , whereas suppression did not.

### *Stroop*<sup>3</sup>

Before reporting the Stroop effect results, we first report participants' accuracy rates. The analyses for Stroop data revealed that overall accuracy in the Stroop task was high, with a mean of 96.6% across all blocks. As expected from previous demonstrations of the Stroop effect (e.g., Stroop, 1935; MacLeod, 1991), accuracy was lower for incongruent trials (95.12%) compared to congruent (97.44%) and neutral trials (97.17%),  $F(1, 120) = 17.53, p < .001$ , partial  $\eta^2 = .23$ . After removing the error trials, we calculated and compared the magnitude of Stroop interference (i.e., the Stroop effect) across participants and blocks.

As shown in Table 2, the expected reaction time Stroop effect was found across coping strategies and blocks,  $t(121) = 4.71, p < .001$ . However, the magnitude of the Stroop effect after early rumination did not differ by condition or coping strategy. This means that offense rumination and coping across strategy types were associated with typical Stroop effect results.

Given that no Stroop effect differences occurred between conditions and groups, we examined other measures of subtle cognitive demands, namely accuracy and reaction time. Compassionate reappraisal was associated with lower accuracy on the Stroop ( $M = 94.8\%$ ) than practiced suppression ( $M = 97.1\%$ ),  $t(181) = 3.27, p = .001$ . Furthermore, across trial types with accurate responses, reaction times showed a Coping  $\times$  Strategy Type interaction. Specifically, compassionate reappraisal and suppression produced changes from offense rumination in opposite directions, leading to an interaction (see Table 2). While practiced suppression (vs. early rumination) led to faster responses on both congruent and incongruent trials (but not neutral trials), practiced compassionate reappraisal (versus early rumination) led to slower responses on

these trials (see RT means in Table 2). Together these results suggest that the slower RTs for compassionate reappraisal indicated increased difficulty with the task, rather than the adoption of a more cautious response strategy (i.e., they did not slow down to be more accurate). Overall, results suggest that compassionate reappraisal was associated with subtle cognitive demands rather than executive control impairment.

### **Discussion**

The purpose of this experiment was to test whether practicing *compassionate reappraisal for an offender* or *suppressing one's negative emotions about an offender* had similar or different effects on empathy for the offender, forgiveness of the offender, and emotion-regulation variables. Our aim was to discover which ratings effects would emerge quickly and which would develop with repeated practice of the strategies.

Overall, participants using either of these randomly assigned strategies showed similar results related to reductions in negative emotion and arousal. However, significant differences between the two coping strategies emerged for empathy, forgiveness, and positive emotion. With coping strategies placed immediately after ruminations, this design showed that learning compassionate reappraisal of an offender can change empathy for the offender when later ruminating about the hurtful offense. The two coping strategies also produced different responses for a cardiac response and for measures of subtle cognitive demands.

The current work responds to theoretical developments in forgiveness and emotion regulation research. Our focus on empathy follows a recent meta-analysis in which a strong predictor of granting forgiveness was a state of empathy for the offender (Fehr et al., 2010). The current study design allows us to assess empathy not only when using compassionate reappraisal and emotion suppression, but also during ruminative memories of the offender, early and late in

the study. Previous research on interpersonal offense rumination, emotional suppression, and compassionate reappraisal called for experimentation. Specifically, it was important to test hypotheses that changes associated with learning both coping strategies would be found in participants who repeatedly coped (Sandage & Worthington, 2010; Worthington & Sotoohi, 2009) using only one strategy in direct response to rumination rather than as a stand-alone condition (see Witvliet et al., 2011). Because our goal was to compare randomly assigned compassionate reappraisal to emotion suppression patterns, we did not compare these strategy types to a control condition (e.g., a group of participants who ruminated for all six trials without using any coping strategy). Thus, we only draw conclusions about the strategies in comparison to each other as a between subjects factor interacting with repeated measures conditions such as coping versus rumination or repetitions of coping or ruminating.

***Strategy similarities for compassionate reappraisal and emotional suppression***

Half of the participants practiced compassionate reappraisal of the offender as a human being whose offense demonstrated his or her need to experience positive or healing transformation. The other half practiced emotional suppression by thinking of their offense and offender, but trying not to feel or show negative emotions.

