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Positive reappraisals after an offense: Event-related potentials and emotional effects of benefit-finding and compassion

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Positive reappraisals after an offense: Event-related potentials and emotional effects of benefit-finding and compassion

Using a within subjects design, three emotion regulation strategies (compassion-focused reappraisal, benefit-focused reappraisal, and offense rumination) were tested for their effects on forgiveness, well-being, and event-related potentials (ERPs). Participants (N = 37) recalled a recent interpersonal offense as the context for each emotion regulation strategy. Both decisional and emotional forgiveness increased significantly for the two reappraisal strategies compared to offense rumination. Compassion-focused reappraisal prompted the greatest increase in both decisional and emotional forgiveness. Furthermore, both reappraisal strategies increased positively oriented well-being measures (e.g., joy, gratitude) compared to offense rumination, with compassion-focused reappraisal demonstrating the largest effect on empathy. Late positive potential (LPP) amplitudes in response to unpleasant affect words were larger following the benefit-focused reappraisal strategy, indicating frontal LPP augmentation due to affective incongruence of the unpleasant stimuli with the positive, silver-lining orientation of the benefit-focused reappraisal emotion regulation strategy.

Keywords: Forgiveness; empathy; reappraisal; compassion; benefit-finding; late positive potential; event related potential

Positive reappraisals after an offense: Event-related potentials and emotional effects of benefit-finding and compassion

Forgiveness is a moral response that also promotes one's overall health and well-being following an interpersonal offense (Karremans, Van Lange, Ouwerkerk, & Kluewar, 2003; Lawler, Younger, Piferi, Jobe, Edmondson, & Jones, 2005; Witvliet, DeYoung, Hofelich, & DeYoung, 2011; Witvliet, Knoll, Hinman, & DeYoung, 2010; Witvliet, Ludwig, & Vander Laan, 2001). Specifically, forgiveness decreases symptoms of depression and anxiety (Freedman & Enright, 1996), anger and grief (Coyle & Enright, 1997), and posttraumatic stress disorder (Orcutt, Pickett, & Pope, 2005, 2008). Furthermore, forgiveness improves one's physical health evidenced by a decrease in somatic complaints, fatigue symptoms, and amount of prescription medications used (Lawler et al., 2005).

Recently, interpersonal forgiveness has been studied in relation to emotion regulation strategies (Hodgson & Wertheim, 2007; Witvliet et al., 2010, 2011; Witvliet, Hofelich Mohr, Himan, & Knoll, 2015). Forgiveness is a moral response to a person responsible for a perceived interpersonal injustice, and forgiveness involves shifts in cognition that are tied to emotion. Emotion regulation is understood as a way that individuals may modify their emotional experience or expression (Gross, 1998). Specifically, reappraisal is a cognitive strategy demonstrated to alleviate unpleasant emotions associated with a stressful event and aid in decreasing anxiety, depression, and substance use (Aldao, Nolen-Hoeksema, & Schweizer, 2010). Two types of reappraisal have been studied in interpersonal forgiveness contexts. Compassionate reappraisal and benefit-focused reappraisal have each promoted other-oriented responses (e.g., empathy,

forgiveness) and pleasant emotion, while decreasing unpleasant emotions (e.g., anger, sadness) following an interpersonal event (e.g., Witvliet et al., 2010).

Rumination about a past experience is also an emotion regulation strategy of repeatedly returning to the cognitions, affect, and consequences of the precipitating event (Gross, 2007). Rumination is often associated with increased negative affect such as anger and sadness (Witvliet et al., 2010, 2011, 2015) that is strongly associated with increased symptoms of pathology such as depression, anxiety, eating, and substance-related disorders (Aldao & Nolen-Hoeksema, 2010; Aldao et al., 2010).

Building upon the work of Witvliet et al. (2010), we aim to examine the effects of specific emotion regulation strategies (compassion-focused reappraisal, benefit-focused reappraisal, and offense rumination) following an interpersonal offense, on participants' likelihood of granting decisional and emotional forgiveness. In addition to self-report measures, we included neurophysiological measures to contribute to what is known about participants' rumination and reappraisal processing of emotional sequelae following an interpersonal offense.

Forgiveness Type: Decisional and Emotional Forgiveness

Fitzgibbons (1986), in an article examining forgiveness as an intervention for the treatment of anger, was the first to conceptualize decisional and emotional forgiveness as distinct constructs. Since this early article, *decisional forgiveness* has come to be defined in cognitive and behavioral terms as an intentional choice to reduce one's behavior of acting in an unforgiving manner and to respond differently towards the transgressor, either by reducing negative behavioral intentions or increasing positive behavioral intentions, or

both (Exline, Worthington, Hill, & McCullough, 2003; Worthington, Witvliet, Pietrini, & Miller, 2007). By contrast, *emotional forgiveness* is understood as a reduction or even a possible elimination of negative emotions associated with an unforgiving response style, by replacing such emotions with positive prosocial emotions (Exline et al., 2003). This transformation of thoughts, feelings, and behaviors, such as when a victim focuses on reducing outwardly vengeful and avoidant responses, and replacing them with expressions of empathy and compassion towards an undeserving perpetrator, may involve physiological changes that result in a greater likelihood of improvement in one's overall physical health and well-being (Witvliet et al., 2010, 2011, 2015; Worthington et al., 2007).

Empathy as a Predictor of Forgiveness

Researches have shown that empathy is an important predictor of granting forgiveness to others (Fehr, Gelfand, & Nag, 2010; McCullough et al., 1998; McCullough, Worthington, & Rachal, 1997, Sandage & Worthington, 2010). Empathy is defined as 'an other-oriented emotional response congruent with the perceived welfare of another person (if the offender is in need, empathy includes feeling sympathetic, softhearted, compassionate, tender, and the like)' (Batson, Klein, Highberger, & Shaw, 1995, p. 1042). In a seminal meta-analysis, Fehr et al. (2010) found that state empathy was the strongest predictor of granting interpersonal forgiveness. Two separate studies demonstrated that empathy mediated participants' forgiveness scores regardless of which intervention they received (Sandage & Worthington, 2010), or which coping condition they were randomly assigned (Witvliet et al., 2015). Empathy is also strongly linked to compassion in participants completing cognitive reappraisal strategies following an interpersonal offense (Witvliet et al., 2010, 2011, 2015).

