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The impact of forgiveness on cardiovascular reactivity and recovery

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Abstract

The current study investigated the relationship between trait forgiveness and cardiovascular reactivity (CVR) and recovery in 99 normotensive participants (mean age=33.8). Cardiovascular parameters were obtained at 2-minute intervals during a 10-minute baseline period and a 20-minute recovery period, and at 1-minute intervals during a 4-minute anger recall task and a 4-minute serial subtraction task without harassment. Participants filled out a self-report measure of forgiveness prior to the laboratory procedure. Although forgiveness was not related to CVR, higher levels of trait forgiveness were predictive of lower diastolic blood pressure (DBP) at baseline ($p<.02$) and faster DBP recovery ($p<.003$). Findings suggest that forgiveness may be related to overall reductions in blood pressure levels and may aid in cardiovascular recovery from stress. The results also provide preliminary evidence that forgiveness may impact cardiovascular health not through a myocardial or vascular pathway, but through another mechanism.

Keywords: Forgiveness; Cardiovascular reactivity; Blood pressure; Recovery

1. Introduction

Although the link between health and negative attributes such as anger and hostility has been a focus of behavioral medicine research for years, researchers have only recently begun to explore the relationship between health and positive psychological traits such as forgiveness, empathy, and optimism (e.g., Fitzgerald et al., 1993; Lawler et al., 2003; Scheier et al., 1989). In particular, there has been an increased focus on the concept of forgiveness in recent years.

Forgiveness entails a series of motivational changes following an interpersonal insult or injury in which individuals let go of their desire for revenge, and instead feel empathy and compassion towards the transgressor (McCullough, 2001). In other words, forgiving implies a reduction of negative emotions related to unforgiveness, including anger, resentment, and hostility, with a simultaneous increase in positive emotions such as empathy, compassion, and affection for the transgressor (Worthington and Wade, 1999). Researchers distinguish between trait forgiveness – which is an individual's tendency to forgive over time and across a variety of situations – and state forgiveness, or forgiveness in response to a single transgression or individual.

Forgiveness has been linked to physiological markers of health, specifically cardiovascular health. Witvliet et al. (2001) conducted the first published experimental examination of forgiveness and cardiovascular reactivity (CVR) in response to stress provocation — which may be a marker for future development of atherosclerosis (Jennings et al., 2004) and hypertension (Tuomisto et al., 2005). This study specifically focused on the link between state forgiveness and CVR. Participants engaged in unforgiving (hurt and grudge) and forgiving (empathy and forgiveness) imagery with regard to an interpersonal offense in which they were victims. Measures of corrugator electromyogram (EMG), skin conductance, mean arterial pressure (MAP) and heart rate (HR) were higher during the unforgiving imagery condition than during the forgiving imagery, and, with the exception of MAP, remained elevated during the recovery period following unforgiving imagery. These results suggest that state forgiveness has a significant inverse relationship CVR and cardiovascular recovery.

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Another study examined the relationship between state and trait forgiveness and CVR (Lawler et al., 2003). Similar to the findings in the aforementioned study, state forgiveness was related to diastolic blood pressure (DBP) and rate pressure product (RPP) reactivity during interviews about interpersonal betrayals. Both state and trait forgiveness were negatively correlated with baseline blood pressure. Trait forgiveness was associated with delayed BP recovery following the transgression interviews. Though Lawler et al. (2003) did not find a relationship between trait forgiveness and CVR in the above study, which was conducted with a college-age sample, they did find an association between trait forgiveness and RPP reactivity during an interview about an interpersonal hurt or betrayal in another study of community adults (Lawler et al., 2005). Given the paucity of research on the relationship between trait forgiveness and CVR, as well as the conflicting results of the two aforementioned studies, it is clear that more investigation of this relationship is needed.