When compared with ruminating about one's offender and offense, both strategies immediately down-regulated negative emotion ratings (see the first trials, Table 1). Linguistic analyses (depicted in Figure 4) show that across strategy type, participants similarly reduced their use of negative emotion words when describing their experiences of coping versus ruminating in the middle of the study. By the end of the study, both coping strategy types not only reduced the negative valence of emotion, but also decreased arousal ratings. These ratings and linguistic effects are consistent with results found by Witvliet et al. (2011).

Physiologically, both coping strategies significantly reduced *corrugator EMG* (i.e., brow muscle tension) and heart rate in comparison to offense rumination trials (see Table 2). These patterns are consistent with basic emotion research using an imagery paradigm, which found more reactive *corrugator EMG* for conditions characterized by negative (versus positive) emotional valence, and greater heart rate reactivity for conditions with high (versus low) arousal (Witvliet & Vrana, 1997).

Finally, Stroop interference effects occurred for all conditions, and the two strategies (vs. rumination) did not differ statistically (see Table 2). This suggests that the coping conditions were not cognitively depleting (e.g., Vohs, Baumeister, & Ciarocco, 2005), in contrast to prior research associating suppression (Inzlicht & Gutsell, 2007) and reappraisal (Sheppes & Meiran, 2008) with increased Stroop interference.

### ***Differences between compassionate reappraisal and emotion suppression***

Interactions between the strategy type participants used (compassionate reappraisal vs. suppression coping) and their repeated measures conditions contribute to what is known about how quickly empathy and forgiveness effects emerge, differences in positive emotion, and changes to the cardiac response and subtle cognitive demands. Only compassionate reappraisal learners immediately showed significantly higher levels of empathy and forgiveness while coping rather than ruminating (Figures 1 and 3). Furthermore, these changes were maintained throughout the study (Table 1). These results demonstrate that transformations of empathy and forgiveness emerged despite briefer compassionate reappraisal trials than prior work (Witvliet et al., 2010, 2011).

Mid-study, participants described what they had been thinking, feeling, how their body had responded, and what they would say or do to the offender. Linguistic analyses showed

significantly more positive emotion words for compassionate reappraisal coping vs. offense rumination. As can be seen in Figure 4, only compassionate reappraisal coping prompted a significant increase in positive emotion words—as many positive emotion words as rumination had negative emotion words.

By the end of the study, *rumination* was also transformed in compassion learners (Figure 1, Table 1). Compared to their early rumination ratings, compassionate reappraisal learners changed the way they ruminated, reporting that they had more empathy for the offender *while ruminating at the end of the study*. Transformation of rumination was so potent that the final rumination and compassion trials had statistically equivalent levels of empathy. The auxiliary mediational analysis (Hayes, 2012) demonstrated that participants' empathy ratings after the first experience of coping mediated the relationship between coping strategy type and their empathy ratings when ruminating at the end of the study (Figure 2). This is the first study to show that when interspersed with episodes of compassionate reappraisal, rumination can take on some of the benefits offered by compassionate reappraisal.

This finding is consistent with recent research demonstrating that initial instructions to reappraise a photograph can produce lasting emotional and neural effects that persist in later encounters with the same stimulus (MacNamara, Ochsner, & Hajcak, 2011). Such results have implications for clinical therapies, suggesting that imaginal exposure with reappraisal can be combined in ways that transform one's empathic response to subsequent ruminations about an offender. It will be important to replicate the findings from the current study with other populations to determine whether samples varying in spiritual, religious, socioeconomic, academic, and age-related characteristics can also experience immediate compassionate reappraisal increases in empathy for an offender, which mediate empathy responses to later

ruminations about the offense.

As the first study to measure cardiac sympathetic nervous system control for emotion regulation in relation to forgiveness, we found that only compassionate reappraisal tended to increase the duration of the cardiac pre-ejection periods compared to offense rumination. This is consistent with prior research finding increased sympathetic activations during rumination, but not during reappraisal (Ray et al., 2008). Other studies have shown that compassionate reappraisal had equivalent levels of parasympathetic activity compared to relaxation (Witvliet et al., 2010, 2011). However, the present study indicates that compassionate reappraisal may buffer against the potentially harmful sympathetic nervous system activations of the heart during offense rumination.

