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Compassion-Focused Reappraisal, Benefit-Focused Reappraisal, and Rumination after an Interpersonal Offense: Emotion Regulation Implications for Subjective Emotion, Linguistic Responses, and Physiology

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Abstract

This repeated measures psychophysiology experiment studied three responses to a past interpersonal offense (38 females, 33 males). We compared rumination with two offense reappraisal strategies. Compassion-focused reappraisal emphasized the offender's humanity, and interpreted the transgression as evidence of the offender's need for positive transformation. Benefit-focused reappraisal emphasized insights gained or strengths shown in facing the offense. Supporting the manipulations, compassion-focused reappraisal stimulated the most empathy and forgiveness, whereas benefit-focused reappraisal prompted the most benefit language and gratitude. Both reappraisals decreased aroused, negative emotion and related facial muscle tension at the brow (*corrugator*). Both reappraisals increased happiness and positive emotion in ratings and linguistic analyses. Compassion stimulated the greatest social language, calmed tension under the eye (*orbicularis oculi*), and slowed heart beats (R-R intervals). A focus on benefits prompted the greatest joy, stimulated smiling (*zygomatic*) activity, and buffered the parasympathetic nervous system against rumination's adverse effects on heart rate variability (HRV).

(150 words)

Keywords: benefit-finding; compassion; forgiveness; gratitude; rumination; facial EMG; heart rate variability (HRV); spectral analysis

Compassion-Focused Reappraisal, Benefit-Focused Reappraisal, and Rumination after an Interpersonal Offense:

Emotion Regulation Implications for Subjective Emotion, Linguistic Responses, and Physiology

As the field of positive psychology has burgeoned in recent years, research has begun to focus on strategies to promote happiness and well-being even after hurtful interpersonal offenses (Witvliet, 2008). How people cope with a transgression can significantly affect their well-being, with evidence for the salutary effects of forgiveness (e.g., Berry & Worthington, 2001; Lawler-Row, Karremans, Scott, Edlis-Matityahou, & Edwards, 2008; Witvliet, Ludwig, & Vander Laan, 2001) and of gratitude cultivated by focusing on benefits even in adversity (e.g., Emmons & McCullough, 2003; McCullough, Root, & Cohen, 2006; Tennen & Affleck, 2002). Meanwhile, the field of emotion regulation has focused on the beneficial effects of reappraisal—thinking differently about a situation, stimulated by Gross' (2007) process model of emotion regulation. The current study brings together these research streams in positive psychology and emotion regulation, using an experimental paradigm to induce rumination and reappraisal strategies, and testing their effects on well-being across subjective, narrative, and physiological measures.

The aim of this study is to test the emotion effects of two positive reappraisal approaches: a focus on *compassion* as a means to approach forgiveness, and a focus on *benefits* as a way to cultivate gratitude. This repeated measures experiment is designed to test whether each reappraisal strategy is more effective than rumination for promoting well being, and whether one reappraisal strategy—compassion-focused reappraisal or benefit-focused reappraisal—is superior to the other in countering the effects of offense-related rumination. We assess well-being effects by 1) measuring subjective ratings of emotion, 2) conducting linguistic analyses of participants'

written descriptions of their thoughts, emotions, physical responses, and behavioral motivations, and 3) measuring physiological responses relevant to emotion communication and emotion-regulation. These include measures of even subtle emotion displays on the face detected with electromyographic (EMG) measures at the brow (*corrugator*) associated with negative emotion, under the eye (*orbicularis oculi*) associated with aroused emotion, and at the cheek (*zygomatic*) associated with positive emotion (see Witvliet & Vrana, 1995). We also include cardiac measures because of relationships between emotion, regulation, and cardiac functioning (*e.g.*, Mauss, Cook, Cheng, & Gross, 2007; Witvliet & Vrana, 1995). We especially highlight the measure of heart rate variability (HRV) as an indicator of parasympathetic nervous system functioning and regulatory control, the system which calms the body's aroused "fight-or-flight" response (*e.g.*, Thayer & Brosschot, 2005).

Using a focus on multi-method assessments of well-being, we now turn to examine the literature pertinent to the three experimental conditions of *rumination* and both cognitive reappraisal strategies: c*ompassion-focused reappraisal* as an approach to forgive, and *benefit-focused reappraisal* as an approach to cultivate gratitude.

Rumination

Rumination can occur naturally or be induced in the laboratory. It involves perseverative thinking about one's problems and emotions (Nolen-Hoeksema, Wisco, and Lyubomirsky, 2008), which Rottenberg and Gross (2007) conceptualize as a failure in emotion regulation. Rumination impairs problem-solving, worsens depression, decreases motivation, and erodes social support (Nolen-Hoeksema et al., 2008). In the aftermath of an interpersonal offense, rumination can incite an increase in negative emotions and deter prosocial responses such as empathy (Witvliet et al., 2001; Witvliet, Worthington, Root, Sato, Ludwig, & Exline, 2008) and

forgiveness (McCullough, Bono, & Root, 2007). Rumination serves as a moderating variable between anger and blood pressure (see Hogan & Linden, 2004). Rumination about an interpersonal offender—as induced in the laboratory—has been associated with aroused and negative emotion, increased blood pressure, heart rate, and sweat (skin conductance) levels, as well as tension under the eye (*orbicularis oculi*) associated with emotional arousal, and tension at the brow muscle (*corrugator*) associated with negative emotion (Witvliet et al., 2001).

Reappraisal: An Emotion-Regulation Antidote to Rumination

The purpose of this study is to test two ways to cognitively reappraise a hurtful offense. In contrast to rumination, cognitive reappraisal construes an emotion-eliciting circumstance in ways that can change the situation's emotional impact, usually down-regulating adverse emotions (see Lazarus & Alfert, 1964; Gross, 1998), but also up-regulating positive emotions (Gross 2007; Rottenberg & Gross, 2007).[1] Reappraisal is associated with less depression, and with more positive emotions and relationships, life satisfaction, self-esteem, optimism, and overall well-being (Gross & John, 2003). Reappraisers also tend to overcome anger and show more adaptive cardiovascular responses (Mauss et al., 2007). In an experimental design, participants who reappraised—rather than ruminated about—an upsetting event experienced less anger, cognitive perseveration, and sympathetic nervous system activity (Ray, Wilhem, & Gross, 2008). This evidence suggests that implementing positive reappraisals of an interpersonal transgression may be effective strategies, at least in down-regulating rumination-driven psychophysiology patterns.

Compassion-focused reappraisal as an approach to forgiveness. Compassion has been conceptualized as an emotional response of connecting to another person, often through an emphasis on shared humanity with the other (Cassell, 2002). Whereas compassion often is an

expression toward another who is suffering in a victim role, in this study we are interested in a compassion-focused response to an offender. From this perspective, compassion emphasizes the complex humanity of the offender and can interpret the offense as evidence showing that the offender needs to experience positive transformation or healing. With an emphasis on the offender's human problems, the victim may find a genuine way to wish the offender well, even while holding the offender accountable for his or her offense (Worthington, 2009).

Research has conceptualized compassion as a warmth-based virtue associated with altruistic concern and with forgiveness in relevant contexts (Berry, Worthington, Wade, Witvliet, & Kiefer, 2005). A study of crime victims, and their family and friends, showed that respondents who valued warmth-based virtues (e.g., compassion, love) more than conscientiousness-based virtues (moderation, self-control, justice) were more likely to grant forgiveness to the offender (Berry et al., 2005).

Additional conceptual groundwork for the current investigation was developed by Witvliet and McCullough (2007), who emphasized an approach to forgiveness that accents altruistic concerns. With this approach to forgiveness, the victim cultivates genuine prosocial responses and goodwill toward an unworthy offender, even if a relationship with the offender is not re-established. This view resonates with theorizing that forgiveness involves the replacement of negative emotions with positive and prosocial emotions (Worthington & Scherer, 2004). This work further distinguishes forgiveness and reconciliation, calls offenders to accountability, and resists condoning, minimizing, or excusing the offense (Witvliet & McCullough, 2007).