Compassion-focused Reappraisal and Benefit-focused Reappraisal

Two reappraisal strategies—compassion-focused reappraisal and benefit-focused reappraisal—are effective coping strategies that prompted emotional forgiveness following an interpersonal offense (Witvliet et al., 2010). Compassion-focused reappraisal is conceptualized as an other-oriented focus on the offender as a human being whose behavior shows that person's need to experience a positive transformation or healing; it encourages the victim to find a way to give a gift of mercy and genuinely wish that offender well—perhaps by experiencing growth, transformation, or healing—while at the same time holding the offender accountable for his or her offense. Benefit-focused reappraisal focuses on the victim's attention on the self and tries to think of the unwanted offense as nevertheless being an opportunity to grow, learn, or become stronger; it encourages the victim to think of benefits one may have gained from the experience such as self-understanding and insight. In a repeated measures design, Witvliet et al. (2010) found that both reappraisal strategies decreased arousal and anger when compared to offense rumination. Additionally, measures of emotional valence, control, happiness, joy, empathy, emotional forgiveness, and gratitude all increased when utilizing the two reappraisal strategies compared to offense rumination. More specifically, compassion-focused reappraisal demonstrated a greater increase in empathy ratings and forgiveness language use compared to benefit-focused reappraisal, whereas benefit-focused reappraisal demonstrated a greater increase in joy and gratitude ratings compared to compassion-focused reappraisal.

Emotion Regulation and Event Related Potentials

The study of participants' electrophysiological response is a useful method of

understanding the neural processes of emotion regulation (e.g., Hajcak, MacNamara, & Olvet, 2010). The late positive potential (LPP), a positive slow-wave event related potential (ERP) normally occurring approximately 300–2,000 ms post-stimulus is a measure used in the study of emotion regulation. The LPP is larger following the introduction of both pleasant and unpleasant stimuli, such as pictures and words, when compared to neutral stimuli (e.g., Dillon, Cooper, Grent-'t-Jong, Woldorff, & LaBarr, 2006; Hajcak, Moser, & Simons, 2006; Hajcak & Nieuwenhuis, 2006; Krompinger, Moser, & Simons, 2008).

In two separate studies by Hajcak and Nieuwenhuis (2006) and Hajcak et al. (2006), cognitive reappraisal modified the emotional response to a stimulus as evidenced by a change in the LPP. In the first study, Hajcak and Nieuwenhuis (2006) instructed participants to reappraise an unpleasant picture in a way that decreased the negative emotional valence of the picture, by reappraising the presented stimuli to have a positive outcome. Following training in use of this reappraisal strategy, participants completed trials, half of which prompted them to reappraise unpleasant pictures, and half of which instructed them to simply attend to the picture and allow normal emotional responses to occur. Cognitive reappraisal of the presented stimuli decreased the negative emotional valence experienced by the participants, as evidenced by a reduction of the LPP amplitude.

In the Hajcak et al. (2006) study, participants completed three experimental blocks: a passive viewing block, an affective decision-making block, and a non-affective decision-making block. Results indicated that the LPP was enhanced while viewing the pleasant and unpleasant images during the passive viewing block. Furthermore, the LPP was significantly reduced during the non-affective decision-making block compared to the affective decision-making block.

Additional studies demonstrated the LPP to be sensitive to positive and negative valenced stimuli. Krompinger, Moser, and Simons (2008) found increased LPP amplitudes to positive, highly arousing images compared to neutral images. Furthermore, they found decreased LPP amplitudes to positive images following instructions to cognitively reappraise the image in a way so as to decrease one's emotional response. The authors were unable to demonstrate any up-regulation of the LPP following the enhance instructions, suggesting a ceiling effect of depleted attentional resources to the already emotionally salient stimuli.

Similar results with unpleasant stimuli were also demonstrated (Moser, Hajcak, Bukay, & Simons, 2006). Researchers found that LPP amplitudes were larger following the presentation of unpleasant arousing images compared to neutral images. They also demonstrated that instructions to cognitively reappraise the arousing images to decrease one's emotions led to attenuated LPP waves. As found with the pleasant images, instructions to further enhance emotions in a negative direction did not increase LPP amplitudes, again suggesting a ceiling effect to the arousing unpleasant stimuli.

This study will examine whether neurophysiological changes will occur when modulating one's emotional response to pleasant and unpleasant word stimuli following each emotion regulation strategy. Specifically, we predict that positive reappraisal strategies, compared to a ruminative harboring of unpleasant cognitions and feelings, will decrease one's focus on unpleasant features following an interpersonal offense and increase one's focus on positive attributes and emotions. However, the two positive reappraisal strategies we study differ in important ways. Compassionate reappraisal acknowledges the wrongdoing by the responsible perpetrator and then seeks to find a way

to wish the offender well by drawing on insights about the offense which show how the offender clearly needs to grow or change. In that way, compassionate reappraisal has congruence with the negative emotion associated with remembering the harm while also using them to pivot in a new direction of mercy. Benefit-finding or reminding is focused on a response that emotionally contrasts with the negative valence of remembering the hurtful offense. Benefit-focused reappraisal focused exclusively on the good that was gained in facing the offense (e.g., insights, learning, growth, strengths shown). The emotional contrast of benefit-focused reappraisal compared to the offense situation is striking.

Current Study

Building upon the existing literature of emotion regulation, sensitivity of the LPP to emotional stimuli, and previous forgiveness research, the current study used a within subjects design to investigate the explicit and implicit effects of three emotion regulation strategies. More specifically, this study focused on compassion-focused reappraisal, benefit-focused reappraisal, and offense rumination as three separate emotion regulation strategies that an individual may employ following an interpersonal offense. The effects of these strategies were tested on explicit measures of decisional and emotional forgiveness, well-being measures, emotional experience ratings, and implicit measures of participants' electrophysiological responses.

