Research Article

GRANTING FORGIVENESS OR HARBORING GRUDGES: Implications for Emotion, Physiology, and Health

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Abstract—*Interpersonal offenses frequently mar relationships. Theorists have argued that the responses victims adopt toward their offenders have ramifications not only for their cognition, but also for their emotion, physiology, and health. This study examined the immediate emotional and physiological effects that occurred when participants (35 females, 36 males) rehearsed hurtful memories and nursed grudges (i.e., were unforgiving) compared with when they cultivated empathic perspective taking and imagined granting forgiveness (i.e., were forgiving) toward real-life offenders. Unforgiving thoughts prompted more aversive emotion, and significantly higher* corrugator *(brow) electromyogram (EMG), skin conductance, heart rate, and blood pressure changes from baseline. The EMG, skin conductance, and heart rate effects persisted after imagery into the recovery periods. Forgiving thoughts prompted greater perceived control and comparatively lower physiological stress responses. The results dovetail with the psychophysiology literature and suggest possible mechanisms through which chronic unforgiving responses may erode health whereas forgiving responses may enhance it.*

Social relationships are often marred by interpersonal offenses. An expanding group of theorists, therapists, and health professionals has proposed that the ways people respond to interpersonal offenses can significantly affect their health (McCullough, Sandage, & Worthington, 1997; McCullough & Worthington, 1994; Thoresen, Harris, & Luskin, 1999). Unforgiving responses (rehearsing the hurt, harboring a grudge) are considered health eroding, whereas forgiving responses (empathizing with the human condition of the offender, granting forgiveness) are thought to be health enhancing (e.g., Thoresen et al., 1999; Williams & Williams, 1993). Although several published studies have found a positive relationship between forgiveness and mental health variables (Al-Mabuk, Enright, & Cardis, 1995; Coyle & Enright, 1997; Freedman & Enright, 1996; Hebl & Enright, 1993), the current literature lacks controlled studies of forgiveness and variables related to physical health.

Indirect evidence suggests that the health implications of forgiveness and unforgiveness may be substantial. Research associates the unforgiving responses of blame, anger, and hostility with impaired health (Affleck, Tennen, Croog, & Levine, 1987; Tennen & Affleck, 1990), particularly coronary heart disease and premature death (Miller, Smith, Turner, Guijarro, & Hallet, 1996). Further, research suggests that reductions in hostility—brought about by behavioral interventions that emphasize becoming forgiving—are associated with reductions in coronary problems (Friedman et al., 1986; Kaplan, 1992).

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Another line of research suggests that granting or withholding forgiveness may influence cardiovascular health through changes in *allostasis* and *allostatic load*. Allostasis involves changes in the multiple physiological systems that allow people to survive the demands of both internal and external stressors (McEwen, 1998). Although allostasis is necessary for survival, extended physiological stress responses triggered by psychosocial factors such as anxiety and hostility can result in allostatic load, eventually leading to physical breakdown. Interpersonal transgressions and people's adverse reactions to them may contribute to allostatic load and health risk through sympathetic nervous system (SNS), endocrine, and immune system changes (e.g., Kiecolt-Glaser, 1999). In contrast, forgiveness may buffer health by reducing physiological reactivity and allostatic load (Thoresen et al., 1999).

A THEORETICAL FRAMEWORK

An understanding of the relationships among unforgiving responses, forgiving responses, physiology, emotion, and health may benefit from the established framework of bioinformational theory (Lang, 1979, 1995). Lang posited that physiological responses are essential aspects of emotional experiences, memories, and imagined responses. An extensive literature has supported this view, documenting that physiological responses reliably vary depending on the emotional experiences people think about, or imagine (e.g., Cook, Hawk, Davis, & Stevenson, 1991; Lang, 1979; Witvliet & Vrana, 1995, 2000). Two emotional dimensions strongly influence the physiological reactions that occur: *valence* (negative–positive) and *arousal* (e.g., Lang, 1995; Witvliet & Vrana, 1995). For example, the valence of emotion is important for facial expressions, with negative imagery stimulating greater muscle tension in the brow than positive imagery (Witvliet & Vrana, 1995). With heightened emotional arousal, cardiovascular measures such as blood pressure (e.g., Yogo, Hama, Yogo, & Matsuyama, 1995) and heart rate show greater reactivity, and skin conductance—an index of SNS activity—is also more reactive (e.g., Witvliet & Vrana, 1995).