Until now, empirical research has not explicitly examined forgiveness in relationship to compassion-focused reappraisal. Yet, the current study has a strong foundation in prior research. When considering subjective and physical well-being, forgiveness-related conditions that

cultivated empathy and benevolent responses toward the offender—compared to rumination—stimulated an increase in positive emotion, a reduction of negative and aroused emotion, and a calming of cardiovascular and sympathetic nervous system activity (Witvliet et al., 2001). Additional research associated forgiveness—as opposed to rumination—with less sympathetic nervous system input to the heart (measured with rate pressure products; Lawler et al., 2003; 2008; Witvliet et al., 2008), lower blood pressure (Friedberg, Suchday, & Shelov, 2007), and fewer reported illness-related symptoms (Bono, McCullough, & Root, 2008). The current study focuses on implementing cognitive reappraisal to cultivate compassion toward a past offender.

Benefit-focused reappraisal as an approach to cultivate gratitude. Another type of reappraisal strategy people can employ is to focus on the benefits they have experienced even in the face of adversity. As a means of prompting gratitude, benefit-focused reappraisal can involve either looking for evidence or reminding oneself of perceived benefits (Tennen & Affleck, 2002). Such a focus on benefits has been associated with positive well-being and less depression in a meta-analysis (Helgeson, Reynolds, & Tomich, 2006).

In the present study we investigate the effects of focusing on benefits experienced in the face of an interpersonal offense. Examples of these benefits include self-understanding, insight, personal growth, or strengthened relationships. Emmons (2008) has linked the "positive recognition of benefits" to gratitude (p. 470). While gratitude involves both being grateful *for* a benefit and being grateful *to* the source of the benefit (Emmons (2008), the current study explicitly emphasizes the first component of focusing on benefits as a process that may generate gratitude.

Experimental research on gratitude has investigated the effects of writing about things in one's life for which one is grateful (Emmons & McCullough, 2003). Across two studies, this

writing exercise prompted increases in gratitude, well-being, optimism when compared to writing about daily hassles or control conditions. When written weekly for 10 weeks, grateful participants also spent more hours exercising and had fewer physical symptoms. When written daily for 13 days, grateful writers were more willing to help others, although no exercise or physical effects were found. In a third study, participants with neuromuscular diseases who kept a daily gratitude journal for 21 days reported significantly higher gratitude, satisfaction with life as a whole, optimism about the next week, better sleep, and more connection to others. Other research also associates gratitude with positive affect, life satisfaction, and happiness (Watkins, Woodward, Stone, & Kolts, 2003), lower negative emotions and higher prosocial responses (McCullough, Emmons, & Tsang, 2002), as well as positive personality traits (McCullough, Kilpatrick, Emmons, & Larson, 2001).

Research links focusing on benefits to better physical outcomes and views appraisal and positive emotion as possible pathways for this relationship (see Bower, Low, Moskowitz, Sepah, & Epel, 2008). As noted, writing about one's blessings has effectively stimulated optimism, more time spent exercising, and better health compared to writing about daily hassles (Emmons & McCullough, 2003). Other research found that inducing states of appreciation (versus anger) reliably enhanced parasympathetic activity, as indicated by heart rate variability (HRV; McCraty, Atkinson, Tiller, Rein, & Watkins, 1995). Such activation of the calming branch of the autonomic nervous system is related to a variety of beneficial mental and physical outcomes (Hughes & Stoney, 2000) such as lower anxiety and greater cognitive flexibility (Thayer & Brosschot, 2005).

Only one experimental study has induced a focus on benefits after an interpersonal transgression. McCullough et al. (2006) asked participants to write about benefits they

experienced following a transgression, traumatic aspects of the transgression, or a mundane control condition. Common benefits participants named included the realization of inner strength, improved interpersonal relationships, renewed spirituality, a needed readjustment of one's priorities, and a new appreciation for one's life. Writing about such benefits stimulated significantly greater forgiveness toward the offender (McCullough et al., 2006), perhaps because focusing on benefits reduced the perceived size of the injustice (Witvliet et al., 2008) .

Current Study

Emotional imagery paradigm. The current study adapts existing experimental paradigms (Witvliet et al., 2001; 2008) to test the effects of compassion-focused reappraisal and benefit-focused reappraisal approaches in comparison to ruminating about a past real-life offense. By using a within-subjects, repeated measures design, we can compare participants' responses in all of the conditions as we test hypotheses about emotion ratings, linguistic narratives, facial displays of emotion using electromyography (EMG), and cardiovascular functioning, with a specific focus on parasympathetic nervous system activity that is relevant to emotion regulation (see Witvliet & McCullough, 2007). As we do so, we draw on a foundation of research that links affective valence and arousal ratings to facial EMG and cardiac responses during emotional imagery (e.g., Witvliet & Vrana, 1995).

Hypotheses. We hypothesized that we would see converging evidence across responses systems, consistent with prior research. Overall, we predicted that each of the reappraisal strategies would diminish negative and aroused emotion and promote positive and calm emotion compared to offense rumination. Compared to rumination subjective ratings, each reappraisal strategy would decrease ratings of arousal and anger, while increasing ratings of overall valence, along with happiness and joy. As manipulation checks, we tested whether compassion-focused

reappraisal would be even more effective in stimulating empathy and heartfelt forgiveness in comparison to offense rumination and benefit-focused reappraisal. We also tested whether benefit-focused reappraisal would be more effective than rumination and compassion-focused reappraisal in stimulating an increase in written benefits and gratitude.

For linguistic analyses, we hypothesized that both reappraisals (compassion-focused and benefit-focused)—as opposed to rumination—would stimulate narratives more closely aligned with positive emotion language, but more distant from negative emotion language. In terms of word counts, we hypothesized that forgiveness language would be increased to a greater extent by compassion than by a benefit-focus in comparison to rumination. Similar to findings by McCullough et al. (2006), benefit-finding would stimulate a greater increase in benefit and gratitude language than compassion. Both reappraisal strategies would increase positive emotion language and decrease negative emotion language compared to rumination. Because of compassion's outward focus toward the offender, we hypothesized that it would generate more social language than benefit-focused reappraisal.

Based on research investigating the physiological effects of reappraisal in relationship to anger (Mauss et al., 2007), we hypothesized that the reappraisal conditions would reduce anger and yield cardiac benefits in contrast to rumination. In prior research comparisons to unforgiving hurt rumination and grudge-holding, empathy and forgiveness slowed heart rates while decreasing anger (Witvliet et l., 2001). In the current study, we hypothesized that in comparison to offense rumination, compassion-focused reappraisal would prompt empathy and forgiveness, along with slower R-R intervals. Based on the conceptual groundwork of Witvliet and McCullough (2007), we hypothesized that the compassion-focused reappraisal would increase parasympathetic functioning, as assessed by heart rate variability (HRV). Prior research has

demonstrated that in contrast to anger, appreciation is associated with improved parasympathetic functioning, evident in increased heart rate variability as indicated by high frequency (HF) values in the power spectrum (McCraty et al., 1995). Thus, we hypothesized increases in HRV for benefit-focused reappraisal.

Hypotheses about facial EMG were based on basic emotion and offense-related experimental paradigms. In basic research on emotional imagery that systematically varied valence and arousal in a 2 x 2 design, Witvliet and Vrana (1995) found that joy imagery stimulated the most positive and aroused emotion, with highest cheek (*zygomatic*) muscle activity associate with smiling. We predicted that in comparison to offense rumination, the positive reappraisal responses would stimulate more positive affect and corresponding activity at the cheek (*zygomatic*) muscle, with greatest activity occurring for the condition with the most joy. We further predicted that reappraisal responses would decrease muscle activity at the brow (*corrugator*) muscle associated with negative affect, and decrease muscle activity under the eye (*orbicularis oculi*) associated with affective arousal arousal (Witvliet & Vrana, 1995). Prior research showed that empathy and forgiveness yielded these effects compared to rumination (Witvliet et al., 2001).

Methods

Participants

Seventy-one introductory psychology students (33 males, 38 females) participated as one way to meet a research requirement. Participants ranged in age from 17 to 26 (M = 18.9 years, SD = 1.3). Of the 71 participants, 63 were White, 3 Latin-American, 2 African-American, 1 Asian-American, and 2 did not specify ethnicity.

