J Behav Med (2007) 30:291–302
DOI 10.1007/s10865-007-9105-8

Forgiveness, Health, and Well-Being: A Review of Evidence for Emotional Versus Decisional Forgiveness, Dispositional Forgivingness, and Reduced Unforgiveness

Everett L. Worthington Jr · Charlotte Van Oyen Witvliet · Pietro Pietrini · Andrea J. Miller

Accepted: April 2, 2007 / Published online: April 24, 2007

Abstract The extant data linking forgiveness to health and well-being point to the role of emotional forgiveness, particularly when it becomes a pattern in dispositional forgivingness. Both are important antagonists to the negative affect of unforgiveness and agonists for positive affect. One key distinction emerging in the literature is between decisional and emotional forgiveness. Decisional forgiveness is a behavioral intention to resist an unforgiving stance and to respond differently toward a transgressor. Emotional forgiveness is the replacement of negative unforgiving emotions with positive other-oriented emotions. Emotional forgiveness involves psychophysiological changes, and it has more direct health and well-being consequences. While some benefits of forgiveness and forgivingness emerge merely because they reduce unforgiveness, some benefits appear to be more forgiveness specific. We review research on peripheral and central nervous system correlates of forgiveness, as well as existing interventions to promote forgiveness within divergent health settings. Finally, we propose a research agenda.

Keywords Forgiveness · Health · Cancer · Cardiovascular · Intervention · Peripheral nervous system · Central nervous system · Stress · Coping

The first author gratefully acknowledges support for the present project by the Fetzer Institute, grant # 2254.01 and the General Clinical Research Center at Virginia Commonwealth University, NIH 5M01 RR000065–410535. For the second author, this manuscript contributes to an interdisciplinary project on The Pursuit of Happiness established by the Center for the Study of Law and Religion at Emory University and the John Templeton Foundation.

E. L. Worthington Jr (✉) · A. J. Miller
Virginia Commonwealth University, 806 West Franklin, Box 842018, Richmond, VA 23284-2018, USA
e-mail: eworth@vcu.edu

C. V. O. Witvliet
Hope College, Holland, MI, USA

P. Pietrini
University of Pisa Medical School, Pisa, Italy

Introduction

Recent reviews of literature pertaining to forgiveness and health have argued that (a) forgiveness is an emotion-focused coping process that can promote health (Worthington 2006; Worthington and Scherer 2004); (b) forgiveness might have its major impact on health through reducing unforgiveness rather than creating positive emotional experiences (Harris and Thoresen 2005); (c) forgiveness, especially when undertaken for altruistic motives, can affect both physical and mental health (Witvliet and McCullough 2007; Worthington et al. 2005); and (d) forgiveness interventions are appropriate for but infrequently used in medical settings (Harris and Thoresen 2006). Previous reviews have been based on relatively few studies, whereas the present review capitalizes on the recent virtual agreement by researchers on what forgiveness is (see Worthington 2005a), incorporates more empirical studies than did the previous reviews, and sets a research agenda based on both theory and research.

Definitions of Forgiveness

For years, definitional disagreements permeated the field of forgiveness studies. Many electronic bytes were occupied in proposing and justifying definitions (see Enright and

Fitzgibbons 2000; McCullough et al. 2000). However, by 2005, the definitional controversies had quietly subsided, with broad consensus on what forgiveness is not, and much agreement on what it is. Forgiveness is not excusing, exonerating, justifying, condoning, pardoning, or reconciling. Depending on the context, intrapsychic processes may be both necessary and sufficient for forgiveness, although a complex interpersonal process may surround forgiveness experiences (Worthington 2005a). Forgiveness is broadly understood as a process of decreasing inter-related negative resentment-based emotions, motivations, and cognition (Worthington 2005b) This composite is referred to as unforgiveness with the content of the *primary* negative experiences (i.e., cognition, emotion, motivation, or behavior) still under debate (Worthington 2006). Mullet et al. (2005) identified two types of personal dispositions toward unforgiveness—grudge-holding and vengeful orientation. Some researchers have argued that forgiveness also involved enhanced positive experience (Fincham et al. 2005). Worthington (2005b) proposed that most researchers who studied transgressions by strangers or people in non-continuing relationships defined full forgiveness as simply reducing unforgiveness, and researchers who studied continuing relationships defined full forgiveness as decreasing and eventually eliminating unforgiveness by replacing the negative with positive and eventually building to a net positive forgiveness experience. He suggested that forgiveness was of two types: a decision to control one's behaviors (i.e., *decisional forgiveness*) and a multifaceted *emotional forgiveness* that involved changed cognition, emotion, and motivation.

The common denominators in definitions seem to be the following. First, unforgiveness involves ruminations that may be begrudging, vengeful, hostile, bitter, resentful, angry, fearful of future harm, and depressed. Second, unforgiveness is hypothesized to be directly related to the amount of remaining injustice being experienced (called the *injustice gap*, by Exline et al. 2003). Third, forgiveness involves reducing unforgiveness. Fourth, forgiveness is a process rather than an event. There is less agreement about the sequence, mechanisms, key components, and the *sine qua non* changes in the process. Fifth, the internal experience of forgiveness can be distinguished from its interpersonal context. As Baumeister et al. (1998) observed in grudge-theory, a person could internally forgive and not express it or could express forgiveness but not experience it internally. Sixth, forgiveness of strangers or people with whom one does not want nor expect continuing contact is fundamentally different from forgiving a loved one. Seventh, making a decision to change one's behavior could be a sincere and permanent form of forgiving, and yet that decision must be differentiated from emotionally forgiving. Decisional and emotional forgiveness are different processes, likely with different sequelae. Decisional forgiveness, while it might reduce hostility does not necessarily reduce stress responses. Thus, it is probably related to reconciliatory processes and through improved relationships, indirectly to health. Emotional forgiveness is likely more related to health sequelae because of its strong connection to overcoming negative affect and stress reactions by cultivating positive affect. Eighth, most would agree that (a) decisional forgiveness has the potential to lead to changes in emotion and eventually behavior whereas (b) emotional forgiveness, by definition, involves changes in emotion, motivation, cognition, and eventually behavior.

Many acts reduce unforgiveness and are thus often confused with forgiveness (Worthington 2001). As a stark example, successful vengeance will eliminate unforgiveness, but no one would confuse it with forgiveness. Other examples of unforgiveness-reducing alternatives to forgiveness include (1) seeing justice done (including civil justice, criminal justice, restorative justice), (2) shadenfreude, (3) letting go and moving on, (4) excusing an offense, (5) justifying an offense, (6) condoning an offense, (7) forbearing, (8) turning the issue over to God because one does not believe oneself capable of judging, or (9) turning the issue over to God in hopes of divine retribution. All of those reduce unforgiveness, thus usually contributing to positive health outcomes (Harris and Thoresen 2005). However, none is forgiveness.