Interpersonal transgressions are emotionally laden experiences that often stimulate negative and arousing memories or imagined emotional responses (e.g., grudges). According to Lang's theory, unforgiving memories and mental imagery might produce negative facial expressions and increased cardiovascular and sympathetic reactivity, much as other negative and arousing emotions (e.g., fear, anger) do. In contrast, forgiving responses should reduce the negativity and intensity of a victim's emotional response, quelling these physiological reactions, as more pleasant and relaxing imagery does (Witvliet & Vrana, 1995). In terms of allostasis (McEwen, 1998), emotional states (e.g., unforgiving responses) that intensify and extend cardiovascular and sympathetic reactivity would increase allostatic load, whereas those that limit these physiological reactions (e.g., forgiving responses) would improve health.

PARTICULAR UNFORGIVING AND FORGIVING RESPONSES TO INTERPERSONAL TRANSGRESSIONS

The literature on forgiveness has focused on the effects of two unforgiving responses (rehearsing the hurt, harboring a grudge) and two forgiving responses (developing empathy for the offender's humanity, granting forgiveness) to interpersonal violations.

Unforgiving Responses

Rehearsing the hurt

Once hurt, people often rehearse memories of the painful experience, even unintentionally, perhaps because the physiological reactivity that occurs during emotionally significant events facilitates memory encoding and retrieval (cf. Witvliet, 1997). When people rehearse hurtful memories, they may perpetuate negative emotion and adverse physiological effects (Witvliet, 1997; Worthington, 1998). Interestingly, Huang and Enright (2000) found that in the first minute of describing a past experience with conflict (vs. describing a typical day), individuals who had forgiven because of religious pressure showed greater blood pressure increases compared with those who had forgiven because of unconditional love.

Harboring a grudge

When people hold a grudge, they stay in the victim role and perpetuate negative emotions associated with rehearsing the hurtful offense (Baumeister, Exline, & Sommer, 1998). Despite this, victims may be drawn to hold grudges because they may secure tangible or emotional benefits, such as a regained sense of control or a sense of "saving face" (Baumeister et al., 1998). Yet nursing a grudge is considered "a commitment to remain angry (or to resume anger periodically)," and to perpetuate the adverse health effects associated with anger and blame (Baumeister et al., 1998, p. 98).

Forgiving Responses

Developing feelings of empathy

Developing feelings of empathy for the perpetrator is considered to play a pivotal role in turning the victim away from unforgiveness and beginning the forgiveness process (Worthington, 1998). Empathy involves thinking of the offender's humanity (rather than defining the person solely in terms of the offense) and trying to understand what factors may have influenced the offending behavior (Enright & Coyle, 1998). When victims engage in this sort of perspective taking, the resulting empathic compassion reduces the intense arousal and negative valence of hurts and grudges and introduces more positively valent emotion for the victim (McCullough et al., 1997). Empathy is also thought to shift victims' facial expressions and reduce their stress responses in the cardiovascular and sympathetic nervous systems (Worthington, 1998).

Granting forgiveness

Granting forgiveness builds on the core of empathy and involves cognitive, emotional, and possibly behavioral responses (McCullough et al., 1997). It is important to note that forgiveness still allows for holding the offender responsible for the transgression, and does not involve denying, ignoring, minimizing, tolerating, condoning, excusing, or forgetting the offense (see Enright & Coyle, 1998). Although no universal definition of forgiveness exists, theorists emphasize that it involves letting go of the negative feelings and adopting a merciful attitude of goodwill toward the offender (Thoresen, Luskin, & Harris, 1998). This may free the wounded person from a prison of hurt and vengeful emotion, yielding both emotional and physical benefits, including reduced stress, less negative emotion, fewer cardiovascular problems, and improved immune system performance (McCullough et al., 1997; Worthington, 1998).