Hypotheses 1-2: Emotion Regulation, Empathy, and Forgiveness

We hypothesized that compassion-focused reappraisal and benefit-focused reappraisal will increase participants' empathy and both their decisional and emotional forgiveness

scores compared to the offense rumination strategy (Hypothesis 1). Additionally, we predicted that participants' empathy, decisional and emotional forgiveness scores will be highest when using the compassion-focused reappraisal strategy (Hypothesis 2), based on experimental research comparing these emotion regulation strategies (Witvliet et al., 2010), research showing learning compassion can prompt increased empathy even when later remembering the offense (Witvliet et al., 2015), and a landmark meta-analysis pointing to empathy as a strong predictor of granting forgiveness (Fehr et al., 2010).

Hypotheses 3-4: Emotion Regulation, Responses to Affective Words, and Ratings

Following the work of Witvliet et al. (2010), we hypothesized that for both reappraisal conditions versus offense rumination, participants will demonstrate increased scores on emotional congruency with pleasant affect words as well as higher ratings of emotional valence, peace, gratitude, happiness, and joy (Hypothesis 3).

Furthermore, we predicted that offense rumination will demonstrate the highest scores for emotional congruency with unpleasant affect words, as well as the highest ratings of anger, sadness, and arousal (Hypothesis 4). In previous studies, rumination has been demonstrated to increase self-report ratings of anger and sadness (Witvliet et al., 2010, 2011) as well as exacerbate symptoms attributed to depression and anxiety (Aldao & Nolen-Hoeksema, 2010; Aldao et al., 2010).

Hypotheses 5-6: Emotion Regulation Type and Neurophysiology

For the electrophysiological LPP responses, we hypothesized that when viewing unpleasant affect words, both reappraisal strategies (compassion-focused and benefit-focused) will decrease LPP amplitudes compared to the offense rumination (Hajcak &

Nieuwenhuis, 2006; Moser et al., 2006) (Hypothesis 5). We also predicted that when viewing pleasant affect words, both reappraisal strategies will demonstrate an increase in LPP amplitudes compared to the offense rumination paradigm (Hypothesis 6), as both pleasant and unpleasant stimuli have shown to augment LPP amplitudes (Hajcak et al., 2006; Krompinger, Moser, & Simons, 2008).

Method

Participants

Forty-five participants were recruited from undergraduate psychology courses at a liberal arts university in the western United States. In exchange for their participation, students were awarded class credit or extra credit for completion of the experiment. Of the 45 participants, 7 were excluded due to incomplete ERP data or due to computer errors. Additionally, one participant was excluded due to not being able to identify an interpersonal offense. The demographic breakdown of the remaining 37 participants was as follows: 92% female; 54% Caucasian, 16% Asian/Asian-American, 16% Latino-Latina Origin/Hispanic, 8% Biracial/Multicultural, 6% other. Participants ranged in age from 18 to 23 ($M = 19.3$ years, $SD = 1.37$).

Measures

Interpersonal offense questionnaire. Following demographic questions (age, gender, handedness, and ethnicity), participants were asked to write out a short description of a recent interpersonal offense and answer a series of questions. Example scenarios were provided to help participants recall and imagine a hurtful offense that they may have experienced in their life. After participants chose a specific interpersonal offense, they completed a series of Likert-scale questions regarding the situation, including the severity

of the offense, frequency, relationship to their offender, and grudge-holding and revenge-seeking attitudes.

Forgiveness and well-being measures. Participants rated several forgiveness and well-being measures (e.g., decisional and emotional forgiveness; happiness, joy, and anger) on 7-point Likert-scale ratings in which 1 represented *not at all* and 7 represented *completely*, based on work by Witvliet et al. (2010).

Emotional congruency. Participants rated their emotional congruency on a six-point Likert-scale, following the presentation of each pleasant and unpleasant affect word during the experiment.

Affective norms for English words. Pleasant and unpleasant affect words were chosen from the Affective Norms for English Words (ANEW) database (Bradley & Lang, 1999). Twenty-five unpleasant descriptive words were chosen on the basis of words commonly associated with unforgiveness¹ (e.g., betrayal, anger, and resentment; Worthington et al., 2007).

Twenty-five pleasant words were chosen on the basis that the words describe how people may feel towards someone whom they have forgiven² (e.g., gratitude, love, and acceptance; Worthington et al., 2007). All words chosen were matched on word arousal values with no

¹ Numbers of the unpleasant affect words from the ANEW database: 17, 20, 21, 37, 55, 82, 107, 113, 120, 122, 123, 126, 127, 149, 177, 195, 235, 348, 349, 368, 428, 463, 797, 856, 959

² Numbers of the pleasant affect words from the ANEW database: 5, 7, 79, 105, 116, 152, 173, 175, 193, 200, 212, 240, 241, 246, 251, 263, 354, 355, 372, 433, 437, 464, 625, 759, 794

significant differences in arousal levels between the pleasant and unpleasant affect words, $t(24) = 0.09, p = .93$.

Neural assessment. Electroencephalogram (EEG) data were monitored and recorded utilizing 13 sintered Ag-AgCl electrodes positioned on participants' scalps, in a standard 10-20 International system design that included electrodes placed along the midline at anterior (Fz, FCz), central (Cz, CPz), and posterior (Pz, POz) sites. Electrodes were held in place on participants' scalps with an elastic cap, and electro-gel was utilized for the connection making sure to keep impedances for all electrodes below 10 k Ω . The electrodes were positioned in reference to linked mastoid electrodes situated behind the participant's left and right ears, and grounded to the Cz electrode. To monitor eye movements, Ag-AgCl electrodes were positioned above and below the left eye and 1-2 cm to the outside of each eye to record the vertical and horizontal electrooculographic activity (EOG). Additionally, to reduce potential interference with the EEG signal, participants were instructed to relax their facial muscles and keep eye blinks to a minimum during each experimental block. Participants were provided breaks during each experiment block to prevent fatigue.

EEG data were amplified utilizing a Neuroscan Synamps2 bioamplifier (Neuro Inc., El Paso, TX, USA). The incoming data was amplified with a gain of 10, digitized without interruption at 1000 Hz sampling rate, and filtered using a 70 Hz low-pass filter with a 24 bit A/D converter and ± 200 millivolt (mV) input range in DC mode. E-prime (v 2.0) software was used for the presentation of pleasant and unpleasant words. It also recorded participants' current emotional experience ratings to each presented word.