Forgiveness, Forgivingness, and Health

Forgivingness is seen as a disposition, while forgiveness is seen as being related to a state response (Mullet et al. 2005). Forgivingness—and more rarely forgiveness—has been found to be related to health. Toussaint et al. (2001) conducted a telephone survey with a national probability sample of 1,423 respondents (young, ages 18–44, $n = 737$; middle-aged, ages 45–64, $n = 410$; and old, ages 65 and older, $n = 276$). Self-rated health was related to forgivingness of self in young and middle aged participants and to forgivingness of others in older adults. Typically, forgivingness takes years before it has discernible effects on physical health. This is reasonable when seen in the context that stress-related disorders often do not develop until chronic stress has taken a physical toll on one's body. If unforgiveness is interpersonally stressful (see Worthington 2006, for a stress-and-coping theory of forgiveness), then it should be expected that self-rated health is related to habitually forgiving others only for people who have practiced it for many years. In the methodology of the cross-sectional phone survey, it was not possible for Toussaint et al. to determine how long people considered themselves to be dispositionally forgiving.

Forgivingness of the self was related to physical health only for young and middle aged respondents—not for elderly respondents. Forgiveness of the self involves quite different psychological processes than does forgiveness of others (see Hall and Fincham 2005). In many ways, forgiveness of self is more related to being an offender than a victim of injustice. Namely, people struggle with self-condemnation because they believe they have done wrong (to self or others) and they feel guilt and shame, which are stressful. Forgiveness of self has been related to the adjustment of women with breast cancer (Glinder and Compas 1999; Romero et al. 2006) as well as college students (Macaskill et al. 2000). The mechanism by which forgiveness of self affects health, however, is likely to have features distinct from forgiveness of others. We hypothesize that self-condemnation may impair self-care, produce depression and anxiety, and demotivate coping. That might result in more immediately apparent negative health consequences than would forgiveness of others, which probably exerts most of its influence by being a coping mechanism for the chronic stress of unforgiveness (McEwen 2002).

Lawler-Row and Piferi (2006) provided some insight into why forgivingness of others might be related to health in a study of 425 participants aged 50 to 95 years. They found that a forgiving personality was related to stress, subjective well-being, psychological well-being, and depression. High and low forgivingness conditions differed on four potential mediators—healthy behaviors, social support, religious well-being, and existential well-being. Furthermore, high and low forgivingness conditions also differed on several indices of successful aging—autonomy, environmental mastery, positive relations with others, purpose in life, personal growth, and self-acceptance. Mediational analyses were conducted to determine mediators between forgivingness and health. The connection between forgivingness and depression was mediated by healthy behaviors, social support, and existential and religious well-being. Forgivingness and stress were mediated by sex, age, healthy behaviors, existential and religious well-being. Forgivingness and subjective well-being were mediated by sex, age, healthy behaviors, social support, and existential and religious well-being. Forgivingness and psychological well-being were partially mediated by age, healthy behaviors, social support and existential well-being.

The empirical literature on forgivingness and health is growing. At present, it appears that a variety of mechanisms operate and support the forgivingness-health relationships in different ways at different stages of life. However, these are survey data for which major criteria of health are self-reports. A need remains for prospective studies documenting the incidence of disease in people exhibiting self- and other-forgivingness. Some of the self-report measures created for the purpose of a survey were short and had no data supporting their estimated reliability or validity. Lawler-Row and Piferi (2006) used measures with psychometric support to establish the relationships. However, there is also a need to examine the mechanisms of influence using procedures to assess central and peripheral nervous system processes when people do and do not forgive.

Forgiveness in Relation to Brain Physiology and Functioning and Health

The development of more and more sophisticated methodologies for the functional exploration of the brain has made it possible to investigate the molecular correlates of cognitive, emotional, and behavioral functioning in the living human brain with no harm for the subjects. Several studies using electroencephalographic techniques or functional brain imaging tools, including positron emission tomography and functional magnetic resonance imaging, have been successfully used to investigate the neural bases of the decisional and emotional components involved in the modulation of behavior, in moral evaluation as well as in adopting forgivingness strategies.

Functional Magnetic Resonance Imaging and Positron Emission Tomography Studies

As one basis for distinguishing decisional and emotional forgiveness, Worthington (2006) referenced a highly visible and often cited study of moral dilemmas. Greene et al. (2001) studied two similar moral dilemmas. In the trolley dilemma, the participant imagines himself or herself to be standing on a footbridge overlooking trolley tracks and must decide whether to pull a switch to prevent the trolley from killing five strangers. By throwing the switch, that diversion will kill one stranger. About 90 percent of the people chose to divert the trolley and kill one person. In the footbridge dilemma, the runaway trolley can only be diverted (thus saving the five) by pushing a stranger from the footbridge to his death. About 10 percent of the participants were willing to push the stranger. Why the difference? Greene et al. (2001) suggested, ''Some moral dilemmas (those relevant to the footbridge dilemma) engage emotional processing to a greater extent than others (those relatively similar to the trolley dilemmas), and these differences in emotional engagement affect people's judgments'' (p. 2106). In Greene et al.'s experiment, people ($N = 9$) were in functional magnetic resonance imaging units as they were presented with these two dilemmas. As they contemplated the unfolding story, brain

activity was the same in both scenarios until, in the footbridge problem, the experimenter posed the possibility of pushing the person to his death. Suddenly, activity in the brain areas associated with rational thought declined and activity in the emotional areas increased.

In a follow-up experiment, they found that people who went against the ''natural'' tide had longer decision times than those who went with the tide. In the trolley dilemma, those who sided with the 10% (do not throw the switch) delayed their choice. In the footbridge dilemma, those who sided with the 10% (push the person) delayed their choice. The researchers suggested that the delay occurred because cognition was needed to overcome the ''natural'' tendency. On the surface, these findings may seem remote from forgiveness processes. However, just as there is a distinction between decisional and emotional decision making, there may be a similar distinction between decisional and emotional forgiveness and processes.

In a more direct study of forgiveness, Farrow et al. (2001) used functional magnetic resonance imaging to determine the brain structures that were active in making judgments about what one might, or might not, forgive (called *forgivability* judgments), what one might or might not empathize with, and what judgments one might make in social situations. Participants ($N = 10$; 7 males, 3 females) were subjected to a number of decision-making choices while being monitored in a functional magnetic resonance imaging unit. Among the many findings, Farrow et al. reported that the judgments about whether an act was forgivable and how empathic it was involved a different portion of the cortex than judgments about fairness. Presumably, to forgive one must consider the other person, which stimulates empathy. To judge whether a decision is fair, though, does not necessarily bring in the human element and promote prosocial emotions. The left frontotemporal region was most associated with both forgivability and empathy. The implications of Farrow et al. for understanding forgiveness is that when one imagines a scenario involving judgments of fairness—as one might do in thinking about the injustice gap (as it affects oneself or others) —and one empathizes or forgives, different regions of the brain are activated.

In additional studies, Farrow and Woodruff (2005) reported that they used the regions associated with forgivability judgments as a map to indicate whether forgiveness might be occurring. Using a pre- and post-test design, they gave 13 patients who were diagnosed with post-traumatic stress disorder 10 weekly 1-hour sessions of forgiveness-oriented cognitive-behavior therapy. Relative to pretest patterns, post-test patterns showed evidence of increased forgivability judgments and empathy. Also, 14 patients with schizophrenia increased their forgivability judgments relative to healthy controls.