APPLYING THE EMOTIONAL IMAGERY PARADIGM

Unforgiving responses may erode health by activating negative, intense emotion and cardiovascular and SNS reactivity. Forgiving responses may buffer health or promote healing by quelling cardiovascular reactivity and SNS hyperarousal (Thoresen et al., 1999). In this study, we investigated these hypotheses by measuring physiology continuously as each participant thought about a real-life offender in unforgiving and forgiving ways, providing a window into the moment-by-moment effects of choosing each response. We used a within-subjects repeated measures design (Vrana & Lang, 1990; Witvliet & Vrana, 1995, 2000), allowing us to compare the physical effects of adopting unforgiving versus forgiving responses to a particular offender. Building on the psychophysiology literature relevant to health, we measured imagery effects on self-reports of emotion valence and emotional arousal; self-reports of perceived control, anger, and sadness; facial electromyogram (EMG) measured at the *corrugator* (brow) region; skin conductance (as an indicator of SNS activity); heart rate; and blood pressure. We hypothesized that unforgiving imagery would prompt more negative and arousing emotion and hence lower perceived control than forgiving imagery (cf. Witvliet & Vrana, 1995). We also predicted that unforgiving imagery would be associated with greater increases in *corrugator* muscle tension and greater skin conductance, heart rate, and blood pressure changes (associated with heightened emotional arousal during unforgiving imagery).

Given the importance that extended physiological reactivity may have for allostatic load and health consequences (e.g., McEwen, 1998), we examined whether differences between the effects of unforgiving and forgiving imagery would persist after the imagery periods, when participants tried to stop their imagery and engaged in a relaxation task. Although such persistence had not been tested previously, evidence from the trauma literature suggests that negative and arousing personal imagery that evokes heightened physiological reactivity is difficult to quell (cf. Witvliet, 1997). Physiological differences may also persist because the valence and arousal of unforgiving imagery differs considerably from the target mood of relaxation. If the physiological reactivity persists after imagery, unforgiving responses to interpersonal offenses may contribute to adverse health effects because the heightened cardiovascular and SNS reactivity both during and after imagery may increase allostatic load.

METHOD

This study used a standard within-subjects emotional imagery paradigm (Vrana & Lang, 1990; Witvliet & Vrana, 1995, 2000), adapting it to study the emotional and physiological effects of imagining unforgiving and forgiving responses to an interpersonal offender.

Participants

Seventy-two introductory psychology students voluntarily participated in this experiment. Because 1 female discontinued the study before its conclusion, the data for 71 (36 male, 35 female) participants are reported. Data for 2 participants were excluded from blood pressure analyses because of equipment problems.

Stimulus Materials

The script materials used to prompt autobiographical forgiveness-related imagery were based on the forgiveness literature (McCullough et al., 1997). To maximize internal validity, we had all participants use the same unforgiving scripts (rehearsing the hurt, harboring a grudge) and forgiving scripts (empathizing with the offender, granting forgiveness). To maximize external validity, we instructed each participant to apply all the unforgiving or forgiving responses to the same interpersonal offense from his or her life. This approach allowed us to assess the emotional and physiological effects of choosing to adopt unforgiving versus forgiving responses to a particular real-life offender. The imagery scripts encouraged participants to consider the thoughts, feelings, and physical responses that would accompany each type of unforgiving and forgiving response.

Apparatus

We used a Dell 486 computer to time the experimental events and collect on-line physiological data (VPM software; Cook, Atkinson, & Lang, 1987). Auditory tones at three frequencies—high (1350 Hz), medium (985 Hz), and low (620 Hz)—signaled imagery and relaxation trials. The tones were 500 ms long and 73 dB[A]. They were generated by a Coulbourn V85-05 Audio Source Module with a shaped-rise time set at 50 ms. The tones were presented through Altec Lansing ACS41 speakers located 2.5 feet to the left of the participant's head during the instructions, and through Optimus Nova 67 headphones during data collection.

Facial EMG was recorded at the *corrugator* (i.e., brow) muscle region using sensor placements suggested by Fridlund and Cacioppo (1986). Facial skin was prepared using an alcohol pad and Medical Associates electrode gel. Then miniature Ag-AgCl electrodes filled with Medical Associates electrode gel were applied. EMG signals were amplified (× 50,000) by a Hi Gain V75-01 bioamplifier, using 90-Hz high-pass and 1-kHz low-pass filters. A Coulbourn multifunction V76-23 integrator (nominal time constant = 10 ms) then rectified and integrated the signals.

