

Effects of lifetime stress exposure on mental and physical health in young adulthood: How stress degrades and forgiveness protects health

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Abstract

To examine risk and resilience factors that affect health, lifetime stress exposure histories, dispositional forgiveness levels, and mental and physical health were assessed in 148 young adults. Greater lifetime stress severity and lower levels of forgiveness each uniquely predicted worse mental and physical health. Analyses also revealed a graded Stress \times Forgiveness interaction effect, wherein associations between stress and mental health were weaker for persons exhibiting more forgiveness. These data are the first to elucidate the interactive effects of cumulative stress severity and forgiveness on health, and suggest that developing a more forgiving coping style may help minimize stress-related disorders.

Keywords

coping, forgivingness, disease, mechanisms, stress

Life stress is strongly associated with poor mental and physical health (Cohen et al., 2007; Slavich et al., 2010). These effects exceed those of other well-known risk factors, such as tobacco use, excessive alcohol consumption, and physical inactivity (Holt-Lunstad et al., 2010), and account for substantial morbidity and mortality (Pedersen et al., 2011). Understanding how stress impacts health, and what factors mitigate these effects, is thus critically important.

One of the most important advances in this area of research involves the recent adoption of a life-course perspective for studying stress and health (Graham et al., 2006; Lupien et al., 2009). Theorists now generally appreciate that stress occurring over the lifespan can have a cumulative effect on health; however, few

studies have actually measured lifetime stress exposure and assessed the effects that such exposure has on mental and physical health outcomes. This has occurred in part because no system has existed for measuring cumulative

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stress exposure in an efficient, cost-effective manner. This issue has been addressed by the development of automated stress assessment systems such as the Stress and Adversity Inventory (STRAIN), which measures individuals' lifetime exposure to different types of stress that influence the onset and progression of disease (Slavich and Epel, 2010). As a result, researchers are now poised to assess the effects that cumulative life stress exposure has on health and to examine factors that might modify these effects.

One factor that may influence the effects that cumulative stress exposure has on health is forgiveness. Forgiveness is the release of negative—and the potential enhancement of positive—feelings, emotions, and behaviors toward an offender (Enright et al., 1998). Research has demonstrated that forgiveness is associated with several mental health outcomes, including less anxiety, depression, and other major psychiatric disorders (Hirsch et al., 2011; Lin et al., 2004; Ryan and Kumar, 2005; Toussaint and Cheadle, 2009a; Toussaint et al., 2008). Forgiveness is also associated with better physical health and with physiological profiles that underlie good health. In this context, forgiveness predicts fewer physical health symptoms, better overall physical health (Lawler et al., 2005; Seawell et al., 2014), healthier cardiovascular responses to stress (Lawler et al., 2003), and lower rates of cardiovascular disease (Friedberg et al., 2007; Toussaint and Cheadle, 2009b; Waltman et al., 2009). As can be expected, forgiveness is thus also associated with lower rates of mortality (Krause and Hayward, 2013; Toussaint et al., 2012).

Forgiveness has been conceptualized as an emotion-focused coping process or style that can help people manage negative psychological and emotional experiences (i.e. unforgiveness) evoked by interpersonal conflict and stress (Strelan and Covic, 2006; Worthington and Scherer, 2004). From this perspective, forgiveness is just one of several approaches that individuals can use to cope; however, it has been proposed as one of the more healthy options for dealing with adversity (Worthington

and Scherer, 2004). Hence, to the extent that the victim of an offense can cope with the ensuing stress of unforgiveness through forgiveness, the negative effects of stress on health should be mitigated. Like many psychological constructs, forgiveness can be both a state and a trait (Berry et al., 2001; Roberts, 1995). Trait forgiveness has been called *forgivingness*, and high levels of forgivingness are thought to predispose a person to experience state forgiveness more often. Put another way, a stronger dispositional proclivity toward forgiveness is hypothesized to increase the experience of forgiveness that in turn mitigates the negative effects of stress. Forgivingness is thus a coping style that may play a salutary role in the stress–health relationship.

Studies have shown that perceptions of stress fully mediate associations between forgiveness and mental and physical health symptoms (Green et al., 2012), and that forgiveness partially mediates the link between traumatic stress exposure and post-traumatic stress disorder symptoms (Orcutt et al., 2005). In contrast to this mediational work, little research has examined whether forgivingness moderates or buffers associations between stress and health, despite the fact that the transactional model and the adapted stress and coping model of forgiveness offer the theoretical flexibility to consider coping variables as both mediators and moderators (Lazarus and Folkman, 1984). Evidence suggests that reductions in stress perceptions may help explain why forgiveness is related to health (Green et al., 2012; Orcutt et al., 2005), but to date it is not known if forgiveness offers a protective benefit in the stress–health equation. Demonstrating a buffering effect of forgiveness on stress-related health symptoms requires evidence of moderation.