Using positron emission tomography to measure regional cerebral blood flow, Pietrini et al. (2000) studied the neural correlates of anger and aggression in 15 healthy young people (8 men, 7 women). People were instructed to imagine four scenarios involving themselves, their mother, and two men in an elevator. In one scenario, which represented the baseline non-emotional condition, the participant simply looked around while riding in the elevator. In the other three emotionally-laden scenarios, the two men assaulted the participant's mother while the participant (a) watched, unable to help; (b) tried to intervene but was restrained by one man while the other continued the assault; or (c) attacked the two men with a sincere intent to injure or kill them. A 9-point Likert-type scale (1 = *extremely so* to 9 = *not at all*), revealed that participants experienced greater anger, frustration, and anxiety during the aggressive scenarios as compared to the neutral baseline condition. Of note, participants reported much greater anger and frustration when they could not intervene (conditions ''a'' and ''b'' above) than when they were free to carry out their aggressive response (scenario ''c'').

In their functional analysis of reaction to aggressive behavior, Pietrini et al. (2000) found that when people were asked to imagine vividly angry situations—regardless of which of the three aggressive scenarios described above— they had higher activity within limbic system structures such as the anterior cingulate cortex and functional reduction in the activity of the orbitofrontal cortex, as compared to the baseline neutral condition. The medial orbitofrontal cortex is considered to be the limbic portion of the frontal association cortex. It is intimately connected with the amygdala and the limbic system, and it plays an important role in integrating emotional and motivational processes. Thus, one implication might be that negative emotion acts antagonistically toward reasoning. This suggests that reasoning is disrupted by anger and that imaginally rehearsing angry and aggressive mental scenarios (i.e., ruminating angrily) could (a) catapult one into negative emotive responding and (b) shut down rational approach and calm emotions.

Imagery as well as verbal rumination might stimulate similar effects. For example, Blair et al. (1999) found increased orbitofrontal activation when healthy males viewed pictures of angry faces. They interpreted this activation as an attempt to control a socially inappropriate behavioral response elicited by the angry faces.

Taken together, the results of these studies along with the clinical observation that traumatic or degenerative lesions of the prefrontal cortex lead to disinhibition of behavior including poor control of aggression, may indicate that a functional suppression of the orbitofrontal cortex is needed in order to enact a socially unacceptable behavior. In this regard, it is interesting to note that in the

sample studied by Pietrini et al. (2000) the reduction in neural activity during the aggressive scenarios as compared to the neutral baseline condition was significantly greater in females than in males. This may suggest that a greater suppression of orbitofrontal inhibitory control is needed in females to express a violent behavior—even at an imaginal level—and is consistent with the finding that females inhibit violence more than males (Pietrini et al. 1998). With respect to males, females also showed a much greater activation of the anterior cingulate cortex during the aggressive scenarios as compared to the neutral baseline (Pietrini et al. 2000).

Adopting a similar visual imagery paradigm in conjunction with functional magnetic resonance imaging, Pietrini's group has begun to investigate the brain correlates associated with the imaginal evocation of forgiveness and unforgiveness in response to hurtful events. Ten young healthy participants (5 females and 5 males) underwent functional magnetic resonance imaging while they were asked to evoke a series of specific imaginal scenarios that comprised a hurtful event. Then they were randomly instructed to forgive or not. Imagery ability, behavioral and emotional responses were measured using the procedure described in the aggressive behavior study (Pietrini et al. 2000). Imaginal evocation of emotionally relevant hurtful events followed by forgiving and not forgiving was associated in each participant with modulation of brain areas implicated in visual/semantic representation and imagery, and with activation of more anterior areas, such as ventromedial and prefrontal cortex, amygdala, anterior cingulate and striatum, that are involved in the regulation of emotional responses, moral judgment, perception and modulation of physical and moral pain, reward and decision making processes (Pietrini et al. 2004). It is worthy to note that during the hurtful condition females showed a greater activation in the anterior cingulate cortex than did males, consistent with the positron emission tomography findings from the aggression study. Given that the anterior cingulate cortex has been shown to respond to physical and moral pain (Eisenberger et al. 2003; Rainville et al. 1997), these findings suggest that morally hurtful events likely elicit a stronger response in the areas of the brain that process the affective valence of painful stimuli in females than in males. The anterior cingulate cortex was strongly engaged when subjects granted forgiveness; furthermore, the degree of neural activation was correlated with the individual's capability to grant forgiveness. Because neural activity in the anterior cingulate cortex is modulated by pain-killing drugs but also by hypnosis and placebo (Casey et al. 2000; Lieberman et al. 2004; Rainville et al. 1997), the authors propose that forgiviness may represent a natural ''self-aid medication mechanism'' that was selected through evolution for people to overcome distressful situations much before pharmacological agents or therapeutic interventions became available (Pietrini et al. 2004). As discussed below, chronic stressful situations involve damaging processes - stress hormone secretion, neuronal loss and so on - for brain function and structure as well as for the whole organism (Pietrini and Guazzelli 1997). Therefore a mechanism that enables the individual to rapidly overcome such a situation confers a strong advantage for well-being and survival.

Electroencephalographic Studies

EEG studies have shown that experiencing state anger has been associated with relative left-frontal activity compared to right-frontal activity. Harmon-Jones et al. (2004) noted how left-frontal cortical activity has been repeatedly shown to be associated with approach motivation, emotion, and behavior identified with the Behavioral Approach System (Gray 1994). Right cortical activity has been repeatedly shown to be associated with withdrawal motivation, emotion, and behavior (Coan et al. 2001), associated with the Behavior Inhibition System (Gray 1994). Harmon-Jones et al. (2003) showed that in anger provocation, people experienced high left-frontal cortical activity, especially when they were able to move toward the source of anger in order to try to resolve the anger-producing situation. If people did not anticipate having the chance to resolve the situation, they did not show an increase in left-frontal activity. Left-frontal activity is more associated with approaching a person and working things out when one is angry instead of simply stewing in resentment.

Harmon-Jones et al. (2004) sought to determine whether sympathy, which has been shown to reduce aggressive motivations, would also reduce relative left-frontal cortical activity relative to right-frontal activity. They suggested that if such a finding were to occur, it would suggest that the increase in relative left-frontal activity that has been observed after arousal to anger would be due more to approach motivations than other processes. College students (53 women, 26 men) participated in their electroencephalograph study in which sympathy was manipulated. A manipulation in which participants received insults was associated with increased left-frontal activity and decreased right-frontal activity. Notably, for participants who had high levels of sympathy, the electroencephalograph effect was eliminated. Sympathy acted in opposition to anger arousal in decreasing brain activity in the left-frontal cortex. This sympathy manipulation finding echoed previous research (Coan et al. 2001). Harmon-Jones et al. (2003) showed that manipulating (a) coping capability and (b) the experience of a positive other-oriented emotion both affected brain activity that was associated with unforgiveness, anger, and hostility.

Taken together, work from the labs of Farrow, Pietrini, and Harmon-Jones underscore how brain regions and functions are affected by decisional and affective processes in ways that are consistent with the differentiation of decisional and emotional forgiveness. Results also suggest that emotional forgiveness may happen through a mechanism of emotional replacement of negative with positive, other-oriented emotions.