Neuroscan software (v 4.5) was used in the analysis and offline processing of the EEG data. EEG signals for each recorded electrode site (Fz, FCz, Cz, CPz, Pz, and POz) were segmented into 1300 ms stimulus-locked epochs (-100 to 1200 ms relative to presented stimuli at 0 ms) and a low-pass filter was applied (30 Hz; 24 dB/octave) offline. To control for the effects of eye blinks and other irregularities in the EEG data, epochs containing EOGs that were greater than $\pm 50 \mu\text{V}$ were removed. Separate averaged ERP waveforms were created for each emotion regulation strategy (compassion-focused reappraisal, benefit-focused reappraisal, and offense rumination) and word type (pleasant and unpleasant affect words) for an average of 39 trials per condition. Previous literature has demonstrated good internal consistency of the LPP wave after only 8 trials within the common time window of 400-700ms (Moran, Jendrusina, & Moser, 2013). A similar time window of 495-710ms was analyzed in this current study averaging the amplitude of the LPP component following the presentation of the word stimulus. LPP components were analyzed at FCz, following a visual inspection of all recorded electrode sites that demonstrated the most significant differences at FCz. While the LPP is typically demonstrated at more parietal sites, this study demonstrated frontal LPP patterns elicited by the emotional incongruence experienced by participants (Cunningham, Espinet, DeYoung, & Zelazo, 2005 & Baetens, Van der Cruyssen, Achziger, Vandekerckhove, & Van Overwalle, 2011).

Procedure

Following informed consent, participants were randomly assigned to one of two groups and completed the demographics and interpersonal offense questionnaires. All participants began with a practice imagery task, which oriented the participant to the

various experimental tasks. The practice imagery task adapted instructions (Witvliet et al., 2010) for participants to focus on the word “one” for one and a half minutes. Participants were then instructed to think over various words presented individually on the screen and rate their emotional congruency to these words using a six-point Likert-scale where computer key s = *extremely different*, d = *very different*, f = *somewhat different*, j = *somewhat similar*, k = *very similar*, and l = *extremely similar*. Upon the presentation of each word, EEG activity was monitored. Each word was presented for 2,000 ms, with a pretrial blank screen presented before each word for 1,000 ms to provide a smooth transition between word trials (see Figure 1). Participants had a total of 5,000 ms to rate their emotional

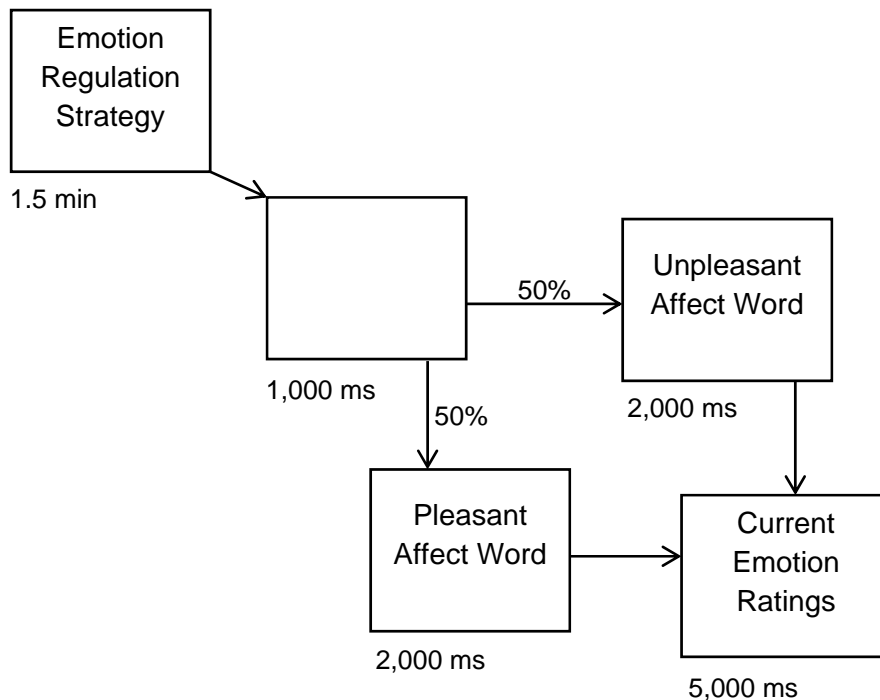


Figure 1. Experimental design of the presentation of pleasant and unpleasant word stimuli including the presentation of the emotional regulation strategy, time course of stimuli, and current emotion ratings.

congruency before transitioning to the next word trial. Participants completed a set of six practice words to become familiar with this task of reviewing and rating words. At the end of the individual word presentations and ratings, participants finished the practice set by completing the forgiveness and well-being measures.

Participants completed the experimental trials in two counterbalanced groups, with each reappraisal strategy preceded by the offense rumination condition. Instructions for offense rumination and the two reappraisal strategies were adapted from Witvliet et al., 2010 (see Appendix). The offense rumination condition was interspersed between the two reappraisal conditions to ensure that positive emotion enhancing strategies would not be in successive order, potentially confounding the results. In order to retain the same number of trials in all three conditions, the offense rumination condition was split, with pleasant and unpleasant affect words presented once during the two offense rumination rounds and pleasant and unpleasant affect words presented twice in the two reappraisal conditions. This ensured 100 presented word trials for each condition within all participants.

Both groups started with the offense rumination condition. Group 1 completed the compassion-focused reappraisal condition before completing the second round of offense rumination, finishing the experiment with the benefit-focused reappraisal condition. Group 2 completed the same process, but completed the benefit-focused condition as the first reappraisal strategy. During each emotion regulation strategy, following the presentation of each pleasant and unpleasant affect word, participants rated their current emotional congruency. At the end of each condition, participants completed the forgiveness and well-

being measures. Following the completion of the study, participants were appropriately debriefed and thanked for their participation.