Design

The study used a repeated measures within-subjects design similar to that used by Witvliet et al. (2001, 2008), counterbalancing across participants the presentation order of compassion-focused reappraisal and benefit-focused conditions. Each participant identified and reflected on a particular prior offense in which another person hurt and offended him or her. In a 90-minute paradigm, the participant completed four trials, each comprised of a two-minute pre-trial baseline, followed by a two-minute period in which the participant ruminated about the past real-life offense or implemented a reappraisal strategy. Half of the participants (blocked by gender) were randomly assigned to proceed from offense rumination to compassion-focused reappraisal, and then from offense rumination to benefit-focused reappraisal. The other half were assigned to proceed from offense rumination to benefit-focused reappraisal, and then from offense rumination to compassion-focused reappraisal.

To assess the effect of imagery on each physiological dependent variable, the data values for each pretrial baseline were first subtracted from the values for each imagery period. For facial EMG, each condition's pretrial baseline values for the final 10-sec epoch were subtracted from each 10-sec epoch during imagery. For R-R (beat-to-beat) interval data, the full 2-min period was used because these values are collected on a beat-by-beat basis rather than as a function of

time. For heart rate variability (HRV), the full 2-minute values were required because calculations of HRV are time dependent, requiring equal durations to be compared.

To determine the influence of each reappraisal strategy compared to rumination on each variable, the data values for each reappraisal strategy trial (imagery minus pretrial baseline) were statistically compared to the data values for the preceding offense rumination trial (imagery minus pretrial baseline). In order to compare the effects of the two reappraisal strategies to each other, a compassion-focused reappraisal effect score was calculated as compassion-focused reappraisal (imagery - pretrial baseline) minus its preceding rumination trial (imagery – baseline) and then statistically compared to a benefit-focused reappraisal effect score (imagery - baseline) minus its preceding rumination trial (imagery - baseline).

Stimulus Materials

Instructions were displayed for 30-seconds on a computer monitor directly in front of the participant. A tone signaled participants to open their eyes and read the relevant pre-trial baseline relaxation, or imagery instructions for rumination, compassion-focused reappraisal, or benefit-focused reappraisal. Experimental instructions directed them to close their eyes for all baseline and imagery periods (each of which lasted for 120-seconds).

Pre-trial baseline instructions. "Please sit still for the next two minutes and try your best to follow the instructions. It is important for you to sit still and get used to being quiet for a while. Your job is to sit, relax, and think the word 'one.' Keep your arms, legs, and body still as you remain quiet for a minute, thinking the word 'one.'"

Offense rumination imagery instructions. "For the next two minutes, think of the person you blame for hurting, offending, or wronging you. Think of the ways the offense harmed you when it happened, and how it continued to negatively affect you. During your imagery,

actively focus on the negative thoughts, feelings, and physical responses you have as you think about the negative ways the offender and offense harmed you."

Compassion-focused reappraisal instructions. "For the next two minutes, try to think of the offender as a human being whose behavior shows that person's need to experience a positive transformation or healing. Try to give a gift of mercy and genuinely wish that person well. During your imagery, actively focus on the thoughts, feelings, and physical responses you have as you cultivate compassion, kindness, and mercy for this person."

Benefit-focused reappraisal instructions. "For the next two minutes, try to think of your offense as an opportunity to grow, learn, or become stronger. Think of benefits you may have gained from your experience such as self-understanding, insight, or improvement in a relationship. During your imagery, actively focus on the thoughts, feelings, and physical responses you have as you think about positive ways you benefited from your experience."

Dependent Measures

Ratings. Participants privately and in random order rated their subjective emotions and experiences after each imagery period (using a Biopac RB-730 response-pad and SuperLab software). On a seven-point scale, participants rated their emotional valence (1 = negative to 7 = very positive), perceived control (1 = not in control to 7 = very much in control), and arousal (1 = calm, relaxed, or sleepy to 7 = aroused, excited, or intense). Ratings for anger, happiness, joy, empathy, forgiveness, and gratitude were assessed with a seven-point scale (1 = not at all to 7 = completely). The empathy, forgiveness, and gratitude ratings were primarily assessed as manipulation checks for the reappraisal strategies.

Analyses of written responses: Latent Semantic Analysis (LSA) and Linguistic Inquiry and Word Count (LIWC). After each imagery period, participants were prompted to

describe their experience during imagery by typing sentences in response to four questions on a laptop: “What were you THINKING during your imagery? What were you FEELING during your imagery? What were your PHYSICAL REACTIONS during your imagery? What do you WANT TO DO or SAY to your offender?” Latent semantic analysis (LSA: http://lsa.colorado.edu) was used to compare the narrative a participant produced in an experimental condition to a comparison positive emotion text and to a negative emotion text.[2]

For word-count assessments of participants’ responses, Linguistic Inquiry and Word Count (LIWC: Pennebaker, Booth, & Francis, 2007) software counted the number of words in submitted texts that matched dictionaries. The standard LIWC English dictionary containing categories for affect and social language was used to analyze the paragraphs in each experimental condition. In addition, cost, benefit, forgiveness, and gratitude dictionaries were created in LIWC to analyze participants’ use of these constructs, primarily as manipulation checks.[3]

Physiology[4]

During the baseline and imagery periods, we continuously measured physiological responses using standard methods (Biopac MP150 and Acqknowledge 3.9 software for an Apple iMac G5). We measured covert facial muscle activity relevant to emotion using standard electromyography methods at the *zygomaticus* (cheek) muscle, *orbicularis oculi* (under eye) muscle, and *corrugator supercilii* (brow) muscle regions. Heart rate was measured using electrocardiography (ECG).

Heart Rate Variability (HRV) was used because it is an important indicator of parasympathetic nervous system activity. HRV was calculated using a frequency domain method derived from R-R (beat-to-beat) intervals from the ECG data collected during each 120-s pretrial

baseline and each 120-s imagery period for each of the experimental conditions. The 0.15-0.4 Hz High Frequency (HF) range of the power spectrum was used as the measure indicative of the parasympathetic influences on the cardiac cycle (Task Force, 1996).[5]

Procedure

Participants gave informed consent and individually completed an approximately 90–minute experiment session. As they sat in a recliner in front of a flat screen monitor, their electrodes and physiological recording devices were affixed and monitored on the computer screen in the adjacent equipment room. The electrode areas were prepped with alcohol (and electrode gel for the facial muscle sites) and allowed to dry before attaching electrodes. All physiological measures were tested for clear and reliable signals before beginning a 120-second baseline period of relaxation. Afterward, the participants completed a questionnaire on which they identified a real-life interpersonal offense for which they held a particular person responsible for having caused a personal hurt or offense.

Following the confidential questionnaire, participants completed a series of trials pertaining to this specific real-life offense. Each trial consisted of a 120-second pretrial baseline relaxation period, immediately followed by a 120-second imagery period. Each relaxing pretrial baseline served as a control condition so that we could detect the physiological effects of the experimental rumination, compassion-focused reappraisal, or benefit-focused reappraisal conditions. During the pretrial and imagery periods, physiological measures were continuously measured while participants closed their eyes and actively imagined responses according to the instructions. A tone signaled participants to open their eyes at the end of each baseline, rumination, or reappraisal period.

After each of the imagery periods, participants typed answers to questions related to how they were thinking, feeling, physically reacting, and what they wanted to say or do to the offender. Participants also made ratings on subjective emotions. When all imagery periods and accompanying measures were completed, physiological recording devices were removed, participants were debriefed.

Data Reduction

Following the experiment, physiology data were acquired using Acqknowledge 3.9.2 software. To ensure accuracy of the facial electromyography (EMG) data, outliers were identified with the *Explore* function of SPSS 15.0 and removed to decrease any error due to technological difficulties with the apparatus, possible electrical noise, or movement artifacts. To ensure accuracy of the electrocardiogram (ECG) data and heart rate variability (HRV), the R-R plots were inspected for outliers indicative of artifacts, which led to re-inspection of cardiac wave forms. All Power Spectrum Density plots (see footnote 4 for HRV methods) were visually inspected for well-defined High Frequency peaks. Finally, we inspected correlational plots of High Frequency and RMSSD values in each baseline and imagery period for outliers.