Forgiveness in Relation to Peripheral Physiology and Health

To the extent that forgiveness buffers against illness or promotes health, this may be due to the emotional-replacement functions of forgiveness (see Worthington 2006, for a summary of evidence supporting that mechanism). Forgiveness may serve both as an antidote to the health-eroding processes of stress, hostility, and rumination, and as an agonist for the health-promoting processes of positive other-oriented emotion. Below, we review findings on forgiveness and peripheral physiology, with a focus on the emotional processes potentially related to forgiveness and physical health.

Forgiving Others

In a psychophysiology study, Witvliet et al. (2001) measured continuous facial electromyograph, heart rate, blood pressure, and skin conductance as 71 college students each adopted two states of unforgiveness versus two states of emotional forgiveness toward a particular real-life offender. The two unforgiving conditions were (a) rumination about the transgression and (b) nursing a grudge toward the offender. The two forgiving conditions were (a) cultivating empathic perspective taking toward the offender and (b) forgiving the offender by finding a way to genuinely wish him or her well while releasing hurt and angry emotions. This last condition is an emotional forgiveness condition. Witvliet et al. used a within-subjects design so that each participant imagined all four types of imagery multiple times using counterbalanced orders. Physiological reactivity during each imagery trial and recovery patterns during the subsequent relaxation period were assessed and compared to that same trial's pretrial baseline data. This approach highlighted the impact of each imagery condition on the physiological measures, as well as how those response patterns recovered after imagery.

As predicted, unforgiving imagery evoked higher arousal and more negative emotion ratings compared to forgiving imagery. Consistent with the high arousal ratings, unforgiving imagery was associated with higher levels of tonic eye muscle tension (orbicularis oculi electromyograph) during imagery, and higher heart rate and skin conductance level scores (indicating sympathetic nervous system activation) both during imagery and recovery. Consistent with the negative valence of unforgiving imagery (versus the positive valence of forgiving imagery), participants showed more brow muscle tension (corrugator electromyograph) during imagery and recovery periods. Systolic blood pressure (during the middle of imagery), diastolic blood pressure, and mean arterial pressure—indicating arousal and negative valence—were all higher during unforgiving versus forgiving imagery. Participants reported significantly higher joy, pleasant relaxation, empathy, and perceived control in the forgiveness conditions, but higher sadness, anger, and fear during the unforgiveness conditions. These data patterns were substantially replicated in a subsequent study of the associations of justice and forgiveness with effects on continuous measures of physiological functioning (Witvliet et al., in press).

These findings resonate with the work of Lawler et al. (2003, 2005) and Toussaint and Williams (2003), who used combined between and within subjects designs and interview-based psychophysiology paradigms. Although these researchers did not explicitly study emotional forgiveness per se, Lawler in particular has framed her group's findings in terms of a forgiving change of heart (Lawler et al. 2003). They found cardiovascular benefits of both trait and state forgiving in college students (N = 108; 44 males, 64 females). Higher trait forgivingness was associated with lower systolic, diastolic, and mean arterial pressure. Lower state unforgivingness and higher state forgiveness for both a parent and a peer/partner were associated with lower systolic, diastolic, and mean arterial pressure, heart rate, and rate pressure product (rate pressure product is the systolic blood pressure times heart rate divided by 100, and is an indicator of myocardial oxygen demand and stress). In response to an interview about a salient memory of conflict with a parent or primary caregiver, Lawler et al. (2003) also found that high trait forgivers showed the least reactivity and best recovery patterns for systolic, diastolic, and mean arterial pressure and rate pressure product, and forehead electromyograph, whereas low trait forgivers in unforgiving states showed the highest levels of cardiovascular reactivity and poorest recovery patterns.

In follow-up research with a community sample of 27–72 year olds (N = 81), Lawler et al. (2005) found that trait forgivingness was associated with lower levels of rate pressure product reactivity—but not mean arterial pressure—in the first part of an interview. Using path analyses, they found that trait forgivingness predicted state forgiveness. Higher state forgiveness and lower hostility predicted lower stress levels, which in turn predicted lower self-reported illness. Lawler et al. (2005) found that reduced negative affect was the strongest mediator between

forgiveness and physical health symptoms. That suggested the importance of emotional forgiveness in reducing unforgiveness. Other variables—spirituality, social skills, and lower stress—mediated the forgiveness-health relationship, too.

In their interview study, Toussaint and Williams (2003) measured blood pressure in a diverse sample of 100 midwestern community residents, with 25 in each cell: 2 [socioeconomic status (high, low)] × 2 [race (Black, White)]. Men and women were almost evenly divided across cells. Across participants, higher levels of total forgiveness (i.e., forgiveness of others and self, and feeling forgiven by God) were associated with lower resting diastolic blood pressure. Among white participants of high socioeconomic status, total forgiveness and forgiveness of self were associated with lower resting diastolic blood pressure. Among black participants with low socioeconomic status, forgiveness of others was associated with lower resting diastolic blood pressure, and forgiveness of others, total forgiveness, and perceived divine forgiveness were associated with lower resting cortisol levels.

Together, this combined set of findings on peripheral physiology suggests that chronic unforgiving responses could contribute to adverse health by perpetuating stress beyond the duration of the original stressor, heightening cardiovascular reactivity during recall, imagery, and conversations about the hurt, and impairing cardiovascular recovery even when people try to focus on something else. By contrast, forgiving responses may buffer health both by quelling these unforgiving responses and by nurturing positive emotional responses in their place.

Additional research points to the importance of experiencing other-oriented positive emotions for emotional forgiveness to occur. Huang and Enright (2000) compared the effects of forgiving out of moral love versus cultural obligation in 22 matched pairs of male and female Taiwanese community members. We see aspects of the moral love condition as more akin to emotional forgiveness. When interviewed about a typical day, the groups did not differ in their blood pressure. When interviewed about a past experience with conflict, the groups did not differ on self-reported anger. However, those who forgave out of obligation-oriented versus moral-love motives cast down their eyes and showed more masking smiles. The authors interpreted those behaviors as signs of hidden anger. These facial patterns are also consistent with the idea that the obligatory forgivers might have been suppressing negative emotion, which we consider to be akin to decisional, rather than emotional forgiveness. In line with this view, the obligatory forgivers had significantly higher blood pressure values than did the moral love forgivers on three of twelve blood pressure comparisons. Obligation forgivers had higher raw systolic blood pressure at the beginning of the interview, and higher raw systolic blood pressure. and diastolic blood pressure one minute into the interview. This study suggests that motivations emphasizing love differ from motivations that emphasize obligation in terms of affective expression and cardiovascular responding.

Receiving Forgiveness

Whereas most forgiveness research has addressed the granting of forgiveness, one study examined the effects of forgiveness on those who receive it (Witvliet et al. 2002). They used a within-subjects psychophysiology study with college students ($N = 40$; 20 females, 20 males) who reflected on and imagined a particular transgression they had committed against someone. Part of this study compared imagery of (a) receiving an unforgiving response from one's victim, with imagery of (b) receiving forgiveness and (c) experiencing reconciliation. Forgiveness and reconciliation imagery each prompted improvements in basic emotions (e.g., sadness, anger) and moral emotions (e.g., guilt, shame, gratitude, hope), with reductions in negative emotions and increases in positive emotions. Receiving forgiveness and reconciliation each also prompted less furrowing of the brow muscle (*corrugator* electromyograph) associated with negative emotion, and more electromyograph activity at the *zygomatic* muscle, indicative of smiling. Autonomic nervous system measures were largely unaffected by imagery, although skin conductance data suggested greater emotional engagement or stress when transgressors imagined reconciling with their victims. Apparently, while reconciliation is often valued, contemplating making a reconciliative gesture can provoke stress reactions.