Results

Forgiveness and well-being measures were computed using a repeated measures multivariate analysis of variance (MANOVA), comparing participants' forgiveness scores and measures of well-being following each emotion regulation strategy. Planned paired sample *t*-tests were computed for each variable comparing offense rumination to benefit-focused reappraisal, offense rumination to compassion-focused reappraisal, and benefit-focused reappraisal to compassion-focused reappraisal. Repeated measures MANOVA statistics are displayed in the first two columns of Table 1. Results of the paired samples *t*-tests are displayed in the remaining columns of Table 1 for each planned comparison.

Hypotheses 1-2: Emotion Regulation Type, Empathy, and Forgiveness

As predicted in Hypothesis 1, both compassion-focused reappraisal and benefit-focused reappraisal demonstrated increased scores for decisional forgiveness, emotional forgiveness, and empathy compared to offense rumination (see Table 1). Furthermore, compassion-focused reappraisal revealed the highest decisional and emotional forgiveness scores and highest empathy scores of the three emotion regulation types (Hypothesis 2).

Hypotheses 3-4: Emotion Regulation, Responses to Affective Words, and Ratings

Rated congruency with pleasant and unpleasant words largely supported Hypotheses 3 and 4. A 3 x 2 repeated measures factorial ANOVA was computed comparing emotion regulation strategies (offense rumination, benefit-focused reappraisal, compassion-focused

Table 1. Means, F values, and t values for forgiveness variables and self-report ratings.

Dependent variable	RM MANOVA		Offense rumination versus benefit-focus		Offense rumination versus compassion-focus		Benefit-focus versus compassion-focus	
	$F(2,66)$	η_p^2	M	$t(33)$	M	$t(33)$	M	$t(33)$
Forgiveness (1-7 range)								
Decisional Forgiveness	36.43***	0.53	3.56	5.01***	3.56	8.05**	5.00	3.27**
Emotional Forgiveness	32.88***	0.50	3.32	5.26***	3.32	7.00**	4.65	3.22**
Well-being ratings (1-7 range)								
Valence	43.78***	0.57	2.78	7.25***	2.78	8.54**	4.74	1.56
Peace	24.22***	0.42	3.06	6.42***	3.96	5.62**	4.88	0.20
Anger	17.66***	0.35	4.26	5.26***	4.26	5.17**	2.65	0.09
Gratitude	29.48***	0.47	2.43	7.17***	2.43	6.93**	4.68	1.43
Happiness	33.76***	0.51	1.99	7.31***	1.99	7.64**	4.26	0.35
Sadness	38.25***	0.54	4.97	6.72***	4.97	7.58**	2.94	0.72
Empathy	30.15***	0.48	2.96	3.88***	2.96	6.67**	3.88	4.68***
Arousal	8.60***	0.21	3.66	3.86***	3.66	3.45**	2.74	0.82
Joy	32.64***	0.50	2.00	6.34***	2.00	7.10**	3.82	0.70

Notes: RM MANOVA: Repeated measures multivariate analysis of variance; t values represented in absolute value; t values are only marked significant if their parent F values are significant;

$p < 0.01$ ** $p < 0.001$ ***

reappraisal) and word type (pleasant vs. unpleasant)³. As expected, there were no significant main effects of strategy, $F(2, 36) = .722, p = .493$ or word type, $F(1, 18) = .518, p = .481$. Importantly, there was a significant interaction between strategy and word type, $F(2, 36) = 35.792, p < .001$ (see Figure 2), which provides partial support for these hypotheses. Follow-up post-hoc *t*-tests showed that following the benefit-focused condition, participants rated pleasant affect words (vs. unpleasant affective words) as more similar to their current emotional experience, $t(18) = 2.197, p = .041$. However, for the compassion-focused reappraisal strategy, rated congruency of the pleasant and unpleasant words did not differ, $t(18) = .984, p = .338$, reflecting mixed emotions for compassionate reappraisal. After rumination, participants rated higher emotional congruency to the unpleasant (vs. pleasant) affect words, $t(18) = -6.256, p < .001$.

Consistent with Hypothesis 3, participants rated greater emotional congruency to pleasant words for both reappraisal strategies compared to rumination. Follow-up pairwise comparisons for the effects of emotion regulation strategy on ratings of pleasant words demonstrated that participants rated greater emotional congruency to the words following compassion-focused reappraisal, $t(18) = 6.07, p < .001$, and benefit-focused reappraisal, $t(18) = 7.26, p < .001$, compared to offense rumination (see Figure 2). There

³ During the administration of the original experiment, a programming error resulted in a partial loss of emotional congruency ratings data. Additional subjects were run to reassess this information. A total of 20 additional participants, who were not in the original study, completed the experimental task of viewing and rating the affective words for each emotion regulation strategy following the procedures outlined above. EEG data was not monitored during the additional administration. One participant discontinued midway through the study, which resulted in a total of 19 participants.