Skin conductance levels (SCLs) were measured by a Coulbourn isolated skin conductance V71-23 coupler using an applied constant voltage of 0.5 V across two standard electrodes. Electrodes were filled with a mixture of physiological saline and Unibase (Fowles et al., 1981) and applied to the hypothenar eminence on the left hand after it was rinsed with tap water. A 12-bit analog-digital converter sampled the skin conductance and facial EMG channels at 10 Hz.

Electrocardiogram data were collected using two standard electrodes, one on each forearm. A Hi Gain V75-01 bioamplifier amplified and filtered the signals. The signals were then sent to a digital input on the computer that detected R waves and measured interbeat intervals in milliseconds.

We continuously measured blood pressure at each heartbeat with an Ohmeda 2300 Non-Invasive Blood Pressure Monitor, placing the cuff between the first and second knuckles on the middle finger of the left hand.

Procedure

Each participant completed a two-part, 2-hr testing session. First, the participant identified a particular person he or she blamed for mistreating, offending, or hurting him or her. Then the participant completed a questionnaire about the nature of the offense and his or her responses to it. Second, in the imagery phase of the study, the participant actively imagined each type of unforgiving and forgiving response to the previously identified offender eight times in systematically manipulated orders that were counterbalanced across participants. The study session was divided into blocks of trials, with two types of imagery trials in each block. Acoustic tones (high, low) were used to signal exactly when the participant was to imagine each type of forgiving or unforgiving response. Medium tones signaled participants to engage in a relaxation task, thinking the word *one* every time they exhaled (e.g., Vrana & Lang, 1990; Witvliet & Vrana, 1995, 2000).

Physiology was monitored continuously during trials consisting of an 8-s baseline (relaxation) period, 16-s imagery period, and 8-s recovery (relaxation) period. On-line monitoring allowed us to measure the immediate psychophysiological effects of people's unforgiving and forgiving responses as they occurred.

After each block of imagery trials, participants rated their feelings during the preceding two types of imagery. Using a video display and computer joystick (see Hodes, Cook, & Lang, 1985), participants rated their level of emotional valence (negative-positive) and arousal (low-high), as well as anger, sadness, and perceived control. As a manipulation check, participants also rated how much empathy they felt for the offender and how much they felt they had forgiven the offender during the different imagery conditions (from *not at all* to *completely*). All ratings were converted to a scale ranging from 0 to 20. Participants privately registered all ratings directly into a computer and were encouraged to be completely honest.

Data Collection and Reduction

During the experiment, participants' heart rate and blood pressure were measured on a heartbeat-to-heartbeat basis, and facial EMG and SCL data were measured on a second-to-second basis. Cardiac interbeat intervals were converted off-line to heart rate in beats per minute for each imagery period. Within each type of imagery condition (hurt, grudge, empathy, forgiveness), the physiology measures were averaged over 4-s epochs, resulting in two 4-s epochs during the baseline period, four 4-s epochs during the imagery period, and two 4-s epochs during the recovery period. During the imagery and recovery periods, change scores for each 4-s epoch were created by subtracting values from the 4-s baseline epoch immediately before the imagery period.

The hurt and grudge imagery trials were considered to constitute the *unforgiving* condition because rehearsing the hurt and holding a grudge are emotionally negative and arousing and are often experienced together (see Baumeister et al., 1998). Thus, for the analyses, data for the hurt and grudge imagery trials were averaged. Similarly, the empathy and forgiveness imagery trials were considered to constitute the *forgiving* condition because feeling empathy for the perpetrator and granting forgiveness are more positive and less arousing, and empathy is considered central to the forgiveness process (Worthing-

ton, 1998). Thus, data for the empathy and forgiveness trials were averaged. The averaged data in the unforgiving condition were compared with the averaged data in the forgiving condition using analyses of variance (ANOVAs) with repeated measures.[1] The overall effect of emotion condition (forgiving vs. unforgiving imagery) during the imagery and recovery periods was assessed.[2]

RESULTS

Self-Reports

Interpersonal offenses

Participants reported that their primary offenders included friends, romantic partners, parents, and siblings. Common offenses included betrayals of trust, rejection, lies, and insults.[3]

Ratings

Comparison of the ratings in the forgiving and unforgiving conditions reveals patterns consistent with predictions (Table 1). During unforgiving imagery, participants reported feeling more negatively valent, $F(1, 70) = 203.46, p < .001$; aroused, $F(1, 70) = 307.24, p < .001$; angry, $F(1, 70) = 466.56, p < .001$; and sad, $F(1, 70) = 55.48, p < .001$; they also felt less in control, $F(1, 70) = 81.02, p < .001$. During forgiving imagery, participants reported significantly greater empathy for and forgiveness toward the offender, $F(1, 70) = 326.74, p < .001$, and $F(1, 70) = 353.87, p < .001$, respectively.