Statistical Analyses

Ratings, written narratives, and physiological data in this repeated measures, within-subjects design were analyzed using multivariate ANOVA analyses. Means, *F* values, *p* values, and ANOVA statistics for ratings and narratives are reported in Table 1. Descriptive and ANOVA statistics for physiological variables are displayed in Table 2 and significant effects, along with 95% confidence intervals, are depicted in the Figures.

Results

Self-reports

Table 1 presents the self-report means and statistical effects for compassion-focused reappraisal compared to its relevant offense rumination, benefit-focused reappraisal compared to its relevant offense rumination, and the two reappraisal strategies' effects compared to each other. In addition to these planned comparisons, we also assessed the ratings and linguistic analyses produced during a relaxation trial versus the experimental conditions. All of the conditions focused on the offender prompted higher ratings of arousal (all Fs > 30.72, ps < .001, partial η^2 > .31) and anger (all Fs > 29.69, ps < .001, partial η^2 > .30). In the written narratives about the different responses to their offenders, participants used more social words (all Fs > 44.24, ps < .001, partial η^2 > .39), anger words (all Fs > 8.28, ps < .005, partial η^2 > .11), and cost words (all Fs > 17.22, ps < ,001, partial η^2 > .20). These findings collectively show that participants were engaged in the experimental responses to their offenders, and that reappraisal did not simply prompt globally calm and positive reports.

Ratings. When each reappraisal strategy was compared to its respective preceding offense rumination period, ratings for emotional valence moved from negative to positive, control increased, and ratings for arousal decreased. Compared to offense rumination, use of a reappraisal strategy down-regulated ratings for anger while up-regulating happiness and joy.

When the effects of offense rumination trials are subtracted from the corresponding reappraisal strategy, the effects of the reappraisal strategies can be compared. Joy increased the most in response to benefit-focused reappraisal.

As confirmation of our manipulation, Table 1 shows that compassion-focused reappraisal reliably increased empathy more than benefit-focused reappraisal, which increased gratitude significantly more than compassion-focused reappraisal.

Linguistic analyses. As shown in Table 1, repeated measures analyses of variance for the Latent Semantic Analysis (LSA) negative emotion word probe (Cronbach's alpha = 0.792) revealed that both compassion-focused reappraisal and benefit-focused reappraisal narratives were more distant from negative affective language in comparison to their preceding offense rumination trials. In addition, a benefit focus decreased use of negative language from offense rumination significantly more than a compassion focus. Tests with the positive emotion text probe (Cronbach's alpha = 0.619) revealed that both compassion-focused reappraisal and benefit-focused reappraisal narratives were closer to positive language compared to their respective rumination periods.

For Linguistic Inquiry and Word Count (LIWC) analyses, repeated measures analyses of variance revealed that compared to the relevant offense trial, both compassion-focused reappraisal and benefit-focused reappraisal increased positive emotion and insight language, as well as forgiveness and benefit language. Both reappraisal strategies decreased negative emotion, anger, and cost language compared to the relevant offense trials. Only compassion-focused reappraisal increased social language compared to the preceding offense condition. In contrast, benefit-focused reappraisal decreased social language compared to its offense. In a direct comparison of the two reappraisal strategies, compassion-focused reappraisal increased social language more than benefit-focused reappraisal, consistent with the prosocial focus of compassion in contrast to a greater emphasis on the self that attends an emphasis on benefits one has received.

As a manipulation check, compassion-focused reappraisal increased forgiveness language more than benefit-focused reappraisal, while benefit-focused reappraisal increased benefit language and gratitude word use more than compassion-focused reappraisal.

Physiology

Table 2 presents the physiological means and statistical effects for compassion-focused reappraisal compared to its corresponding offense rumination, benefit-focused reappraisal compared to its corresponding offense rumination, and both reappraisal strategies' effects compared to each other.

Facial electromyography (EMG). Compared to their respective offense rumination periods, both altruistic imagery and benefit-focused reappraisal imagery were associated with significantly less brow (*corrugator*) EMG reactivity (Figure 1). Because *corrugator* activity has been linked to negative affect (Witvliet & Vrana, 1995), these findings dovetail with ratings results to indicate that negative affect reliably decreased during reappraisal strategies compared to offense rumination. When subtracting out relevant offense rumination trials from each corresponding reappraisal strategy and comparing these effects directly, compassion-focused reappraisal was more effective than benefit-focused reappraisal at reducing *corrugator* activity.

Compared to offense rumination, compassion-focused reappraisal prompted significantly less reactivity under the eye (*orbicularis oculi* EMG) (Figure 2). Along with the findings for *corrugator* activity, this provides support for the theory that reappraisal strategies can decrease the negative affect and emotional arousal associated with rumination (Witvliet et al., 2001).

Benefit-focused reappraisal stimulated significantly higher activity at the cheek (*zygomaticus* EMG) than the preceding offense rumination period (Figure 3). Combined with the increases in positive affective ratings for benefit-focused reappraisal, these findings provide

support for established theories linking *zygomaticus* activity and positive affect (see Witvliet & Vrana, 1995). This benefit-focused reappraisal effect on *zygomaticus* EMG—subtracting the previous offense trial score—was not significantly greater than the effect of compassion-focused reappraisal, $F(1,43) = 3.07$, $p = .087$.

Cardiovascular measures. In contrast to offense rumination, compassion-focused reappraisal significantly lengthened the time between R–R (beat-to-beat) peaks in the ECG waveform (Figure 4). This demonstrates that—unlike rumination, which consistently accelerated R-R intervals compared to pretrial baseline, ts $(65) \geq |2.77|$, ps $< .01$—an altruistic focus on the offender reliably calmed the cardiac cycle.

Heart rate variability (HRV) results for the high frequency (HF) component of the power spectrum showed that benefit-focused reappraisal significantly aided parasympathetic function (Figure 5). Benefit-focused reappraisal effectively countered rumination's impairment of parasympathetic functioning from pretrial baseline levels, $t(62) = -2.84$, $p < .01$.

Discussion

The current experiment brings together the positive psychology and reappraisal literatures to address a common problem—coping with the pain of an interpersonal offense. Because interpersonal offenses affect almost everyone and have been found to influence psychophysiological well-being, research testing positive reappraisal strategies for regulating emotions has broad relevance (McCullough et al., 2006; Witvliet et al., 2001).

We specifically studied two ways to reappraise an interpersonal offense: 1) compassion-focused reappraisal as approach to cultivate forgiveness, and 2) benefit-focused reappraisal as an approach to stimulate gratitude. We compared each to the widely-studied and clinically relevant process of rumination (Nolen-Hoeksema et al., 2008), which holds a significant place in

transgression-related research (Witvliet & McCullough, 2007). We tested which reappraisal strategy more reliably brought about particular affective changes. We tested whether cognitive reappraisals—using a focus on compassion or on benefits—not only down-regulated negative emotions associated with offense-related rumination, but also up-regulated positive emotions (Gross, 2007). We did so by measuring emotion ratings, written narratives about one's thoughts, feelings, physical experiences, and desired behavioral responses to the offender, as well as physiological variables involved in facial displays of emotion and nuances in cardiovascular responding. We begin by examining the effects of rumination, proceed to address effects shared by both positive reappraisal strategies, and then address unique effects attributable to compassion-focused reappraisal and benefit-focused reappraisal.

Rumination Contributions

The results from this study dovetail with research showing that prompts to ruminate about an offense can incite an increase in negative emotions, decrease prosocial responses, and lead to cardiovascular and sympathetic nervous system arousal (Witvliet et al., 2001; 2008). These results fit with recent efforts to summarize findings on rumination and its effects (Nolen-Hoeksema et al., 2008) by showing how the negative thinking process of rumination up-regulates negative emotion and down-regulates positive emotion. These findings resonate with the view that—unless one aims to intensify negative affective appraisals, language, and physiology—rumination is not an effective emotion-regulation strategy (Rottenberg & Gross, 2007). The rumination condition was associated with negative ratings and expressions in written narratives, as well as EMG activity at the brow (*corrugator)* and under the eye (*orbicularis oculi)*, associated with negative emotional valence and emotional arousal, respectively (see Witvliet & Vrana, 2005). Post-hoc analyses showed that rumination changes from pretrial baseline included

significant cardiac acceleration (decreasing the time between heartbeats) and impaired parasympathetic nervous system functioning. Furthermore, rumination was associated with low levels of positive emotions, including happiness, joy, empathy, forgiveness, and gratitude.