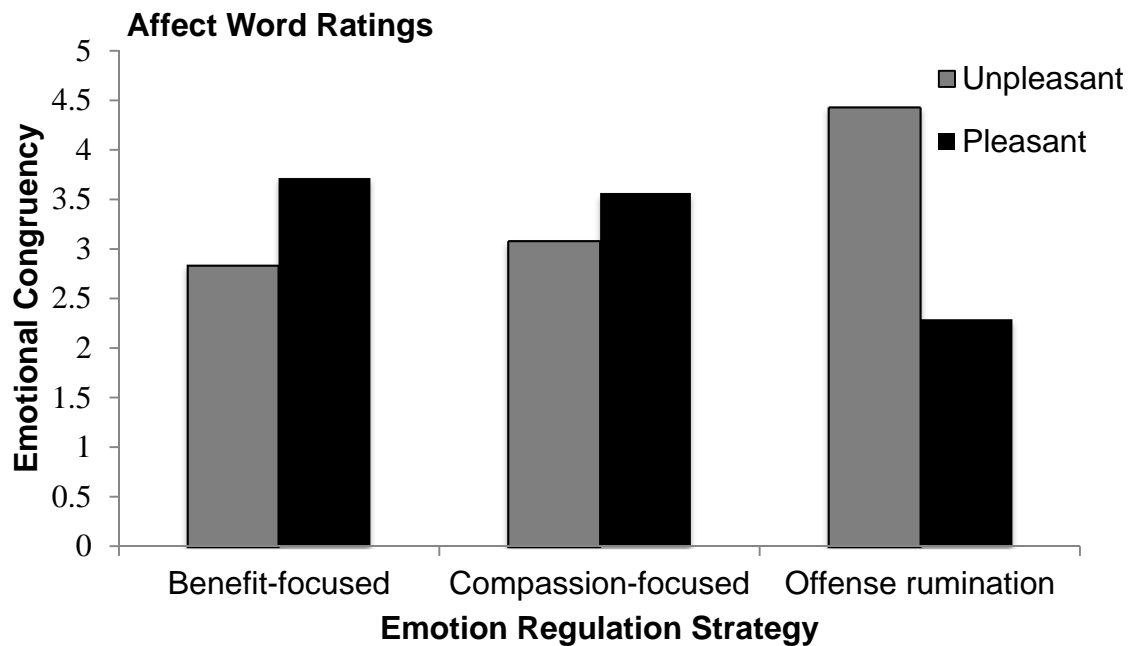


Figure 2. Mean emotional congruency ratings for pleasant and unpleasant affect words for each emotion regulation strategy.

were no significant differences between the two reappraisal strategies in participants' ratings of pleasant affect words, $t(18) = .704$, $p = .490$.

Consistent with Hypothesis 4, participants were more likely to harbor unpleasant feelings (e.g., betrayed, rejected) following the offense rumination condition.

Specifically, follow-up pairwise comparisons of emotion regulation strategy for ratings of unpleasant words indicated that rumination prompted greater emotional congruency to the unpleasant words compared to the benefit-focused reappraisal, $t(18) = -6.90$, $p < .001$, and compassion-focused reappraisal, $t(18) = -6.52$, $p < .001$, conditions (see Figure

2). The two reappraisal strategies did not differ from each other for rated congruency with unpleasant affect words, $t(18) = -1.49, p = .153$.

Ratings of emotions supported Hypotheses 3 and 4. As predicted (Hypothesis 3), participants reported higher ratings for emotional valence (more positive subjective emotion) peace, gratitude, happiness, and joy following each of the reappraisal strategies compared to offense rumination. Consistent with Hypothesis 4, participants also endorsed significantly higher ratings on anger, sadness, and arousal variables, indicating the presence of negative affective states following offense rumination compared to compassion-focused and benefit-focused reappraisal (see Table 1).

Hypotheses 5-6: Emotion Regulation Type and Neurophysiology

Averaged LPP amplitudes computed between 495 ms and 710 ms were analyzed using a 3 (strategy: offense rumination, benefit-focused reappraisal, compassion-focused reappraisal) x 2 (word type: pleasant, unpleasant) repeated measures factorial ANOVA. Figure 3 represents mean averaged stimulus-locked waveforms recorded at FCz while viewing pleasant and unpleasant affect words for each emotion regulation strategy. Following the Greenhouse-Geisser model to correct for sphericity, $\chi^2(2) = 22.591, p < .001$, it was found that there was no significant difference in LPP amplitudes between the different strategy conditions, $F(1.36, 48.79) = .908, p = .375$, nor was there a significant interaction between strategy and word type, $F(1.597, 57.5) = 1.868, p = .171$. Thus, hypotheses 5 and 6 were not supported.

However, there was a significant effect of word type with the unpleasant words producing larger overall LPPs than pleasant words, $F(1,36) = 10.082, p = .003$. This is

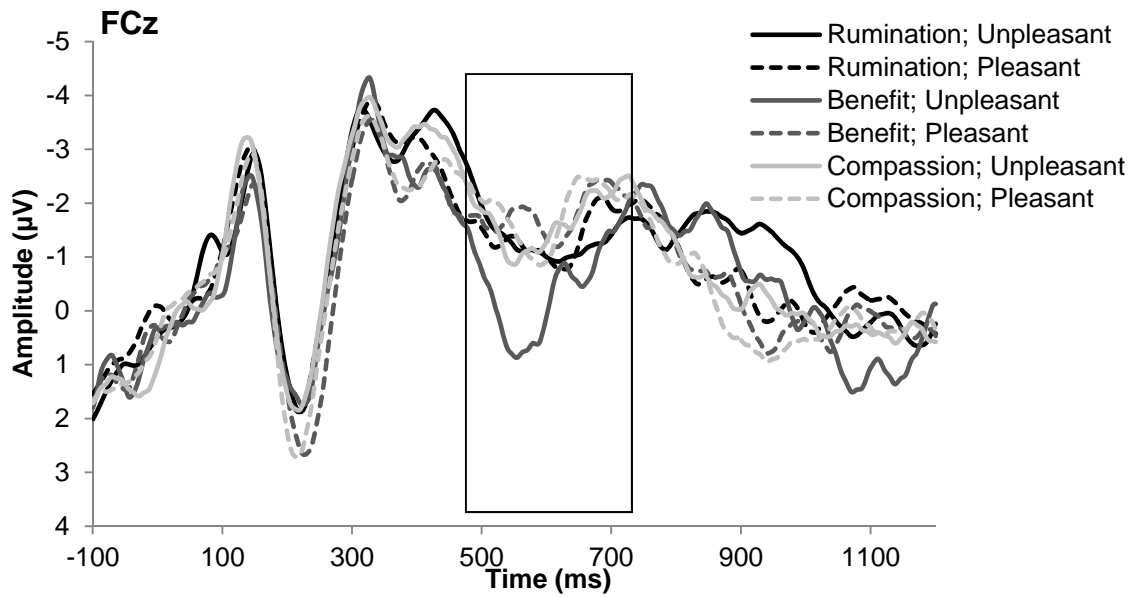


Figure 3. Mean averaged stimulus-locked waveforms recorded at FCz while viewing pleasant and unpleasant affect words for each emotion regulation strategy. LPP amplitudes were analyzed between 495 ms and 710 ms.