Corrugator EMG

Figure 1 shows that *corrugator* EMG change scores were significantly higher for the unforgiving condition than the forgiving condition during both the imagery period, $F(1, 70) = 14.43, p < .001$, and the recovery period, $F(1, 70) = 13.79, p < .001$.[4] These predicted findings parallel the strong relationship between *corrugator* EMG and negative valence in the literature (see Fridlund & Izard, 1983; Witvliet & Vrana, 1995). The data for the recovery period suggest that negative emotion persisted despite efforts to "turn off" the imagery and relax.

Table 1. *Mean self-ratings for the unforgiving and forgiving imagery conditions*

	Imagery condition	
Measure	Unforgiving	Forgiving
Valence	5.63	13.21
	(2.72)	(3.27)
Arousal	15.34	7.21
	(2.95)	(3.68)
Control	8.37	13.03
	(3.85)	(3.43)
Sadness	11.71	7.14
	(4.41)	(4.28)
Anger	15.75	5.11
	(2.63)	(3.84)
Empathy	3.87	13.91
	(3.35)	(3.55)
Forgiveness	4.08	14.64
	(3.27)	(3.92)

Note. Participants' ratings about how they felt during each type of imagery were converted to a scale from 0 to 20. For valence, 0 is strongly negative, and 20 is strongly positive. For arousal and control, 0 is very low, and 20 is very high. For sadness, anger, empathy, and forgiveness, 0 means "not at all," and 20 means "completely." Standard deviations are in parentheses.

SCLs

As depicted in Figure 2, tonic SCLs showed a general decrease both during and after imagery, a pattern reflecting habituation to the experimental context. It is important to note that SCL change scores were significantly lower for the forgiving condition than the unforgiving condition during the imagery period, $F(1, 70) = 14.58, p < .001$, and during the recovery period, $F(1, 70) = 18.62, p < .001$, indicating comparatively less SNS arousal. This pattern dovetails with participants' reports of higher arousal during the unforgiving condition. This

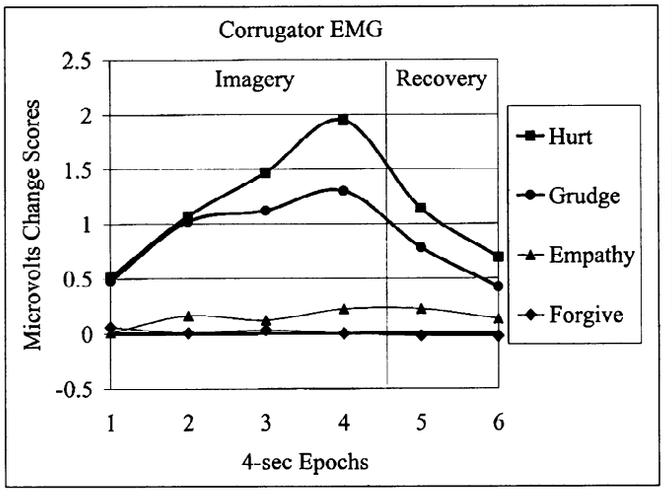

Fig. 1. Change from baseline for *corrugator* electromyograms (EMGs) during the 16-s imagery and 8-s recovery periods.

1. Further analyses supported this theoretical rationale. Physiology did not differ between the hurt and grudge conditions, nor between the empathy and forgiveness conditions, but physiology did differ significantly for each of the two unforgiving conditions compared with each of the two forgiving conditions (for all comparisons of heart rate, skin conductance, blood pressure, and *corrugator* EMG, $Fs > 4$, $ps < .05$, except that blood pressure differences between grudge and both empathy and forgiveness conditions were marginal, $Fs > 3.1$, $ps < .081$).