Positive Reappraisal Contributions

The two positive reappraisal strategies differed substantially in their focus. The compassion-focused reappraisal focused on cultivating compassion for the offender by emphasizing his or her humanity, and by viewing the offense as evidence that this person needed to experience positive change or healing. The benefit-focused reappraisal focused on the offense as an opportunity to grow, learn, or become stronger, and on finding ways in which one had developed self-understanding or relational improvements that benefited oneself. Compassion-focused reappraisal was focused on giving; benefit-focused reappraisal was focused on receiving. Compassion-focused reappraisal focused on the other; benefit-focused reappraisal focused on the self.

Nevertheless, both reappraisal strategies had many similar, significant effects. By reinterpreting the real-life offender and offense, both reappraisals stimulated aroused, angry, and costly responses in comparison to a relaxation period. However, compared to offense rumination, both ways to reappraise the hurt decreased aroused, angry, and cost-oriented measures. Consistent with ratings and written narratives, both approaches significantly quelled tension at the brow (*corrugator*) muscle associated with negative emotion (Witvliet & Vrana, 1995).

The opposite also occurred: both compassion-focused reappraisal and benefit-focused reappraisal moved valence ratings from the negative side of the scale to the positive side, and

significantly up-regulated control, happiness, and joy. Dovetailing with this pattern, the written narratives showed an increase in positive emotion.

Manipulation checks showed that compassion-focused reappraisal prompted the highest empathy ratings and most forgiveness language. Similarly, benefit-focused reappraisal yielded the most benefit language and highest gratitude ratings and word counts. Even so, compassion-focused reappraisal not only prompted forgiveness, but also recognition of benefits and an increased in gratitude—a relationship not previously tested in the literature. Showing the opposite influence, benefit-focused reappraisal not only stimulated writing about one's benefits and increased gratitude, but also forgiveness toward the offender. This pattern replicates a self-report finding by McCullough et al. (2007). When bolstered by benefits—and experiencing the greatest joy—people were motivated to spread their up-regulated positive emotion through forgiveness for the offender.

The positive valence of these compassion-focused reappraisal and benefit-focused reappraisals may have a spill-over effect that generates a broadly positive response set, consistent with Fredrickson's (2001) broaden and build theory of positive emotion. When people work through the process of forgiving or benefit-focused reappraisal, they engage the hurt, interpret its significance, and reshape their response to the offender in a way that integrates the hurtful offense with a larger view of reality. This refocuses victims' attentional, motivational, and emotional processing on cultivating more merciful, positive, prosocial responses to the offender or on recognizing benefits gained in the face of adversity, such as lessons learned, insights gained, or strengths shown. Insofar as forgiveness or benefit-focused reappraisal involve active attempts to reappraise the transgressor and the transgression, these positive reappraisals not only

down-regulate negative and aroused responses, but also up-regulate positive and calmer responses, as indicated by changes in affective ratings, language, and physiology.

Compassion-focused Reappraisal as an Approach to Forgiveness

The current data advance our understanding of the unique effects of compassion for the offender as an approach to forgive. The compassion-focused reappraisal condition prompted participants to cognitively reappraise the offender as a human being whose behavior shows that person's need to experience a positive transformation or healing. Participants were instructed to try to genuinely give a gift of mercy, compassion, and wish that person well. Compassion-focused reappraisal uniquely increased social language in the written narratives, compared to rumination and to benefit-focused reappraisal. These findings are consistent with theorizing about altruistically oriented forgiveness as a positive and prosocial expression of love for one's enemy against the backdrop of the hurtful transgression (see Witvliet & McCullough, 2007). The empathy and forgiveness data dovetail with findings from an experimental study of prosocial forgiveness (Witvliet et al., 2001), and the social language data extend existing findings in theoretically consistent ways.

Physiologically, compassion-focused reappraisal had unique effects on the face and heart. Compassion-focused reappraisal reliably decreased *orbicularis oculi* EMG under the eye and reliably slowed the cardiac cycle, as evident in lengthened R-R (beat-to-beat) intervals in the electrocardiogram. Both of these effects are consistent with reductions in affective arousal as found in basic emotion research using an emotional imagery paradigm (Witvliet & Vrana, 1995).

Benefit-focused Reappraisal in Relationship to Gratitude

This study also advances the literature testing the relationship between a focus on benefits as a way to cultivate gratitude (Emmons, 2008; Emmons & McCullough, 2003).

Conceptualized as the ability to appreciate and to be thankful for benefits recognized or gained in the face of an interpersonal transgression, benefit-focused reappraisal stimulated significantly greater gratitude ratings and writing (as well as benefit language) than compassion-focused reappraisal. Benefit-focused reappraisal stimulated the highest levels of joy along with concomitant increases in *zygomatic* (smile) EMG, fully consistent with basic affective psychophysiology research findings for joy (Witvliet & Vrana, 1995).

Cardiovascular heart rate variability (HRV) data highlight that—similar to appreciation effects (McCraty et al., 1995)—benefit-focused reappraisal buffered the parasympathetic nervous system, countering the reductions in HRV associated with rumination. Future efforts to tease apart sympathetic and parasympathetic nervous system effects may prove fruitful in charting the affective and physiological pathways through which benefit-focused reappraisal may accrue health benefits (Bower et al., 2008).

Opposite to compassion-focused reappraisal, benefit-focused reappraisal narratives were significantly less focused on others than offense rumination. The linguistic data reflect the nature of the reappraisals in that benefit-focused reappraisal explicitly focused participants on themselves and their own perceived benefits, whereas compassion-focused reappraisal was centered on compassionately and generously reappraising the offender in a way that stimulated the granting of forgiveness to that offender. Benefit-focused reappraisal is a less social, more self-focused coping approach that may be a more attractive positive reappraisal for individuals who are not motivated or ready to engage in compassion-focused forgiveness. Despite its focus on receiving benefits for the self, however, benefit-focused reappraisal did stimulate intrapsychic forgiveness both in the current study and in McCullough et al.'s (2007) study.

Summary, Limitations, and Conclusions

The current results suggest that the use of either reappraisal strategy is more psychologically and physiologically beneficial than engaging in offense rumination. These findings converge with efforts to incorporate forgiveness and gratitude in cognitive therapy (Bono & McCullough, 2006). Still, a limitation of the current study is that in this 90-minute paradigm, we could sample only one induction of each offense-related response. Future research may test whether gains can increase with repeated inductions, and whether such gains are maintained for longitudinal assessments. Such work would have useful implications for the types of cognitive interventions that Bono and McCullough (2006) have begun to explore.

Each reappraisal approach exhibited unique effects. Compassion-focused reappraisal was the most socially oriented response, generating the highest empathy and forgiveness language. Complementing this prosocial response set, was a calmer physiological responses on two measures tied to affective arousal in repeated measures research (Witvliet & Vrana, 1995). Compassion-focused reappraisal was uniquely associated with more subdued tension under the eye (*orbicularis oculi*) and cardiac beat-to-beat intervals.

Benefit-focused reappraisal stimulated the highest levels of gratitude ratings and writing, and also differed most from the negative emotion probe used in Latent Semantic Analyses. Benefit-focused reappraisal prompted the greatest subjective experience of joy, consistent with a unique increase in cheek muscle activity (*zygomatic*) suggestive of smiling (Witvliet & Vrana, 1995). Furthermore, heart rate variability (HRV) indicators of parasympathetic functioning were significantly higher for benefit-focused reappraisal in comparison to ruminating. Through its effects on the body's calming, regulating system, benefit-focused reappraisal appears especially effective in countering rumination's impairing effects on the parasympathetic nervous system.