Summary

The study of forgiveness in the psychophysiology laboratory has its limits. To generalize to real life, studies must employ tasks that mirror daily life, aggregate repeated measures across tasks, and measure physiology before, during, and after the conditions of interest (Schwartz et al. 2003). Forgiveness studies with designs close to these ideals show cardiovascular reactivity patterns that reliably distinguish unforgiving responses toward others (as a state or trait) as generating more reactivity and prolonged activation than do forgiving responses toward others (and also link facial electromyograph patterns with the negative, aroused emotion of unforgiveness). Exploratory studies that seek to correlate single resting physiology measures with forgiving personality variables do not show these patterns (Seybold et al. 2001). Nevertheless, it is important to keep in mind that it is sustained elevations in blood

pressure that predict end-organ damage, and the impact of brief peaks in blood pressure, such as those measured in the forgiveness studies, is unclear (see Schwartz et al. 2003). Hence, the extant data speak only to immediate short-term patterns. As we interpret the autonomic and cardiovascular effects, it is also important to keep in mind that they may reflect not only heightened sympathetic nervous system arousal, but also impaired parasympathetically mediated responding.

Forgiveness has been shown to be beneficial in reducing victims' unforgiveness, which is associated with prolonged physiological activation, and is theorized to have more cardiovascular health implications than short-term stress reactivity (Brosschot and Thayer 2003). Forgiveness research suggests it also promotes positive and prosocial emotions for victims (e.g., Witvliet et al. 2001) and offenders (Witvliet et al. 2002), calming physiological indicators of negative and aroused emotion. To the extent that forgiveness may eclipse or reduce anger, sympathetic nervous system activation may be mitigated (McCraty et al. 1995). To the degree that forgiveness involves positive and calm emotion, the parasympathetic nervous system may exert better control (see McCraty et al. 1995).

Forgiveness and Other Mechanisms Not Reviewed

In the present limited review, we cannot consider all of the evidence for mechanisms relating forgivingness and health. For example, Worthington (2006) reviewed at length evidence from evolutionary psychology, the biochemistry of aggression, the relaxation response, emotional expression (i.e., Pennebaker's writing intervention; see McCullough et al. 2006), positive emotions (e.g., love, gratitude, etc.), and Fredrickson's (1998) Broaden and Build Model of Positive Emotions. Several other recent chapters include extensive reviews that address important mechanisms to consider. Witvliet and McCullough (2007) proposed the importance of emotion-regulation pathways for linking forgiveness and health. They address forgiveness as an antagonist to post-offense responses that have destructive effects (e.g., stress, hostility, rumination, and suppression), and forgiveness as an agonist for positive reappraisal and positive emotions. Marques and Sternberg (2007) extensively document biological features of positive emotions and their interfaces with health, and Koenig (2007) highlights the pathways by which expressions of altruistic responses can be linked with health.

Previous reviews have paid little attention to forgiveness interventions in medical settings, although Harris and Thoresen (2006) called for such attention. Until the last couple of years, few juried studies were available. In the following section, we summarize the research on applications of a forgiveness intervention to producing changes in health status.

Forgiveness Interventions in Medical Settings

Based on the preliminary evidence that forgiveness may affect health, teaching forgiveness in medical settings is gaining limited acceptance as a treatment goal (Harris and Thoresen 2006). Yet, forgiveness interventions are still implemented infrequently in medical settings. We explore here the medical conditions for which forgiveness interventions could benefit patients and their loved ones.

Medical Family Therapy

Forgiveness interventions may help families who are dealing with illness of a family member. McDaniel et al. (1999) identified emotional themes in families dealing with the impact of physical illness. One emotional theme identified was guilt versus forgiveness. For example, individuals may ask what they did to deserve the illness or have guilt regarding their illness, child's illness, or parent's illness. Such emotional themes can apply to a variety of illness experiences, whether acute or anticipated, and across the lifespan (McDaniel et al. 1999). Interventions for families dealing with illness and related guilt and forgiveness themes may benefit from including forgiveness of others and of the self.

Cardiovascular Health

Individuals at risk for coronary disease, recurrent coronary disease, and high blood pressure may benefit from forgiveness interventions. This is suggested by stress-and-coping theory (Worthington 2006) but also by the research on peripheral physiology and forgiveness reviewed above. Interventions have considered forgiveness within a treatment protocol. Friedman's Recurrent Coronary Prevention Project (RCPP; Friedman et al. 1986) involved a five-year, clinical trial of a group therapy intervention aimed at reducing the recurrence rate of post-coronary participants by reducing levels of hostility in individuals at risk for coronary problems in patients who had recovered from myocardial infarction. According to Kaplan (1992), forgiveness was an important antidote to hostility in this efficacious intervention. In a post-intervention assessment, patients indicated that learning ''how to cultivate the forgiving heart'' (p. 6) was one of the keys to reducing their hostility.

Waltman (2003) examined a ten-week forgiveness intervention with male patients who had coronary artery disease. No differences were found between the groups

from the pre- to post-test. However, after a 10-week follow up, a difference emerged. Participants in the forgiveness group experienced reduced anger-induced myocardial perfusion defects.

Chronic Pain

Because chronic pain can be complicated by anger and resentment (Greenwood et al. 2003), forgiveness interventions may be beneficial. Carson et al. (2005) examined individuals suffering from chronic low back pain and found that anger, affective pain and sensory pain were all lower for those who were more forgiving. State anger mediated the relationship between forgiveness and sensory pain. However, state anger did not mediate the relationship between forgiveness and affective pain. In addition, Rippentrop et al. (2005) demonstrated that pain patients with higher levels of forgiveness reported experiencing less daily pain interference and less intense pain.

Substance Use

For participants with substance dependence, Lin et al. (2004) examined the effect of either 12 weeks of forgiveness therapy or individual therapy. Individuals who participated in forgiveness therapy experienced a decrease in their vulnerability to use drugs at post-test and four-month follow-up. Individual therapy specifically focused on drug vulnerabilities, whereas forgiveness therapy did not. However, it was the participants in the forgiveness therapy group who decreased their drug vulnerabilities.

In the foregoing areas, forgiveness might be important because it affects the patient's stress response. However, there are medical problems that are not mediated by stress response. Stress shows up within the family support system, or in coping with the disease, and thus can affect physical and mental health outcomes. We illustrate that process with two examples.