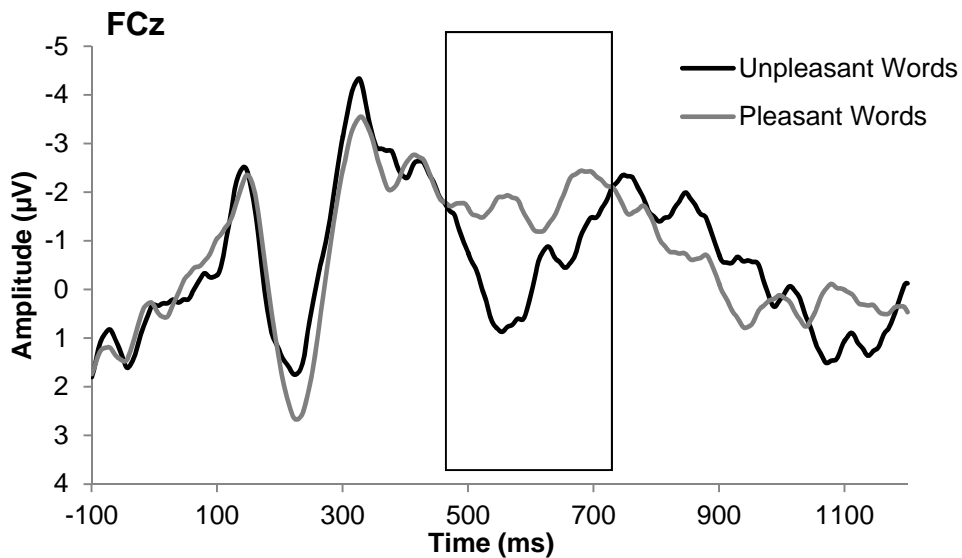


Figure 4. Mean averaged stimulus-locked waveforms recorded at FCz while viewing unpleasant affect words for benefit-focused reappraisal. LPP amplitudes were analyzed between 495 ms and 710 ms.

consistent with current research findings that indicate that unpleasant stimuli increase the amplitude of LPP components as compared to positive stimuli (e.g., Dillon et al., 2006). Follow up comparisons indicated that benefit-focused reappraisal demonstrated larger LPP amplitudes for unpleasant affect words compared to pleasant affect words, $t(36) = 2.675, p = .011$ (see Figure 4). No significant differences between pleasant and unpleasant affect words were found in participants on the compassion-focused strategy, $t(36) = .536, p = .596$, nor the offense rumination strategy, $t(36) = .190, p = .851$.

Discussion

Bringing together research fields of emotion regulation, forgiveness, and electroencephalography, this is the first study of its kind to examine the neurophysiological effects of reappraisal strategies that have been demonstrated to increase forgiveness of a perpetrator following an interpersonal offense (Witvliet et al. 2010, 2011, 2015).

Specifically, the effects of compassion-focused reappraisal, benefit-focused reappraisal, and offense rumination were examined by looking at participants' responses to both explicit and implicit measures. Explicit measures consisted of decisional and emotional forgiveness variables, perceived emotional congruency with pleasant and unpleasant affect words, and ratings of empathy and emotion (e.g., valence, arousal, joy, and anger). Implicit measures consisted of examining participants' LPP, a positive slow-wave ERP that typically demonstrates larger amplitudes in response to emotionally salient stimuli.

Forgiveness Findings

Following both the compassion-focused and benefit-focused imageries, participants were more likely to decisionally and emotionally forgive their perpetrator than after offense

rumination. A comparison of the two reappraisal conditions showed that compassion-focused reappraisal increased participants' scores for both decisional and emotional forgiveness over that of benefit-focused reappraisal. Furthermore, compassion-focused reappraisal has been demonstrated to increase the frequency of forgiveness words used by participants compared to benefit-focused reappraisal and offense rumination (Witvliet et al., 2010), and demonstrated to increase one's decision to forgive and one's emotional forgiveness scores compared to offense rumination and suppression of affect following an interpersonal offense (Witvliet et al., 2011). Taken together, this is strong evidence that compassion-focused reappraisal assists participants in overcoming harbored unpleasant emotions, making a commitment to forgive, and experiencing heartfelt forgiveness compared to benefit-focused reappraisal and offense rumination.

Emotion Ratings Findings

The self-report variables that measured participants' positive and negative affective states following each imagery paradigm aligned with our original hypothesis that positively oriented emotions (e.g., joy and happiness) would increase following the reappraisal strategies and that negatively oriented emotions (e.g., anger and sadness) would increase following the offense rumination imagery task (Witvliet et al., 2010, 2011).

A comparison of the reappraisal strategies showed that empathy scores were greatest following the compassion-focused reappraisal strategy when compared to benefit-focused reappraisal and offense rumination. This replicates the potent empathy-enhancing effects of compassion-focused reappraisal compared to benefit-focused reappraisal and offense rumination (Witvliet et al., 2010), as well as compassion-focused reappraisal

compared to affective suppression (Witvliet et al., 2011, 2015). Both compassion-focused reappraisal and empathy are understood as other-oriented emotional responses where the welfare of the other holds high importance (Batson et al., 1995; Witvliet et al., 2010, 2011). Empathy increases the likelihood that forgiveness will occur following an interpersonal offense (Fehr et al., 2010; McCullough et al., 1998), and learning compassion prompts empathy even during subsequent offense memories (Witvliet et al., 2015). It follows that participants completing the compassion-focused reappraisal strategy were more likely to cultivate empathy for their offender and in turn more likely to endorse increased scores for decisional and emotional forgiveness following an interpersonal offense.

Emotional Congruency Ratings Following Word Presentation

As hypothesized, both reappraisal strategies decreased participants' endorsement of unpleasant affect words compared to offense rumination. Furthermore, participants indicated greater emotional congruency when viewing pleasant affect words following both reappraisal strategies compared to the offense rumination condition. This supports the potent effects of both positive reappraisal strategies for prompting joy and happiness, and for reducing anger and sadness compared to rumination about an offense (Witvliet et al., 2010, 2011). The current experiment provides evidence that both of the reappraisal strategies fostered positively oriented emotions and worked to decrease negatively oriented emotions in participants following an interpersonal offense.