We found that the Stroop effect was similar across conditions and groups, indicating that this measure of executive control was not differentially affected by the ways in which participants thought about their offenders. Rather, compassionate reappraisal showed two subtle cognitive demand effects. First, practiced compassionate reappraisal was associated with lower accuracy rates than practiced suppression. Second, on accurate trials, practiced compassionate reappraisal (vs. rumination) had longer reaction times, whereas emotional suppression showed the opposite pattern. Thus, compassionate reappraisal incurred subtle cognitive costs that were not evident for emotional suppression.

### ***Conclusions***

Forgiveness theory emphasizes the importance of responding to injustice in a moral way that maintains the humanity of the wrong-doer without ignoring or minimizing the wrong-doing (e.g., Luchies et al., 2010; McNulty, 2010; Worthington, 2009). Thus, forgiveness involves a combination of truth-telling and transformation, which is important for compassion-rooted and

responsible forgiveness that can contribute to the flourishing of the forgiver, the offender, and community (Witvliet, 2012; Worthington, 2009). A victim who forgives ideally will see the veracity of the offender's culpability and also see the offender's complex humanity; a forgiving victim ideally will neither totalize the offender's identity in terms of the offense nor minimize the importance and implications of the injustice. Compassionate reappraisal recognizes that the victim is in a unique position to see the offense as evidence of the offender's need for learning, growth, change, and/or healing.

Evidence from the current study associated compassionate reappraisal with immediate increases in empathy and forgiveness that occurred with even shorter trial durations than other research (Witvliet et al., 2010, 2011). Extending prior research, the current study found that empathy at the initial coping trial mediated the relationship between coping strategy type and empathy ratings for the offender during the final offense rumination trial. Importantly, by learning to practice compassion in response to painful offense ruminations, *ruminations themselves changed to become more empathic toward the offender*. These findings illuminate an effective way to induce a state of empathy for one's offender while using a strategy that holds the offender accountable for the wrongdoing. Thus, results from the current study provide an important contribution to the literature recognizing empathy as a strong predictor of forgiveness (Fehr et al., 2010), and the literature emphasizing the importance of justice in considerations of forgiveness (e.g., Luchies et al., 2010; McNulty, 2010; Worthington, 2009).

Forgiveness has been theorized to involve self-control, which may involve the restraint of unforgiving emotions and motivations (Worthington & Sotoohi, 2009). In the current experiment and one other study, emotional suppression of negative offense-related emotions de-escalated negative and aroused emotions without increasing forgiveness or positive language responses

(Witvliet et al., 2011). Thus, emotional suppression appears to have a subduing effect on negative emotion consistent with Dunn et al.'s (2009) adaptive suppression hypothesis.

We cautiously raise implications for clinical interventions. Past research suggested that reappraising an interpersonal hurt by either cultivating compassion for the offender or finding benefits in the situation had positive effects after 120 s periods (Witvliet et al., 2010). Research also suggested that compassionate reappraisal induced positive changes, whereas emotional suppression provided negative reinforcement through the alleviation of negative subjective and physiological responses (Witvliet et al., 2011). The current study suggests that, if replicated in other populations, there may be benefits for intervention sessions that intersperse imaginal exposures to offense memories with exposure immediately followed by compassionate reappraisal.

Future research may fruitfully address whether the differences between suppression and reappraisal strategies change with practice across even extended longitudinal periods. Longer paradigms such as those used in intervention studies could also be designed to measure other peripheral nervous system, hormonal (e.g., oxytocin, cortisol), and central nervous system measures (e.g., EEG, fMRI), which this design was not suited to assess, but which would substantially contribute to what is known about unforgiveness and forgiveness.