Traumatic Brain Injuries

Individuals with traumatic brain injury may blame others (Smith 1989). Many individuals with traumatic brain injury were injured by others (Gisi and D'Amato 2000), and accidents leading to the injury frequently involved carelessness (e.g., running stop sings), lack of responsibility (e.g., hit and run), or alcohol (Gisi and D'Amato 2000). Anger and resentment can result in non-compliance with medical protocol (Smith 1989). Major transgressions might also occur after the injury. Caretakers or spouses might abandon or demean patients. Furthermore, brain injured patients might say hurtful things, express uncontrolled rage, or simply be a source of resentment from causing caretaker burden. To the extent that forgiveness addresses these issues, such interventions may be of benefit.

Cancer

Individuals faced with terminal cancer have been studied in forgiveness interventions. So far, this research has typically been reported in unpublished dissertations (Bennett 1998; Hansen 2002; Phillips 1999; Stone 2001). Philips (1999) identified themes that emerged from two open-ended interviews with five participants diagnosed with cancer. Participants expressed a need for (a) letting go of longstanding patterns of thoughts, feelings, and behaviors that blocked spiritual growth and (b) opening and healing through practicing forgiveness, trust, acceptance, and spirituality. Hansen (2002) reported a dissertation on a forgiveness intervention with participants diagnosed with terminal cancer. Participants expressed emotional pain due to unresolved conflicts or past emotional injuries. They participated either in a four-week forgiveness therapy or supportive therapy wait-list control group (Hansen 2002). From pre- to post-test, the forgiveness group had higher gains in forgiveness, hope, and quality of life, and higher reductions in anger than did the control group.

Published studies of forgiveness in cancer patients include case studies (Mauldin and Andersen 1998) and an uncontrolled study (Phillips and Osborne 1989). Phillips and Osborne provided six sessions of group-based forgiveness therapy to cancer patients. The sessions focused on the relief and dissipation of negative feelings and the resolution of painful psychological issues associated with cancer. The group leader-authors reported that the process of forgiving involved a struggle with guilt, blame, and revenge and growth in the understanding of the reciprocal nature of relationships.

Medical Errors

Forgiveness training could help physicians, patients, and family members in dealing with medical errors (Gerber 1990). Of note, the current culture of medical settings is not set up to encourage forgiveness. For instance, many physicians involved in medical mistakes are informed not to communicate with the patient or patient's family, which makes it difficult for anyone to begin to forgive (Berlinger and Wu 2005). Yet, forgiveness issues still exist for physicians even if they are not allowed to communicate with families (see Gerber 1990). For example, one physician stated that at times physicians need self-forgiveness, which was described as freedom from guilt and self-hatred over mistakes (Berlinger and Wu 2005). Thus, although none have been investigated

empirically, self-forgiveness interventions could help physicians deal with medical mistakes.

Patients and family members could also benefit from forgiveness interventions regarding medical errors. Clearly, redress for mistakes should not be circumvented by participating in a forgiveness intervention, but after mediated resolution or litigation, family members might still need to deal with unforgiveness of physicians, lawyers, judges, juries, and third party payers.

Research Agenda and Conclusion

We suggest a brief research agenda that derives from the foregoing review of (a) whether forgiveness affects health, (b) how it might do so, and (c) how interventions might be crafted.

Refining Knowledge about Forgiveness in Relationship to Health

As outlined in this research review, much is known while much remains unknown about the forgiveness-health relationship. We suggest the importance of further research on these issues. (a) Given that forgiveness and other coping strategies may reduce unforgiveness, how does forgiveness compare to those strategies in terms of making a positive difference in health that goes beyond merely reducing unforgiveness? (b) How does the relationship between forgiveness and health change across the lifespan? Does forgiveness work through different mechanisms, as we have suggested, for the younger than for the older person? (c) What negative health effects might be associated with different approaches to forgiveness, understandings of forgiveness, features of transgressions, contexts, and timelines? It is important for forgivers not to endanger themselves or others by forgoing justice or by reconciling when instrumental behavior is needed to rectify a problem. Are there also negative health effects that directly follow forgiving? (d) What is the nature of the role of forgiveness in coping with disease? Forgiveness might play a palliative role in coping with gastrointestinal, cardiovascular, and stress-related disorders. However, in cancer control, for instance, forgiving might affect cancer risk directly by affecting glutamate and thus the *N*-methyl-D-asparate receptor, which affects free radical concentration, which in turn might affect cancer risk (McEwen 2002). Forgiveness might contribute to the healing or treatment of cancer only indirectly through relationships or social support, or by helping people be more at peace with their ailments, or contributing to fewer mental health consequences and more positive mental health consequences.

Mechanisms by Which Forgiveness May Affect Health

Future research should more specifically address these questions. (a) To what degree is the stress-and-coping model an adequate explanation of the direct versus indirect effects of forgiveness on health? (b) What are the roles of positive emotions such as forgiveness in stress, coping, and health research (Fredrickson 1998)? (c) To what extent might emotional forgiveness relate to meaning- and problem-focused coping (Park and Folkman 1997)? (d) Under what conditions are decisional and emotional forgiveness independent and under what conditions are they interrelated? (e) What are the physiological and behavioral mechanisms by which decisional and emotional forgiveness have different health-related effects? (f) Who tends to experience decisional versus emotional forgiveness, under what circumstances, and with what effects on physical health?

Forgiveness Intervention Research

(a) Controlled clinical trials of forgiveness interventions are in short supply in health settings. A variety of interventions should be tested with different health disorders. Furthermore, eventually, different interventions need to be compared within the treatment of a given disease. (b) Trait by state forgiveness treatment studies are needed. Perhaps those high in trait forgivingness will forgive *naturally*, and they may have ceiling effects on forgiveness intervention benefits. Better candidates for interventions might be those who are lower in trait forgivingness, who potentially have much more to gain.

With each successive review of the literature, the evidence for connections between forgiveness and health mounts. Mechanisms of influence seem highly related to decreasing the effects of the stress response, but indirect mechanisms, such as affecting the social support network, also exist. At present, interventions to promote forgiveness have been applied to a variety of conditions. The time is ripe for controlled clinical trials of tailored interventions to promote forgiveness in patients and caregivers.

References

Baumeister, R. F., Exline, J. J., & Sommer, K. L. (1998). The victim role, grudge theory, and two dimensions of forgiveness. In E. L. Worthington Jr. (Ed.), *Dimensions of forgiveness: Psychological research & theological perspectives* (pp. 79–104). Philadelphia: Templeton Foundation Press.

Bennett, M. L. (1998). A study of the relationship of prayer between family caregiver and cancer patient in easing caregiver burden. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 59*(1-B), 169.

Berlinger, N., & Wu, A. W. (2005). Subtracting insult from injury: Addressing cultural expectations in the disclosure of medical error. *Journal of Medical Ethics, 31*, 106–108.

Blair, R. J. R., Morris, J. S., Frith, C. D., Perett, D. I., & Dolan, R. J. (1999). Dissociable neural responses to facial expressions of sadness and anger. *Brain, 122*, 883–893.

Brosschot, J. F., & Thayer, J. F. (2003). Heart rate response is longer after negative emotions than after positive emotions. *International Journal of Psychophysiology, 50*, 181–187.

Carson, J. W., Keefe, F. J., Goli, V., Fras, A. M., Lynch, T. R., Thorp, S. R., & Buechler, J. L. (2005). Forgiveness and chronic low back pain: A preliminary study examining the relationship of forgiveness to pain, anger, and psychological distress. *Journal of Pain, 6*, 84–91.