One's choice of a reappraisal strategy may hinge largely on whether one's post-transgression orientation is more self-protective or other-directed. A self-protective state or disposition may direct one first toward benefit-focused reappraisal. An other-directed state or trait may make compassion-focused reappraisal one's first choice. Regardless of the reappraisal strategy people adopt to cope with their interpersonal offense, they may stimulate a positive emotional shift that promotes their forgiveness and gratitude. For people who struggle with genuinely offering forgiveness or compassion to their offenders in an altruistic way, choosing benefit-focused reappraisal will still facilitate forgiveness. For those who have difficulty finding the "silver lining" of the offense they suffered, adopting a compassionate response toward their offender may still stimulate feelings of gratitude. Both approaches subdued negative emotions and prompted positive emotions, enhancing psychophysiological well-being. Future investigations may fruitfully explore whether cultivating these responses over time can change one's disposition in ways that promote long-term well-being and flourishing.

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[1] Emotion regulation strategies are categorized into *antecedent-focused* strategies, which are employed to influence responses prior to the full experience of an emotional event, and *response-focused* strategies, which are used after experience of an emotion to down- or up-regulate its effect (Gross, 1998). Such strategies may be employed consciously or automatically. Studies focusing on emotion regulation timing features typically present novel emotion-eliciting sensory stimuli in the lab (e.g. Gross & Levenson, 1997; Gross, 1998). In assessing an emotional response to a real-life interpersonal offense, however, the pre-existence of the emotional event may not allow for the categorization of emotion regulation strategies using time unless it is calculated in relationship to the onset of memory activation.

[2] Latent semantic analysis (LSA: http://lsa.colorado.edu) was used to investigate the similarity of participants' language in these paragraphs compared to affective texts within the context of a repertoire of Western writing. LSA does not count words, but rather simulates representations of human knowledge. LSA uses a semantic corpus based on a large repertoire of Western writing from the third grade level through the first year of college and then applies a technique similar to factor analysis (singular value decomposition). Within the semantic space, LSA determines the similarity of two texts by calculating a cosine value. Here, we compared the narrative a participant produced in an experimental condition to a comparison positive emotion text, and then to a negative emotion text. Thus, for each emotion word probe (positive and negative), each participant has a cosine for each experimental condition (compassion-focused reappraisal, benefit-focused reappraisal, and rumination).

[3] An LIWC dictionary of benefit words was created for the current study based on words present in participants' written paragraphs. Because analyses with our benefit dictionary yielded the same results as using the one developed by McCullough et al. (2006), we report the results using their dictionary. Our LIWC forgiveness word dictionary was: altruism, amend*, compassion*, empath*, forgave, forgiv*, love*, loves*, loving*, merciful*, mercy*, sympath*, appreciativ*. Our Gratitude Word Dictionary for LIWC was: blessed, glad, gladness, grateful*, gratitude, thank*. Two raters—blind to condition—developed mutually exclusive forgiveness and gratitude categories from a random order of participant responses. Raters separately determined whether to accept or reject each word based on goodness of fit in its designated category. Inter-rater reliability was 100% for gratitude and 97% for forgiveness, with consensus used to discard two forgiveness words and reach 100% agreement.

[4] To serve as a ground, we attached skin conductance level pre-gelled Biopac EL507 snap electrodes fitted to LEAD110A electrode leads placed on the index and middle fingers of the left hand. Data were sampled at 62.5 HZ and amplified by a Biopac GSR100C electrodermal response amplifier set for a gain of 5 mho/V. As in other imagery studies, only habituation was found.

Facial electromyography activity (EMG) was measured (Biopac EMG 100C units) on a second-to-second basis for the *zygomaticus* (cheek) muscle, *orbicularis oculi* (under eye) muscle, and *corrugator supercilii* (brow) muscle regions using two 4 mm EL258RT Biopac Ag-AgCl electrodes placed at each site on the left side of the face. Skin was first prepared with an alcohol pad and Biopac Gel 100. Each electrode was fitted with a Biopac ADD204 adhesive collar and filled with gel. EMG was sampled at 2000 Hz amplified by Biopac EMG100C amplifiers set for a gain of 1000 and using 10 Hz high-pass and 5 kHz low-pass filters. EMG data was first digitally filtered using the Comb Band Stop Filter to select the line frequency at 60 Hz and overharmonics selecting all up to the Nyquist frequency. Data were filtered using the FIR Bandpass option to select the Bartlett window with a low frequency cutoff fixed at 28, high frequency cutoff fixed at 500, and Q coefficients set to 286. Next the EMG data were rectified and integrated by averaging over 10 samples and taking the root mean square of the entire wave form.

Electrocardiogram (ECG) data were measured by placing one Biopac pre-gelled El503 snap electrode fitted to a Lead110S on the left rib and one on the right clavicle. Rubbing alcohol was used to clean each electrode placement site. Heart rate data was sampled at 1000 Hz and amplified by 1000 Hz using the Biopac ECG100C electrocardiogram amplifier. Continuous R-R intervals were calculated in seconds for each condition using ECG data.

The Heart Rate Variability Specialized Analysis function of Acqknowledge used methods and produced values that were not consistent with guidelines and expected ranges based on the Task Force (1996) paper. Using the standards published by the Task Force (1996), Paul DeYoung wrote a software program that followed the specifications published for calculating and using the High Frequency component of the power spectrum to determine the parasympathetic contribution to the cardiac cycle. The 120-s trial R-R data were interpolated with cubic splines and then 1024 uniformly spaced values were calculated. A Welch periodogram estimate of the Power Spectrum Density (PSD) was calculated from the Fast Fourier Transform of de-trended subintervals of the 120-s period (7 segments with a 50% overlap). Each subinterval was multiplied by a Hamming window. Results were cross validated with two other programs (HRV Analysis Software 1.1 from the Biomedical Signal Anlaysis Group, Deparntment of Applied Physics, University of Kuopio, Finland; Mindware HRV 2.51). We also calculated correlations with values produced using the Root Mean Squared Successive Differences method (all $rs \geq .8$), and we report the RMSSD results below.

[5] As a comparison to spectral analysis, we used the time domain method of calculating the square root of the mean of the sum of the squares of the differences between consecutive R-R intervals (RMSSD). RMSSD is sensitive to the high frequency indicators of parasympathetic activation, but it also includes some lower frequency fluctuations indicative of sympathetic contributions (Berntson, Lozano, & Chen, 2005). The benefit-focused reappraisal effect on HRV was more reliable for the HF than for the RMSSD method. Only the benefit-focused RMSSD was marginally higher than the relevant offense RMSSD, $F(1, 61) = 3.95$, $p = .051$, partial $\eta^2 = .06$, consistent with Berntson et al.'s (2005) characterization of HF as preferable for repeated measures analyses of HRV.

Table 1

Means, Degrees of Freedom, (1,70), and F values for Ratings, Latent Semantic Analysis, and Linguistic Inquiry and Word Count

	Offense (C)[a] vs. Compassion-Focus				Offense (B)[b] vs. Benefit-Focus				Compassion Effect vs. Benefit Effect[c]			
Dependent Variable	*M*	*M*	*F*	partial η^2	*M*	*M*	*F*	partial η^2	*M*	*M*	*F*	partial η^2
Ratings (1 to 7 range, -6 to 6 change)												
Arousal	4.18	3.10	33.31***	.32	4.31	3.38	21.84***	.24	-1.09	-0.93	0.28	.01
Valence	2.79	4.75	123.00***	.64	2.83	4.96	113.62***	.62	1.96	2.13	0.41	.01
Control	4.01	4.82	19.15***	.22	4.09	4.93	12.89***	.16	0.80	0.85	0.03	.00
Anger	4.23	2.49	68.45***	.49	4.23	2.35	87.26***	.56	- 1.73	-1.87	0.34	.01
Happiness	2.39	3.97	68.21***	.49	2.41	4.48	90.03***	.56	1.58	2.07	3.36	.05
Joy	2.20	3.51	54.95***	.49	2.07	4.23	116.98***	.63	1.31	2.16	10.84**	.13
Empathy	2.79	4.94	110.27***	.61	2.80	4.27	57.44***	.45	2.16	1.47	6.94*	.09
Emotional Forgiveness	3.00	4.96	94.83***	.58	2.86	4.48	56.51***	.45	1.96	1.62	2.12	.03
Gratitude	2.55	4.11	55.35***	.44	2.59	4.78	96.05***	.58	1.56	2.18	3.95*	.05