Such explorations have implications for the development of clinical interventions for fostering forgiveness and transformative change following real-life transgressions. In a meta-analysis of group interventions, Wade, Worthington, and Meyer (2005) found a dose-response relationship in which time spent empathizing with the offender predicted forgiveness. While 4-6+ hour interventions prompted the strongest forgiveness changes, the average time spent on empathizing with the offender in group interventions was slightly over one hour (68.2 minutes,

SD = 54.9). Current findings show that focusing on the humanity of the offender, along with viewing the offense as evidence of that person's need to learn, grow, and/or change for the better not only activates empathy immediately during compassion, but also that these effects can persist within an intervention session and can even change ruminations to become more empathic. These are important within-session changes that bode well for longer term forgiveness work. Thus, we encourage forgiveness interventions to consider testing the effects of teaching compassionate reappraisal and to practice the pattern of transitioning directly from offense memories into compassionate reappraisal.

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Table 1. Means (SDs) for Early and Late Rumination and Coping Trials by Strategy Type Between Subjects.

<u>Compassionate Reappraisal Learners</u>				
<u>Dependent Variable</u>	<u>Rumination 1</u> <u>M (SD)</u>	<u>Coping 1</u> <u>M (SD)</u>	<u>Rumination 3</u> <u>M (SD)</u>	<u>Coping 3</u> <u>M (SD)</u>
<i>Ratings (1-7 range)</i>				
Valence	2.91 (1.40)	3.38 (1.64)	3.84 (1.65)	4.06 (1.52)
Arousal	4.53 (1.63)	4.25 (1.67)	3.31 (1.42)	2.84 (1.55)
Empathy	2.81 (1.47)	3.75 (1.78)	3.88 (1.74)	3.78 (1.66)
Emotional Forgiveness	3.44 (1.63)	4.00 (1.72)	4.03 (1.87)	4.13 (1.86)
<u>Suppression Learners</u>				
	<u>Rumination 1</u> <u>M (SD)</u>	<u>Coping 1</u> <u>M (SD)</u>	<u>Rumination 3</u> <u>M (SD)</u>	<u>Coping 3</u> <u>M (SD)</u>
Valence	3.13 (1.41)	3.66 (1.36)	3.88 (1.81)	4.19 (1.82)
Arousal	4.22 (1.68)	3.81 (1.71)	3.25 (1.85)	2.97 (1.69)
Empathy	3.00 (1.48)	2.91 (1.59)	2.88 (1.66)	2.94 (1.52)
Emotional Forgiveness	3.75 (1.92)	3.47 (1.65)	3.81 (1.99)	3.44 (1.88)

*Note.* Rumination and coping trial orders were counterbalanced.

Table 2

*Physiology and Stroop for the 2 Coping Effect (Offense Rumination, Learned Coping) Repeated Measures  $\times$  2 Strategy Type (Suppression, Reappraisal) Between Subjects Design: Means, F values and partial  $r^2$ s for Offense Rumination and Learned Compassionate Reappraisal, and for Offense Rumination and Suppression*

<u>Dependent Variable</u>	<u>Compassionate Reappraisal Learners</u>		<u>Suppression Learners</u>	
	<u>Rumination</u> <u>M (SD)</u>	<u>Coping</u> <u>M (SD)</u>	<u>Rumination</u> <u>M (SD)</u>	<u>Coping</u> <u>M (SD)</u>
<i>Facial EMG (microVolts change from pretrial baseline)</i>				
Corrugator	1.01 (2.16)	-0.001 (2.32)	0.76 (1.08)	0.21 (1.33)
<i>Cardiovascular (change from pretrial baseline)</i>				
Heart Rate (bpm)	0.86 (2.65)	0.33 (4.46)	1.63 (2.69)	-0.41 (2.27)
Pre-ejection Period (s)	-0.002 (0.01)	0.01 (0.03)	0.003 (0.01)	-0.005 (0.03)
<i>Stroop</i>				
Reaction Time (ms)	403.84 (88.95)	421.11 (105.07)	444.73 (119.01)	432.06 (99.53)
Trial Type				
<i>Congruent</i>	392.31 (71.26)	412.31 (97.82)	432.31 (99.44)	418.55 (86.93)
<i>Incongruent</i>	409.17 (102.02)	436.64 (115.60)	468.19 (151.54)	441.36 (116.89)
<i>Neutral</i>	410.05 (92.79)	414.38 (102.95)	433.70 (98.49)	436.27 (94.02)
Stroop Effect	16.86 (46.49)	24.33 (55.84)	35.88 (70.45)	22.81 (60.93)

Table 2 continues...