Casey, K. L., Svensson, P., Morrow, T. J., Raz, J., Jone, C., & Minoshima, S. (2000). Selective opiate modulation of nociceptive processing in the human brain. *Journal of Neurophysiology, 84*, 525–533.

Coan, J. A., Allen, J. J. B., & Harmon-Jones, E. (2001). Voluntary facial expression and hemispheric asymmetry over the frontal cortex. *Psychophysiology, 38*, 912–925.

Eisenberger, N. I., Lieberman, M. D., & Williams, K. D. (2003). Does rejection hurt? An fMRI study of social exclusion. *Science, 302*, 290–292.

Enright, R. D., & Fitzgibbons, R. P. (2000). *Helping clients forgive: An empirical guide for resolving anger and restoring hope*. Washington, DC: American Psychological Association.

Exline, J. J., Worthington, E. L. Jr., Hill, P., & McCullough, M. E. (2003). Forgiveness and justice: A research agenda for social and personality psychology. *Personality and Social Psychology Review, 7*, 337–348.

Farrow, T. F. D., & Woodruff, P. W. R. (2005). Neuroimaging of forgivability. In E. L. Worthington Jr. (Ed.), *Handbook of forgiveness* (pp. 259–272). New York: Brunner-Routledge.

Farrow, T. F. D., Zheng, Y., Wilkinson, I. D., Spence, S. A., Deakin, J. F. W., Tarrier, N., Griffiths, P. D., & Woodruff, P. W. R. (2001). Investigating the functional anatomy of empathy and forgiveness. *Neuroreport: An International Journal for the Rapid Communication of Research in Neuroscience, 12*, 2433–2438.

Fincham, F. D., Hall, J. H., & Beach, S. R. H. (2005). Til lack of forgiveness doth us part: Forgiveness and marriage. In E. L. Worthington Jr. (Ed.), *Handbook of forgiveness* (pp. 207–225). New York: Brunner-Routledge.

Fredrickson, B. L. (1998). What good are positive emotions?. *Review of General Psychology, 2*, 300–319.

Friedman, M., Thoresen, C. E., Gill, J. J., Ulmer, D., Powell, L. H., Price, V. A., Brown, B., Thompson, L., Rabin, D. D., Breall, W. S., Bourg, E., Levy, R., & Dixon, T. (1986). Alterations of Type A behavior and its effects on cardiac recurrent in post-myocardial infraction patients: Summary results of the coronary prevention recurrence project. *American Heart Journal, 112*, 653–665.

Gerber, L. E. (1990). Transformations of self-understanding in surgeons whose medical treatment efforts were not successful. *American Journal of Psychotherapy, 44*, 75–84.

Gisi, T. M., & D'Amato, C. (2000). What factors should be considered in rehabilitation: Are anger, social desirability, and forgiveness related in adults with traumatic brain injuries? *International Journal of Neuroscience, 105*, 121–133.

Glinder, J. G., & Compas, B. E. (1999). Self-blame attributions in women with newly diagnosed breast cancer: A prospective study of psychological adjustment. *Health Psychology, 18*, 475–481.

Gray, J. A. (1994). Personality dimensions and emotion systems. In P. Ekman & R. J. Davidson (Eds.), *The nature of emotion: Fundamental questions* (pp. 329–331). New York: Oxford University Press.

Greene, J. D., Sommerville, R. B., Nystrom, L. E., Darley, J. M., & Cohen, J. D. (2001). An fMRI investigation of emotional engagement in moral judgment. *Science, 293*, 2105–2108.

Greenwood, K. A., Thurston, R., Rumble, M., Waters, S. J., & Keefe, F. J. (2003). Anger and persistent pain: Current status and future directions. *Pain, 103*, 1–5.

Hall, J. H., & Fincham, F. D. (2005). Self-forgiveness: The stepchild of forgiveness research. *Journal of Social and Clinical Psychology, 24*, 621–637.

Hansen, M. J. (2002). Forgiveness as an educational intervention goal for persons at the end of life. *Dissertation Abstracts International, 63*(1224), 4A.

Harmon-Jones, E., Sigelman, J. D., Bohlig, A., & Harmon-Jones, C. (2003). Anger, coping, and frontal cortical activity: The effect of coping potential on anger-induced left frontal activity. *Cognition and Emotion, 17*, 1–24.

Harmon-Jones, E., Vaughn-Scott, K., Mohr, S., Sigelman, J., & Harmon-Jones, C. (2004). The effect of manipulated sympathy and anger on left and right frontal cortical activity. *Emotion, 4*, 95–101.

Harris, A. H. S., & Thoresen, C. E. (2005). Forgiveness, unforgiveness, health, and disease. In E. L. Worthington Jr. (Ed.), *Handbook of forgiveness* (pp. 321–333). New York: Brunner-Routledge.

Harris, A. H. S., & Thoresen, C. E. (2006). Extending the influence of positive psychology interventions into health care settings: Lessons from self-efficacy and forgiveness. *Journal of Positive Psychology, 1*, 27–36.

Huang, S-T. T., & Enright, R. D. (2000). Forgiveness and anger-related emotions in Taiwan: Implications for therapy. *Psychotherapy, 37*, 71–79.

Kaplan, B. H. (1992). Social health and the forgiving heart: The Type B story. *Journal of Behavioral Medicine, 15*, 3–14.

Koenig, H. (2007). Altruistic love and physical health. In S. G. Post (Ed.), *Altruism and health: Perspectives from empirical research* (pp. 422–441). Oxford: Oxford University Press.

Lawler, K. A., Younger, J. W., Piferi, R. L., Billington, E., Jobe, R., Edmondson, K., & Jones, W. H. (2003). A change of heart: Cardiovascular correlates of forgiveness in response to interpersonal conflict. *Journal of Behavioral Medicine, 26*, 373–393.

Lawler, K. A., Younger, J. W., Piferi, R. L., Jobe, R. L., Edmondson, K. A., & Jones, W. H. (2005). The unique effects of forgiveness on health: An exploration of pathways. *Journal of Behavioral Medicine, 28*, 157–167.

Lawler-Row, K. A., & Piferi, R. L. (2006). The forgiving personality: Describing a life well lived? *Personality and Individual Differences, 41*, 1009–1020.

Lieberman, M. D., Jarcho, J. M., Berman, S., Naliboff, B. D., Suyenobu, B. Y., Mandelkern, M., & Mayer, E. A. (2004). The neural correlates of placebo effects: A disruption account. *Neuroimage, 22*, 447–445.

Lin, W., Mack, D., Enright, R. D., Krahn, D., & Baskin, T. W. (2004). Effects of forgiveness therapy on anger, mood, and vulnerability to substance use among inpatient substance-dependent clients. *Journal of Consulting and Clinical Psychology, 72*, 1114–1121.

Marques, A. H., & Sternberg, E. M. (2007). The biology of positive emotions and health. In S. G. Post (Ed.), *Altruism and health: Perspectives from empirical research* (pp. 149–188). Oxford: Oxford University Press.

Mauldin, G. R., & Anderson, W. T. (1998). Forgiveness as an intervention in contextual family therapy: Two case examples. *TCA Journal, 26*, 123–132.