Table 1 continued…

…Table 1 continued

	Offense (C)[a] vs. Compassion-Focus				Offense (B)[b] vs. Benefit-Focus				Compassion Effect vs. Benefit Effect[c]			
Dependent Variable	*M*	*M*	*F*	partial η^2	*M*	*M*	*F*	partial η^2	*M*	*M*	*F*	partial η^2
Latent Semantic Analysis (Cosines of Distance from Probe Type)												
Positive Emotion Language	0.17	0.22	17.38***	.20	0.17	0.21	11.00**	.14	0.05	0.03	0.63	.01
Negative Emotion Language	0.29	0.26	5.26*	.07	0.30	0.23	39.00***	.36	-0.03	-0.07	4.28*	.06
Linguistic Inquiry and Word Count (Word Count)												
Social Words	9.73	13.78	32.43***	.32	10.62	8.35	6.55*	.09	4.05	-2.27	27.07***	.28
Positive Affective Words	3.01	9.16	41.95***	.38	3.18	9.94	65.98***	.49	6.15	6.76	0.21	.00
Negative Affective Words	8.02	2.91	40.83***	.32	8.35	3.01	67.062***	.49	-5.10	-5.35	0.08	.00
Anger Words	3.37	0.94	19.67***	.22	4.12	1.17	37.77***	.35	-2.43	-2.95	0.72	.01
Cost Words	5.39	1.60	42.74***	.38	5.12	1.94	36.63**	.34	-3.79	-3.25	0.48	.01
Forgiveness Words	0.36	2.79	18.88***	.21	0.39	0.95	5.07*	.07	2.43	0.56	12.84***	.16
Benefits Words	1.49	4.47	35.78***	.34	1.40	5.74	68.16***	.50	2.98	4.34	4.04*	.06
Gratitude Words	0.07	0.19	1.17	.02	0.04	1.00	17.30***	.20	0.12	0.97	10.76**	.13

Note. [a] Offense conditions before Compassion-Focused Reappraisal conditions. [b] Offense Conditions before Benefit-Focused Reappraisal conditions. [c] Offense (before Compassion) subtracted from Compassion, compared to Offense (before Benefit-Focus) subtracted from Benefit-Focus. $^{*}p \leq .05$. $^{**}p \leq .01$. $^{***}p \leq .001$.

Table 2

Physiological Changes from Pretrial Baseline: Means, F Values, and Degrees of Freedom for the Repeated Measures Multivariate Analyses of Variance

	Offense (C) vs. Compassion-Focus					Offense (B) vs. Benefit-Focus				
Dependent Variable	*M*	*M*	*F*	*(df)*	partial η^2	*M*	*M*	*F*	*(df)*	partial η^2
EMG (μV)										
Zygomatic	0.112	0.090	0.11	1,51	.00	0.083	0.223	4.77*	1,50	.09
Corrugator	1.202	0.269	11.54***	1,53	.18	1.867	0.925	4.65*	1,53	.08
Orbicularis Oculi	1.165	0.440	5.31*	1,59	.08	0.775	1.189	1.64	1,57	.03
Cardiovascular Measures										
R-R Interval Average (msec)	-12.817	0.539	6.81**	1,64	.10	-12.760	-8.811	0.43	1,63	.01
High Frequency HRV (ms^2)	-109.085	-45.856	0.21	1,58	.00	-300.370	118.197	13.11***	1,61	.18

…Table 2 continued

…Table 2 continued

Physiological Means, F Values, and Degrees of Freedom for the Repeated Measures Analyses of Variance Multivariate Analyses

	Compassion-Focus Effect vs. Benefit-Focus Effect				
Dependent Variable	*M*	*M*	*F*	*(df)*	partial η^2
EMG (μV change)					
Zygomatic	-0.019	0.155	3.07	1,43	.07
Corrugator	-1.120	-0.544	1.55	1,47	.03
Orbicularis Oculi	-0.772	0.316	7.66**	1,54	.12
Cardiovascular Measures(change)					
R-R Interval Average (msec)	14.040	5.055	1.28	1,62	.02
High Frequency HRV (ms^2)	64.451	392.713	3.19	1,57	.05

Note. [a] Offense conditions before Compassion-Focused Reappraisal conditions. [b] Offense Conditions before Benefit-Focused Reappraisal conditions. [c] Offense (before Compassion) subtracted from Compassion, compared to Offense (before Benefit-Focus) subtracted from Benefit-Focus. $^{*}p \leq .05$. $^{**}p \leq .01$. $^{***}p \leq .001$.

Figure Captions

Figure 1. Both compassion-focused and benefit-focused reappraisals significantly reduced *corrugator* (above the brow muscle) EMG activity compared to their preceding offense imagery periods. Bars indicate 95% confidence intervals. *p < .05, *** p < .001.

Figure 2. Only compassion-focused reappraisal significantly decreased *orbicularis oculi* (under the eye muscle) EMG activity compared to its preceding offense imagery period. benefit-focused reappraisal did not have a significant effect compared to its preceding offense imagery period. Bars indicate 95% confidence intervals. *p < .05.

Figure 3. Only benefit-focused reappraisal significantly increased *zygomaticus* (cheek muscle) EMG activity compared to its preceding offense imagery period. Compassion-focused reappraisal had no significant effect compared to its preceding offense imagery. Bars indicate 95% confidence intervals. *p < .05.

Figure 4. Only compassion-focused reappraisal significantly slowed average R-R intervals compared to its preceding offense imagery period. benefit-focused reappraisal had no significant effect. Bars indicate 95% confidence intervals. **p < .01.

Figure 5. Only benefit-focused reappraisal significantly buffered the High Frequency (HF) indicator of Heart Rate Variability (HRV) compared to its preceding offense imagery period. compassion-focused reappraisal had no significant effect. Bars indicate 95% confidence intervals. ***p < .001.