Further, the physiological endpoints of these studies have been limited to BP, HR, skin conductance, and corrugator EMG. Other cardiovascular indices such as cardiac output (CO) and total peripheral resistance (TPR) have been largely ignored in published studies of forgiveness and CVR. It has been speculated that, while stress tends to result in the activation of the sympathetic nervous system, the hemodynamic response that follows can be due to either the activation of alpha-adrenergic receptors or the activation of beta-adrenergic receptors (Sherwood et al., 1999). The activation of beta-adrenergic receptors may result in a myocardial response and thus an increase in CO as well as vasodilation and a reduction in TPR, while the activation of alpha-adrenergic receptors results in a vascular response including an increase in TPR (Sherwood et al., 1999). Vascular responses to stress have, in particular, been suggested as a potential physiological factor in the development of hypertension and atherosclerosis (Ewart et al., 2004). Clearly, then, there is a need to clarify the physiological means of the buffering effect of forgiveness on BP.

Although the hemodynamic responses related to forgiveness have not been thoroughly examined, several research studies on CVR and hostility suggest that high hostile persons may respond to interpersonal stressors by a vascular response, while low hostile individuals respond with a myocardial response (Davis et al., 2000; Suarez et al., 1998). Given that forgiveness involves a reduction in anger, resentment, and hostility (Worthington and Wade, 1999) and that it has been found to be negatively associated with hostility (Berry et al., 2005; Thompson et al., 2005), it can be hypothesized that individuals who are high in forgiveness would display a myocardial response, while those who are low in forgiveness would display a vascular response to an interpersonal stressor.

The current study investigates the effects of trait forgiveness on cardiovascular reactivity and recovery from laboratory stressor. Blood pressure and heart rate measurements, as well as CO and TPR were obtained during baseline, stressor, and recovery periods in order to help clarify the mechanism by which forgiveness impacts health. Two stressors were administered in order to determine the differential effects of forgiveness on an interpersonal (anger recall) and a non-social (serial subtraction without harassment) stressor.

1.1. Study hypotheses

Individuals who exhibit higher levels of trait forgiveness will display (a) lower hemodynamic measures at baseline, (b) lower cardiovascular reactivity in response to an interpersonal, (c) faster recovery from the stressor between trait forgiveness and recovery from the anger recall task. It was not anticipated that individuals would display a hemodynamic response to the non-social stressor.

2. Method

2.1. Participants

Ninety-nine students and staff members of Albert Einstein College of Medicine and the Ferkauf Graduate School of Psychology, located in the Bronx, NY, between the ages of 22 and 65 years (mean age = 33.8 years) were recruited via flyers, mass e-mails, and announcements in classes. Participants were recruited for a study investigating the effects of 8 weeks of yoga and aerobic exercise on personality variables and cardiovascular functioning in normotensive individuals with no history of cardiovascular disease. Thirteen participants were not interested in the yoga or aerobics classes and agreed to participate in only the initial laboratory portion of the study.

There were 82 females and 17 males. The sample included 65 Caucasian, 16 Asian, eight African American, and seven Latino participants, as well as three participants who classified themselves as "other" ethnicity. Additional sample characteristics are presented in Table 1. Participants were healthy (by self-report) and normotensive (resting SBP < 140 mm Hg and DBP < 90 mm Hg). They did not report any history of hypertension or cardiovascular disease, or use of medications that affect cardiovascular functioning. None of the women were currently pregnant.

A power analysis conducted prior to study initiation for multiple regression analysis with two main independent variables and their effects on cardiovascular reactivity indicated that, for a power of .80 and a medium effect size, a sample size of 85 would be necessary at an alpha level of .05. However, since participants were recruited as part of a larger intervention study in which participants were offered 8 weeks of yoga or aerobic exercise classes and the power necessary for the larger

Table 1
Sample characteristics

Characteristic	*M*	SD
Age (years)	33.8	10.5
Body mass index (kg/m^2)	24.9	4.9
Caffeine intake (drinks/day)	1.5	1.2
Cigarette intake (cigarettes/week)	0*	18.4
Alcohol intake (drinks/week)	1.5	1.9
Exercise frequency (times/week)	2.3	1.9

* Cigarette intake median rather than mean is provided because of the skewed mean and large SD.