2. In the interest of space, we do not report epoch effects, although the figures depict data across epochs to assist readers in understanding the physiological results across the imagery and recovery periods.

3. Individual difference variables included sex, offense severity, whether the offender had apologized, whether the offender and victim had repaired their relationship, and the degree to which the victim had held a grudge and had desired revenge against, had empathized with, or had forgiven the offender. These variables did not have significant effects on heart rate, mean arterial pressure, skin conductance, or *corrugator* EMG.

4. EMG was measured at two additional sites. Increases at the *orbicularis oculi* (under the eye) also were significantly greater during unforgiving imagery, but *zygomatic* (cheek) EMG showed no effects.

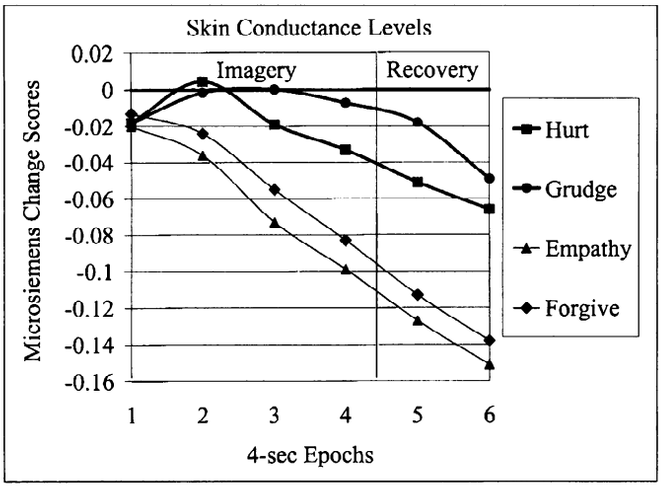

Fig. 2. Change from baseline for skin conductance level during the 16-s imagery and 8-s recovery periods.

result is striking because emotional differences must be highly potent to yield significant effects on SCLs in imagery paradigms (Witvliet & Vrana, 1995), and the differences persisted even as participants tried to quell their responses and relax.

Heart Rate

As depicted in Figure 3, heart rate increased from baseline regardless of how participants imagined responding to their offenders, a pattern found in other studies of personalized emotional imagery (Witvliet & Vrana, 1995, 2000). As hypothesized, the heart rate increases were greater in the unforgiving condition than in the forgiving condition during both the imagery period, $F(1, 70) = 34.94, p < .001$, and the recovery period, $F(1, 70) = 14.46, p < .001$. The persistence of the heart rate increase parallels the persisting SCL and *corrugator*

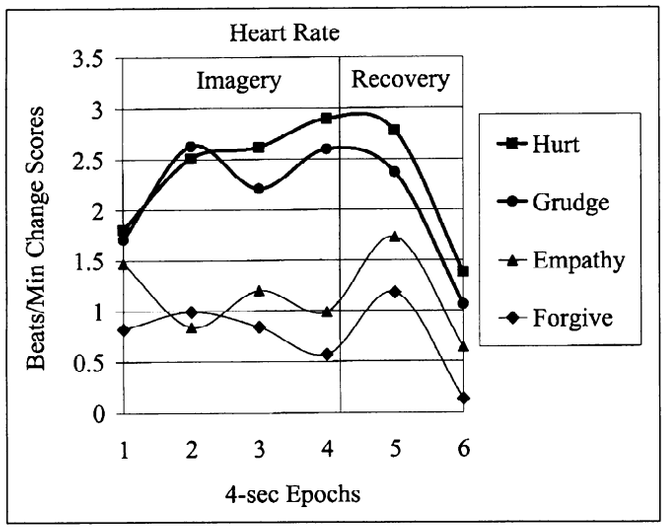

Fig. 3. Change from baseline for heart rate during the 16-s imagery and 8-s recovery periods.