Figure 1

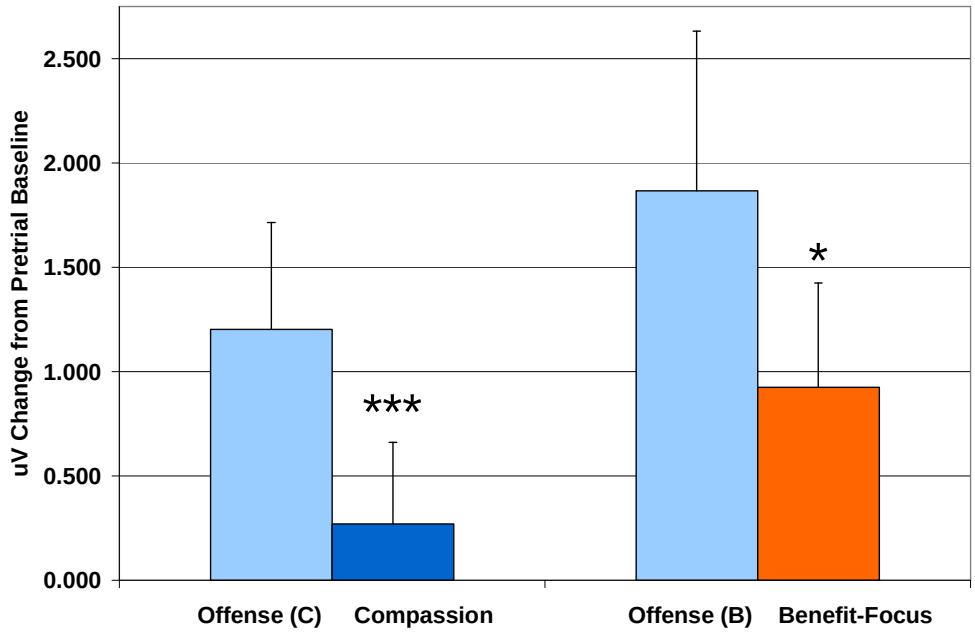


Figure 2

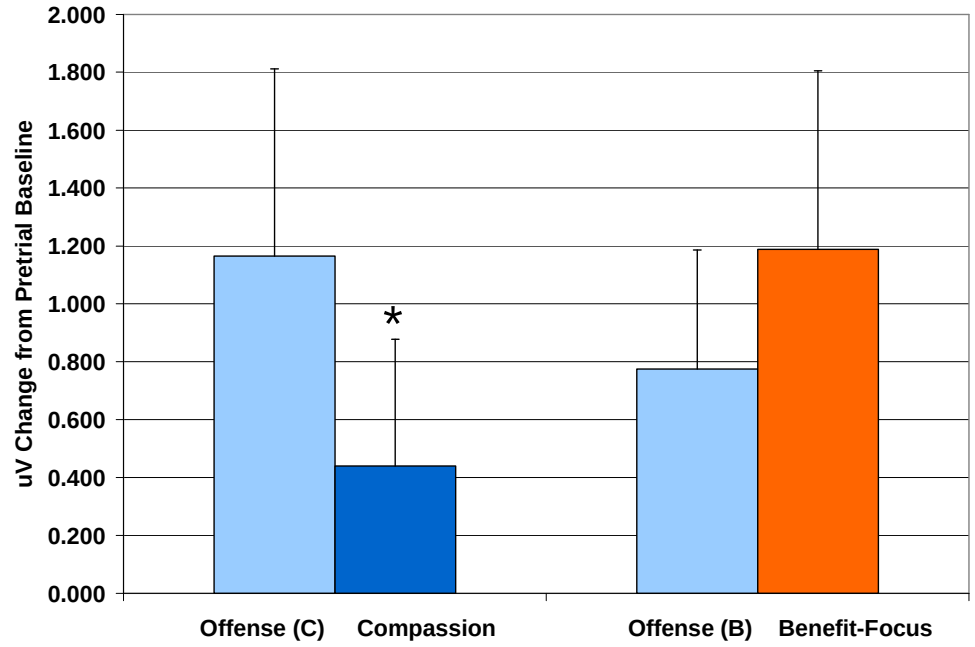


Figure 3

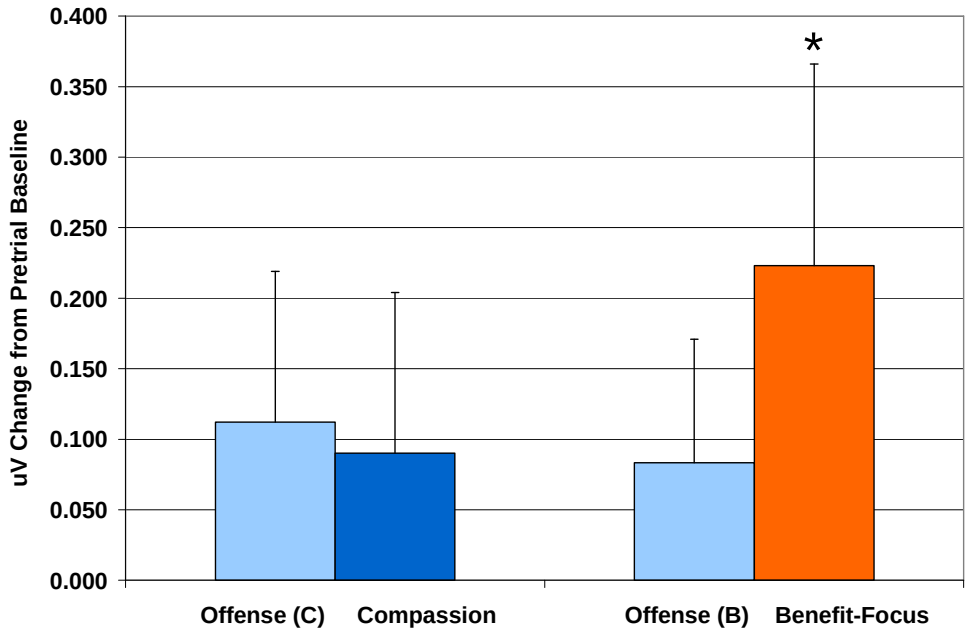


Figure 4

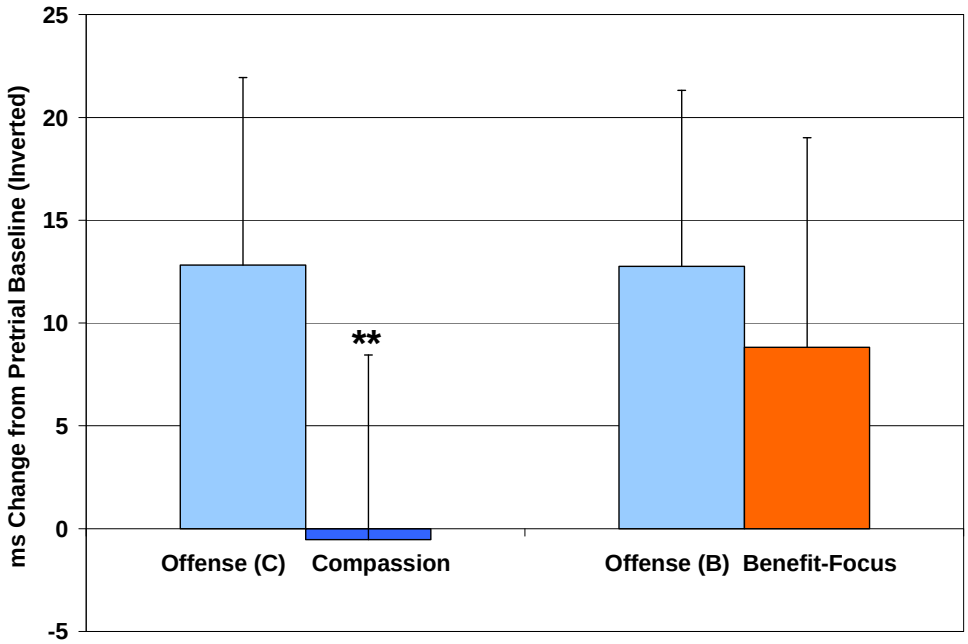
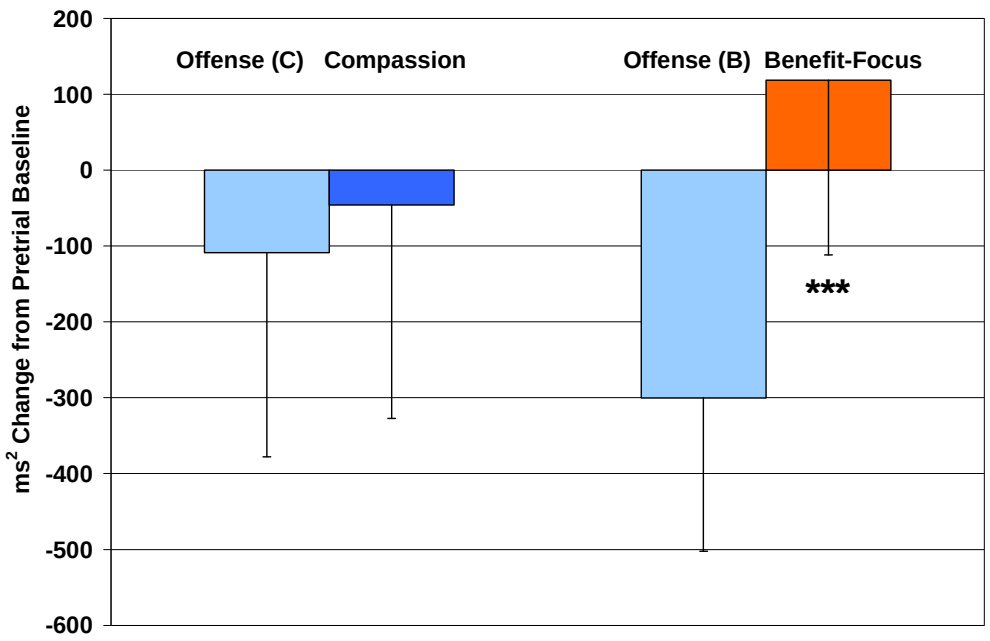


Figure 5


200
100
0
-100
-200
-300
-400
-500
-600
ms2 Change from Pretrial Baseline
Offense (C) Compassion
Offense (B) Benefit-Focus
***