Table 2 continued

	<u>Coping Effect (Rumination vs. Learned Coping)</u>			<u>Coping Effect × Strategy Type (Suppression vs. Reappraisal)</u>		
	<i>(df)</i>	<i>F</i>	<i>partial η<sup>2</sup></i>	<i>(df)</i>	<i>F</i>	<i>partial η<sup>2</sup></i>
<i>EMG (microVolts change from relevant pretrial baseline)</i>						
Corrugator	(1, 56)	5.65*	.09	(1, 56)	0.50	.01
<i>Cardiovascular (change from relevant pretrial baseline)</i>						
Heart Rate	(1, 60)	5.34*	.08	(1, 60)	1.85	.03
Pre-ejection Period	(1, 47)	0.55	.01	(1, 47)	4.38*	.09
<i>Stroop</i>						
Reaction Time	(1, 59)	0.03	.001	(1, 59)	3.04 <sup>+</sup>	.05
Interaction with Trial Type	(2,118)	0.16	.003	(2,118)	5.39**	.08
Stroop Effect	(1, 59)	0.14	.002	(1, 59)	1.36	.02

Note. \* $p \leq .05$ , \*\* $p \leq .01$ , \*\*\* $p \leq .001$ , <sup>+</sup> $p \leq .08$ . Also see Footnotes 2 and 3.

## Figure Captions

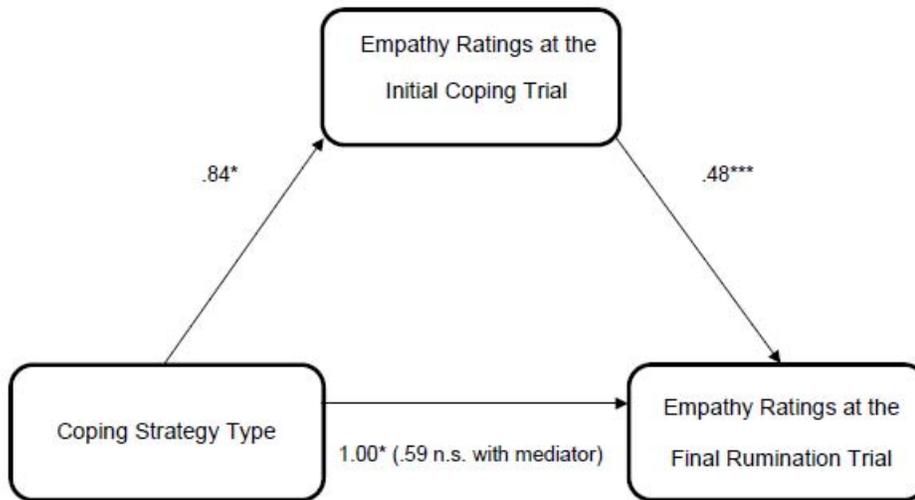
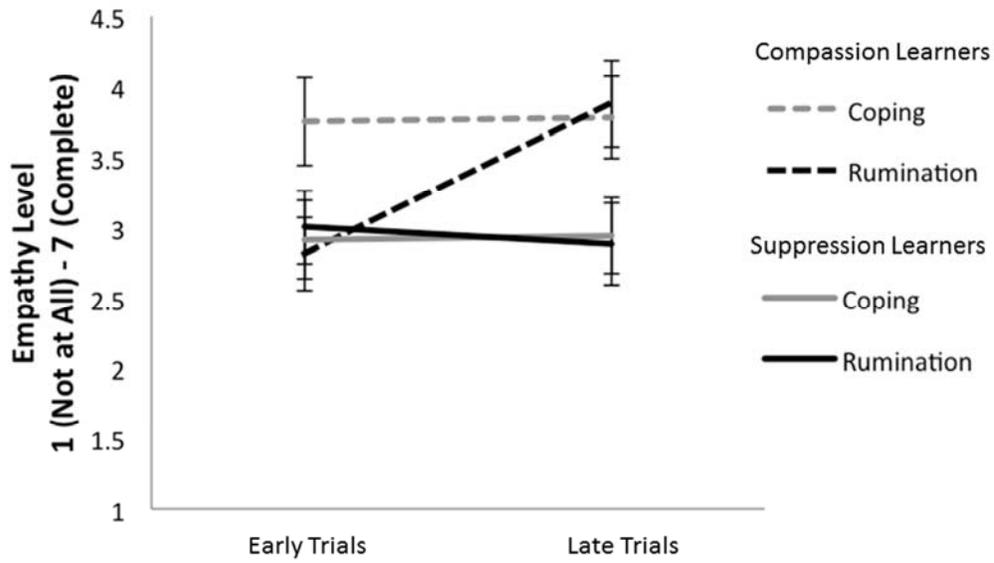
*Figure 1.* Note: In compassion learners, empathy ratings for initial compassionate reappraisal were significantly higher than for initial rumination. Rumination empathy levels increased significantly from the initial to the final trial, becoming equivalent to compassionate reappraisal empathy levels. In suppression learners, rumination and suppression for initial and final trials all showed the same level of empathy ratings. Standard error bars are shown.