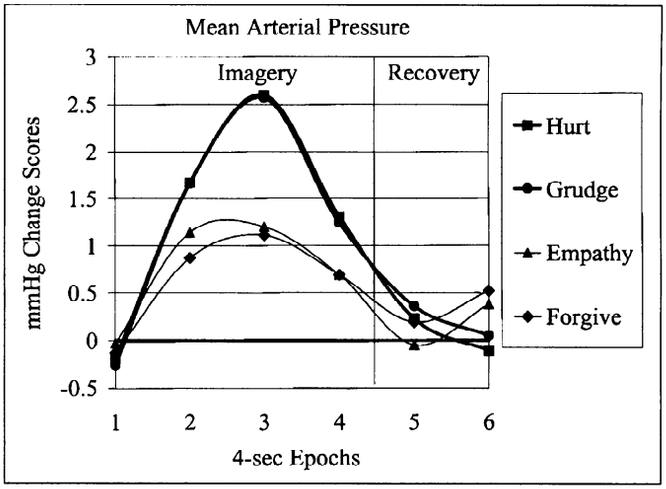

Fig. 4. Change from baseline for mean arterial pressure during the 16-s imagery and 8-s recovery periods.

EMG effects and is consistent with the arousal ratings and findings in the literature, in which significantly greater heart rate increases occurred during highly arousing imagery (e.g., Cook et al., 1991; Witvliet & Vrana, 1995, 2000). Together with the *corrugator* and SCL results, these data suggest that it is difficult to quell the aversive emotion and physiological reactivity associated with unforgiving imagery.

Mean Arterial Pressure

Figure 4 shows that mean arterial pressure increased significantly more during the unforgiving than the forgiving condition, $F(1, 68) = 8.98, p < .01$, as predicted.[5] This finding parallels the heart rate data, the self-ratings, and findings in the literature, which links blood pressure reactivity to higher levels of arousal (e.g., Yogo et al., 1995) and anger (e.g., Kunzendorf, Cohen, Francis, & Cutler, 1996). During the recovery periods, mean arterial pressure did not differ significantly between conditions, $F(1, 68) = 0.185, p = .668$.

DISCUSSION

The physiology of forgiveness and unforgiveness is uncharted territory for empirical study, despite theoretical explorations of the possible health costs of unforgiveness and health benefits of forgiveness (e.g., McCullough et al., 1997; Williams & Williams, 1993). In this study, we investigated the emotional and physiological effects when people imagined responding to their real-life offenders in unforgiving ways (rehearsing the hurt, harboring a grudge) and forgiving ways (empathic perspective taking, granting forgiveness).

Emotion and Physiology

The results were consistent with bioinformational theory (Lang, 1979, 1995) in that imagery of unforgiving and forgiving responses to a particular offender yielded differences in both self-reported emotion

5. Diastolic blood pressure was significantly higher throughout unforgiving imagery than forgiving imagery; systolic blood pressure was significantly greater during unforgiving imagery in Epochs 2 and 3.

and physiological responding. Participants felt significantly more negative, aroused, angry, and sad and less in control during the unforgiving condition than during the forgiving condition (Table 1). They also showed greater facial tension at the *corrugator* (brow) muscle region during unforgiving imagery (Fig. 1), paralleling effects of negative emotion reported in the literature (see Fridlund & Izard, 1983; Witvliet & Vrana, 1995). During the arousing unforgiving imagery, participants experienced significantly greater SNS arousal—as indicated by higher SCL change scores (Fig. 2)—and greater cardiovascular reactivity in terms of heart rate and blood pressure (Figs. 3 and 4). These results parallel arousal effects reported in the literature (e.g., Witvliet & Vrana, 1995; Yogo et al., 1995). Further, the elevated *corrugator* EMG, skin conductance, and heart rate change scores during unforgiving imagery persisted into the postimagery recovery period. Overall, the physiological patterns in this study are quite consistent with the patterns that occur during emotional imagery in general (Witvliet & Vrana, 1995), suggesting that the physiological effects of unforgiving and forgiving responses to interpersonal offenses may be influenced substantially by the emotional quality of these responses.

Health Implications

These four physiological measures provide a window into what happens to the body during emotional thoughts about an offender, even when the thoughts are very brief. Although it is unlikely that the brief unforgiving trials in this study would have a clinically significant effect on health, we believe that the effects obtained in this study provide a conservative measure of effects that naturally occur during unforgiving responses to real-life offenders. Lang (1979) has argued that physiological effects during emotional imagery mirror naturally occurring effects, but are less potent. In daily life, people may intensify their hurtful memories and vengeful thoughts (e.g., embellishing accounts of the offense with language that heightens contempt) and punctuate their imagery with overt behaviors (e.g., slamming doors, shouting), thereby intensifying and extending blood pressure surges, heart rate elevations, and SNS activation.