Neurophysiological Findings

Initial analyses of predictions that both reappraisal strategies would down-regulate unpleasant emotions and up-regulate pleasant emotions, compared to offense rumination

as measured by changes in amplitude of the LPP, were not confirmed. However, LPP amplitudes were larger following the presentation of unpleasant affect words compared to pleasant affect words for the benefit-focused condition. We suggest that following the benefit-focused reappraisal strategy, participants demonstrated an increase in LPP amplitudes due to the incongruence between the benefit-focused reappraisal instructions and the unpleasant stimuli. The benefit-focused reappraisal paradigm instructed participants to focus on positive 'silver-lining' benefits gained following an interpersonal offense. As such, when unpleasant affect words were displayed, they were incongruent with participants' current emotional states. Similar findings were demonstrated in a study that examined evaluative priming; LPP amplitudes were demonstrated to be larger following targets that were incongruently primed (e.g., positive presented before negative) compared to targets that were congruently primed (e.g., positive presented before positive; Herring, Taylor, White, & Crites, 2011). It appears that the LPP is augmented by stimuli with affective incongruence, requiring increased emotional attention to the stimuli.

Furthermore, evaluative incongruence is demonstrated to increase LPP amplitudes at various anterior sites (Baetens et al., 2011; Cunningham et al., 2005). In a recent study, increased frontal LPP amplitudes were demonstrated following the presentation of sentences with trait inconsistent outcomes (Baetens et al., 2011). Participants were shown a series of 120 sentences with two or three positive trait-implying sentences followed by an incongruent trait-implying sentence. When presented with the affectively incongruent stimuli, participants demonstrated increased LPP amplitudes at frontal site locations, with the largest difference demonstrated at Fz in the 450-1,000 ms time window. Similar results were elicited in our study; affective incongruence was demonstrated to significantly

increase LPP amplitudes at FCz in the 495-710 ms time window for the benefit-focused reappraisal condition. We suggest that participants, in focusing on the benefits gained, overlooked unpleasant aspects of the interpersonal offense and thus required increased emotional resources to attend to the affectively incongruent stimuli. The benefit-focused condition, while providing initial improvements to various well-being measures such as joy, gratitude and peace, fell short on measures of empathy and forgiveness when compared to compassion-focused reappraisal, possibly due to the avoidance of working through unpleasant beliefs and feelings following the interpersonal offense.

Explicit emotional congruency ratings demonstrated that participants rated their emotions as congruent to the pleasant affect words and incongruent to the unpleasant affect words, matching the implicit results of the increased LPP wave for the benefit-focused condition. In contrast, following compassion-focused reappraisal, participants rated similar congruency to both pleasant and unpleasant word stimuli, explaining why affective incongruence was not found in the LPP results.

While little can be drawn from null results, further research should investigate the effects of compassion-focused reappraisal as an emotion regulation strategy that potentially provides a working through of unpleasant emotions along with the pleasant emotions, allowing the participant to hold the good with the bad following an interpersonal offense. Benefit-focused reappraisal appears to focus on the positive 'silver-lining' effects, potentially overlooking crucial unpleasant aspects of the interpersonal offense. This would provide further explanation and understanding of the neural underpinnings of compassion-focused reappraisal as increasing empathy and overall forgiveness scores over that of benefit-focused reappraisal.

Limitations and Conclusions

In this first neurophysiological study of cognitive reappraisal strategies that promote forgiveness, the data based on changes of LPP amplitudes following each emotion regulation strategy did not confirm our original hypotheses, that each reappraisal strategy compared to offense rumination would down-regulate LPP amplitudes for unpleasant affect words and increase LPP amplitudes to pleasant affect words. Rather, results showed that benefit-focused reappraisal produced the greatest increase in LPP amplitudes when viewing unpleasant affect words compared to pleasant affect words. This result reinforces previous findings that the LPP, particularly at anterior locations, is increased following the presentation of affectively incongruent stimuli.

Specific limitations of this current study are proposed. First, in the design of this study, words were chosen as target stimuli to assess current emotional states of participants following either rumination or reappraisal of an interpersonal offense. Previous studies looking at the effects of reappraisal strategies utilized arousing images instead of words (e.g., Hajcak et al., 2006; Hajcak & Nieuwenhuis, 2006; Krompinger et al., 2008). While several studies have been successful at finding significant effects using words as stimuli (e.g., Deveney & Pizzagalli, 2008; Dillon et al., 2006), it is likely that stronger effects may be observed when using picture paradigms. However, using words was more appropriate to our study since participants focused specifically on their responses to a personally experienced interpersonal offense.

Additionally, future research could add a category of neutral words in addition to the pleasant and unpleasant affect words that were chosen to establish a baseline for any

LPP amplitude augmentation or reduction to the presented stimuli. By including a neutral category, it would be feasible to ascertain how the pleasant and unpleasant affect words modify the LPP amplitude regardless of the emotion regulation strategies. This would provide an indication of whether the pleasant and unpleasant words chosen modulate the LPP amplitudes, as well as provide a baseline to compare changes in LPP amplitudes following each emotion regulation strategy.

Furthermore, this study had an underrepresentation of male participants limiting the external validity of the findings. Clear gender differences in the neural bases of emotion regulation have been demonstrated (e.g. McRae, Ochsner, Mauss, Gabrieli, & Gross, 2008), and future follow up studies should work to test these findings in male participants.

The results from this study further promote the usefulness of cognitive reappraisal strategies, specifically compassion-focused reappraisal and benefit-focused reappraisal, in promoting empathy, forgiveness, and overall well-being following an interpersonal offense. Findings also support increased neurophysiological understanding of emotional processing, demonstrating frontal LPP augmentation as sensitive to affective incongruence and the allocation of attentional and emotional resources. Future research can further expand upon these findings through looking at longitudinal effects of reappraisal strategies on both the implicit and explicit effects of one's physical, mental, and emotional well-being following an interpersonal offense.

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Appendix: Emotion regulation strategies adapted from Witvliet et al., 2010.

Offense rumination: For the next minute and a half, 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 negative thoughts, feelings, and physical responses you have as you think about the negative ways the offender and offense harmed you.

Compassion-focused reappraisal: For the next minute and a half, 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 thoughts, feelings, and physical responses you have as you cultivate compassion, kindness, and mercy for this person.

Benefit-focused reappraisal: For the next minute and a half, 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.