*Figure 2.* Note. Empathy ratings after the first coping trial mediate the relationship between coping strategy type and empathy ratings after the final rumination trial.  $*p < .05$ ;  $**p < .01$ ;  $***p < .001$ .

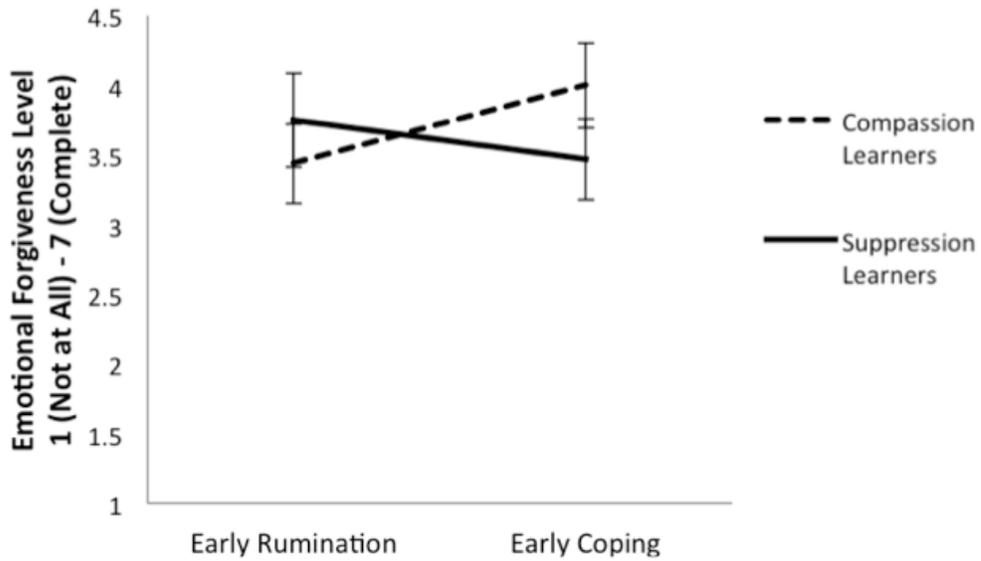
*Figure 3.* Note: The initial compassion trial prompted significantly more emotional forgiveness (vs. rumination), which persisted in later trials. Rumination and coping trial orders were counterbalanced early and late in the study.

*Figure 4.* Note: Rumination was described with significantly more negative words than both coping responses. Only compassion was described with significantly more positive words than rumination. Standard error bars are shown.