The emotional and physiological effects identified in this study may be mediators of a relationship between forgiveness and health (Thoresen et al., 1999). Earlier work identified anger, hostility, anxiety, and depression as psychosocial risk factors for heart disease, and chronic SNS arousal as a mechanism for the relationship between psychosocial factors and heart disease (Allan & Scheidt, 1996). This pattern is reflected in the current study, as participants reported significantly higher anger and sadness, and lower perceived control, during unforgiving imagery than during forgiving imagery, and also showed greater SNS arousal and cardiovascular reactivity during unforgiving imagery.

Chronic unforgiving, begrudging responses may contribute to adverse health outcomes by perpetuating anger and heightening SNS arousal and cardiovascular reactivity. Expression of anger has been strongly associated with chronically elevated blood pressure (Schwenkmezger & Hank, 1996) and with the aggregation of platelets, which may increase vulnerability for heart disease (Wenneberg et al., 1997), especially if the expressions of anger are frequent and enduring (see Thoresen et al., 1999). Although fleeting feelings of unforgiveness may not erode health, more frequent, intense, and sustained unforgiving emotional imagery and behaviors may create physiological vulnerabilities or exacerbate existing problems in a way that erodes health.

SNS arousal may also influence immune system functioning (Kiecolt-Glaser, Malarkey, Cacioppo, & Glaser, 1994; Thoresen et al., 1999). For example, research suggests that marital discord can induce changes in SNS, endocrine, and immune system functioning, even in individuals reporting high marital satisfaction and healthy lifestyles (Kiecolt-Glaser, 1999). When psychosocial stress is chronic, it may have the most impact on these physiological functions, thereby influencing susceptibility to and progression of diseases (e.g., cancer, infectious illnesses). Conversely, interventions that buffer against psychosocial stressors, including interpersonal conflict, may ultimately influence health (see Kiecolt-Glaser & Glaser, 1995).

The concept of allostasis (McEwen & Stellar, 1993) may have considerable utility for understanding possible links between forgiveness and health (Thoresen et al., 1999). Allostatic load can occur when physiological systems remain activated, despite termination of an external stressor (McEwen, 1998). In the present study, varied physiological responses (e.g., SCL, heart rate, blood pressure, and facial EMG) were activated when people thought about responding to their offenders. This reactivity was significantly greater during unforgiving than forgiving imagery. Further, physiological reactivity remained significantly higher for SCL, heart rate, and *corrugator* EMG even in the recovery period after imagery. This suggests that if unforgiving emotion is sufficiently potent and enduring, and if some physiological systems (e.g., SNS, cardiovascular) resist recovery, unforgiving responses could contribute to allostatic load.

In contrast, less heart rate, blood pressure, and EMG reactivity occurred during the forgiving imagery than during the unforgiving imagery, and SCLs showed greater habituation. It may be that when people enact forgiving responses, the physiological demands of unforgiving emotional hurt and anger are reduced, thereby decreasing allostatic load and associated health risks. Interestingly, McEwen (1998) has advocated the use of behavioral interventions that reduce stress, facilitate social support, and increase perceived control to improve allostasis and decrease allostatic load. Interventions to promote forgiveness have already begun to suggest an association between forgiveness and mental health (e.g., Al-Mabuk et al., 1995; Coyle & Enright, 1997; Freedman & Enright, 1996; Hebl & Enright, 1993). Furthermore, "increased frequency of forgiving others . . . could function to reduce the chronicity of distress (e.g., anger, blame, and vengeful thoughts and feelings) that has prospectively been shown to alter brain, coronary, and immune functioning. Such reductions could encourage diminished SNS arousal in frequency, magnitude and duration, resulting over time in less physical disease risk" (Thoresen et al., 1999, p. 259). The present study begins to build the empirical case for this assertion.

Research on forgiveness is still in its early development. We believe that this study—the first to explore the physiological effects of adopting various unforgiving and forgiving responses to real-life offenders—provides a good foundation for future research. Although people cannot undo past offenses, this study suggests that if they develop patterns of thinking about their offenders in forgiving ways rather than unforgiving ways, they may be able to change their emotions, their physiological responses, and the health implications of a past they cannot change.

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