McCraty, R., Atkinson, M., Riller, W.A., Rein, G., & Watkins, A. D. (1995). The effects of emotion on short-term power spectrum analysis of heart rate variability. *American Journal of Cardiology, 76*, 1089–1093.

McCullough, M. E., Pargament K. I., & Thoresen C. E. (Eds.). (2000). *Forgiveness: Theory, research and practice*. New York: Guilford Press.

McCullough, M. E., Root, L. M., & Cohen, A. D. (2006). Writing about the benefits of an interpersonal transgression facilitates forgiveness. *Journal of Consulting and Clinical Psychology, 74*, 887–897.

McDaniel, S. H., Hepworth, J., & Doherty, W. J. (1999). The shared emotional themes of illness. *Journal of Family Psychotherapy, 10*, 1–8.

McEwen, B. S. (2002). *The end of stress as we know it*. Washington D.C.: Joseph Henry Press.

Mullet, E., Neto, F., & Riviere, S. (2005). Personality and its effects on resentment, revenge, and forgiveness and on self-forgiveness. In E. L. Worthington Jr. (Ed.), *Handbook of forgiveness* (pp. 159–182). New York: Brunner-Routledge.

Park, C. L., & Folkman, S. (1997). Meaning in the context of stress and coping. *Review of General Psychology, 1*, 115–144.

Phillips, C. F. (1999). The lived experience of spirituality and healing among persons with life-threatening cancer: ''Making it real. *Dissertation Abstracts International, 59*(4370), 12A.

Phillips, L. J., & Osborne, J. W. (1989). Cancer patients' experiences of forgiveness therapy. *Canadian Journal of Counseling, 23*, 236–251.

Pietrini P., & Guazzelli M. (1997). Life events in the course of chronic diseases: A psychological myth or a psycho-neuro-biochemical loop? *Clinical and Experimental Rheumatology, 15*, 125–128.

Pietrini, P., Guazzelli, M., & Grafman J. (1998). Gender differences in brain activation during aggressive imageries. *International Journal of Psychophysiology, 30*(1–2), 33.

Pietrini, P., Guazzelli, M., Basso, G., Jaffe, K., & Grafman, J. (2000). Neural correlates of imaginal aggressive behavior assessed by positron emission tomography in healthy subjects. *American Journal of Psychiatry, 157*, 1772–1781.

Pietrini, P., Ricciardi, E., Gentili, C., Vanello, N., Sani, L., & Guazzelli, M. (2004). How the brain responds to hurtful events: neural activity elicited by aggressive versus forgiving behavior in humans. *International Journal of Psychophysiology, 54*(1–2), 26.

Rainville P., Duncan G. H., Price D. D., Carrier B., & Bushnell M. C. (1997). Pain affect encoded in human anterior cingulate but not somatosensory cortex. *Science, 277*, 968–971.

Rippentrop, A. E., Altmaier, E. M., Chen, J. J., Found, E. M., & Keffala, V. J. (2005). The relationship between religion/spirituality and physical health, mental health, and pain in a chronic pain population. *Pain, 116*, 311–321.

Romero, C., Friedman, L. C., Kalidas, M., Elledge, R., Chang, J., & Liscum, K. R. (2006). Self-forgiveness, spirituality, and psychological adjustment in women with breast cancer. *Journal of Behavioral Medicine, 29*, 29–36.

Schwartz, A. R., Gerin, W., Davidson, K. W., Pickering, T. G., Brosschot, J. F., Thayer, J. F., Christenfeld, N., & Linden, W. (2003). Toward a causal model of cardiovascular responses to stress and the development of cardiovascular disease. *Psychosomatic Medicine, 65*, 22–35.

Seybold, K. S., Hill, P. C., Neumann, J. K., & Chi, D. S. (2001). Physiological and psychological correlates of forgiveness. *Journal of Psychology and Christianity, 20*, 250–259.

Smith, R. S. (1989). Psychological trauma following automobile accidents: A review of literature. *American Journal of Forensic Psychology, 7*, 5–20.

Stone, B. E. (2001). Cancer as initiation: Surviving the fire. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 62*(1-B), 593.

Toussaint, L. L., & Williams, D. R. (October, 2003). Physiological correlates of forgiveness: Findings from a racially and socio-economically diverse sample of community residents. Presented at A Campaign for Forgiveness Research Conference, Atlanta, GA.

Toussaint, L. L., Williams, D. R., Musick, M. A., & Everson, S. A. (2001). Forgiveness and health: Age differences in a U.S. probability sample. *Journal of Adult Development, 8*, 249–257.

Waltman, M. A. (2003). The psychological and physiological effects of forgiveness education in male patients with coronary artery disease. *Dissertation Abstracts International, 63*(3971), 8–B.

Witvliet, C. V. O. (2001). Forgiveness and health: Review and reflections on a matter of faith, feelings, and physiology. *Journal of Psychology and Theology, 29*, 212–224.

Witvliet, C. V. O., Ludwig, T. E., & Vander Laan, K. (2001). Granting forgiveness or harboring grudges: Implications for emotion, physiology, and health. *Psychological Science, 12*, 117–123.

Witvliet, C. V. O., Ludwig, T. E., & Bauer, D. (2002). Please forgive me: Transgressors' emotions and physiology during imagery of seeking forgiveness and victim responses. *Journal of Psychology and Christianity, 21*, 219–233.

Witvliet, C. V. O., & McCullough, M. E. (2007). Forgiveness and health: A review and theoretical exploration of emotion pathways. In S.G. Post (Ed.), *Altruism and health: Perspectives from empirical research* (pp. 259–276). Oxford: Oxford University Press.

Witvliet, C. V. O., Worthington, E. L., Jr., Root, L. M., Sato, A. F., Ludwig, T. E., & Exline, J. J. (in press). Retributive justice, restorative justice, and forgiveness: An experimental psychophysiology analysis. *Journal of Experimental Social Psychology*, in press.

Worthington, E. L. Jr. (2001). Unforgiveness, forgiveness, and reconciliation in societies. In R. G. Helmick & R. L. Petersen (Eds.), *Forgiveness and reconciliation: Religion, public policy, and conflict transformation* (pp. 161–182). Philadelphia: Templeton Foundation Press.

Worthington, E. L. Jr. (Ed.). (2005a). *Handbook of forgiveness*. New York: Brunner-Routledge.

Worthington, E. L. Jr. (2005b). More questions about forgiveness: Research agenda for 2005–2015. In E. L. Worthington Jr. (Ed.), *Handbook of forgiveness* (pp. 557–574). New York: Brunner-Routledge.

Worthington, E. L. Jr. (2006). *Forgiveness and reconciliation: Theory and application*. New York: Brunner-Routledge.

Worthington, E. L. Jr., & Scherer, M. (2004). Forgiveness is an emotion-focused coping strategy that can reduce health risks and promote health resilience: Theory, review, and hypotheses. *Psychology and Health, 19*, 385–405.

Worthington, E. L. Jr., Witvliet, C. V. O., Lerner, A. J., & Scherer, M. (2005). Forgiveness in medical practice and research. *EXPLORE: The Journal of Science and Healing, 1*, 169–176.