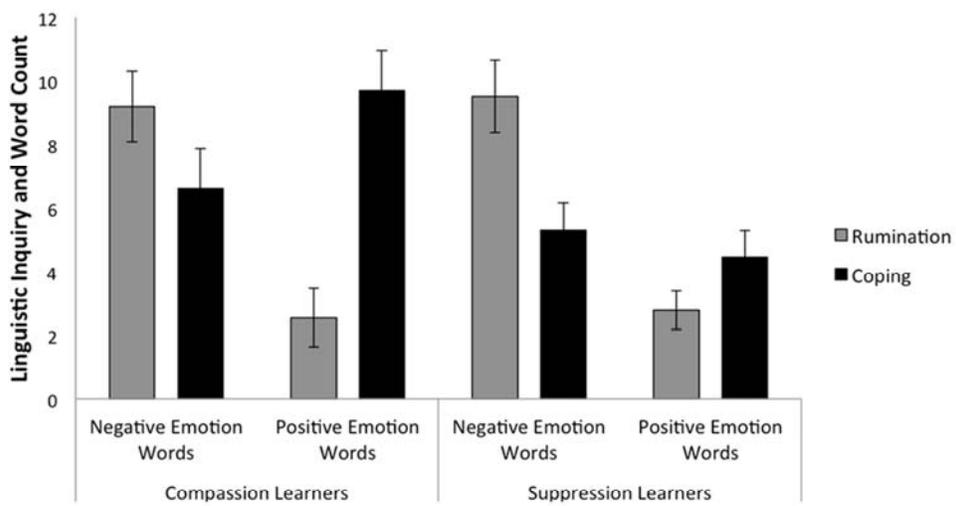
Empathy for the Offender



### Emotional Forgiveness for the Offender



Describe your thoughts, feelings, physical reactions, and what you would want to do or say to the offender



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<sup>1</sup> We used Biopac guidelines and the documented methods of Witvliet et al. (2011). In addition, impedance cardiology was measured with the Biopac NICO 100C module and four disposable EL506 bioimpedance electrode strips on the back, with two strips located above the heart on the base of the neck, and two strips below the heart on the back. Impedance cardiology data were filtered and amplified using Biopac recommended methods for the MP150, NICO 100C and Acqknowledge software. PEP requires both an ECG channel and a dZ/dt channel (which is the derivative of the impedance wave). PEP was measured by comparing the onset of the Q-wave in the ECG to the onset of the B-point in the dZ/dt wave.

<sup>2</sup> We conducted follow-up analyses of pure rumination reactivity versus late rumination reactivity, showing no difference for heart rate,  $F(1, 57) = 2.38$ ,  $p > .05$ , partial  $\eta^2 = .04$ , and no difference for PEP,  $F(1, 57) = 0.55$ ,  $p > .05$ , partial  $\eta^2 = .01$ , whereas *corrugator* reactivity during late rumination (mean = 0.01, SD = 1.77) was lower than pure rumination (mean = 0.88, SD = 1.67), Repetition  $F(1, 57) = 8.20$ ,  $p \leq .01$ , partial  $\eta^2 = .13$ .

<sup>3</sup> Both coping groups showed the expected significant Stroop effect for the baseline trials,  $t(29) > 2.91$ ,  $p < .006$ . Accuracy and the magnitude of the Stroop effect did not differ between groups for the baseline trials,  $t(56) < 1.27$ ,  $p > .20$ . Although our main questions concerned the cognitive effects of practiced coping versus the early rumination trial, we also assessed differences between early and late rumination and coping trials. For the early trials, there was a larger Stroop effect after initial rumination (mean = 26.83, SD = 60.53) than after initial coping (mean = 8.23, SD = 47.91),  $F(1, 59) = 9.50$ ,  $p = .003$ , partial  $\eta^2 = .13$ . This effect and the magnitude of Stroop interference did not differ between rumination and suppression groups,  $F(3, 57) < 1.90$ ,  $p > .14$ , partial  $\eta^2 < .079$ . There were no significant differences in the Stroop effect after late rumination and late coping,  $F(1, 59) = .24$ ,  $p = .70$ , partial  $\eta^2 = .002$ . The early instances of compassionate reappraisal, as well as suppression, were associated with reduced Stroop interference compared to early rumination. This reduction in interference was not seen for practiced coping, which did not differ from interference after early or late rumination. These findings suggest repeated efforts at coping may be associated with greater cognitive demands than the first instances of these strategies.