To address these issues, we assessed the lifetime stress exposure histories, forgivingness levels, and mental and physical health of 148 young adults. Based on the aforementioned research, we hypothesized that greater severity of lifetime stress exposure would be associated with poorer mental and physical health. We tested these associations using

indices of overall severity of exposure to stress, but also assessed these effects using 20 different subdomain indices of stress exposure across 2 time periods (i.e. early life, adulthood), 2 stressor types (i.e. acute, chronic), 11 life domains (e.g. housing, education, work, etc.), and 5 different social-psychological characteristics (e.g. interpersonal loss, physical danger, humiliation, etc.). Second, we hypothesized that greater forgivingness would be associated with better mental and physical health. Finally, we hypothesized an interaction between severity of lifetime stress exposure and forgivingness, such that higher levels of forgivingness would buffer the negative effects of stress severity across all domains on mental and physical health symptoms.

Method

Participants and procedures

Participants were 148 young adults recruited from a mid-sized liberal arts college campus in the Midwest. Most of the participants (99%) began college in the past 4 years. The sample was 54 percent women, with a mean age of 19.32 years (standard deviation (*SD*) = 2.80). Less than 1 percent of participants were married, 29 percent were in a serious relationship, 12 percent were dating, and 60 percent were single. Over 99 percent had no children. Participants provided written informed consent and completed all of the measures online for course credit. Finally, all study procedures were approved by the local Institutional Review Board.

Measures

Lifetime stress exposure. The STRAIN is an online stress assessment system that measures individuals' lifetime exposure to 96 different types of acute and chronic stress that affect health (Slavich and Epel, 2010; see <http://www.uclastresslab.org/STRAIN>). The system combines the reliability and sophistication of an interview-based measure of stress with the simplicity of a self-report instrument. Questions

appear on the computer screen, and for each endorsed stressor, users are asked a series of follow-up questions that ascertain the severity, frequency, timing, and duration of the stressor. Example items are, "Have you ever found out that a partner was unfaithful to you?" and "Have you ever looked for a job for at least six months, but were unable to find a stable job?" The validity of this question set has been demonstrated in the context of predicting metabolic health (Kurtzman et al., 2012), cancer-related fatigue (Bower et al., 2014), and psychological and physical health (Slavich and Epel, in preparation). Lifetime stressor "count" can range from 0 to 96 and cumulative "severity" can range from 0 to 480, with higher scores representing higher stressor count and severity, respectively.¹ In addition, 20 subscale scores can be computed to index stress exposure occurring across 2 time periods (early life, adulthood), 2 stressor types (acute, chronic), 11 life domains (housing, education, work, treatment/health, marital/partner, reproduction, financial, legal/crime, death, life-threatening situations, and possessions), and 5 social-psychological characteristics (interpersonal loss, physical danger, humiliation, entrapment, and role change).

Forgivingness. The Heartland Forgiveness Scale (HFS) is an 18-item measure of forgivingness, which assesses the general disposition toward engaging in all types of forgiveness. Responses are given on a 1 (*almost always false of me*) to 7 (*almost always true of me*) scale, and scores can range from 18 to 125, with higher scores representing more forgivingness. Psychometric work on the HFS shows acceptable confirmatory factor analyses, convergent/divergent validity, and internal and test-retest reliability (Thompson et al., 2005). Internal consistency for the HFS for this study was excellent ($\alpha = .90$).

Mental health symptoms. The Kessler 6 (K6) measures nonspecific psychological distress. Responses are given on a 1 (*never*) to 5 (*very often*) scale, and scores can range from 6 to 30, with higher scores representing more distress.

The K6 possesses excellent psychometric properties (Kessler et al., 2002, 2010). Internal consistency for the K6 for this study was excellent ($\alpha = .90$).

Physical health symptoms. The 14-item Physical Health Questionnaire (PHQ) assesses somatic symptoms (Spence et al., 1987). Responses to 12 items are given on a 1 (*not at all*) to 7 (*all the time*) scale, and responses to 3 items are given on a 0 *times* to 7+ *times* scale. Scores range from 14 to 98, with higher scores representing more physical health symptoms. Psychometric work on the PHQ shows acceptable exploratory and confirmatory factor analysis, excellent convergent/divergent validity, and strong internal consistency (Schat et al., 2005). Internal consistency for the PHQ for this study was good ($\alpha = .82$).

Analyses

Preliminary analyses included descriptive statistics and bivariate correlations for all study variables. Primary analyses included hierarchical regression models that examined direct and interactive effects of lifetime stress severity and forgiveness on health. Life stress and forgiveness were entered as direct effects on Step 1, and the Life Stress \times Forgiveness interaction effect was entered in Step 2.² Simple slopes analyses followed guidelines described by Cohen et al. (2003). These analyses involved examining the effects of life stress on health at low, moderate, and high levels of forgiveness. Data were examined for adherence to assumptions, and the alpha level was set at $p < .05$.

Results

Preliminary analyses

On average, participants experienced nearly 13 major life stressors each and rated those stressors as being moderately stressful ($M = 3.08$; range = 1–5). Participants reported levels of overall forgiveness that were relatively high ($M = 87.56$, $SD = 15.20$), and a moderate number of mental ($M = 13.91$, $SD = 5.24$) and physical

health symptoms ($M = 35.65$, $SD = 11.29$). The most frequently reported stressors involved keeping up with the demands of college, death of a close friend or loved one, isolation and loneliness, relationship difficulties, and financial problems. In bivariate analyses, most of the 20 stress severity indices were strongly associated with poorer health. As shown in Figure 1, only reproductive-, legal/criminal-, death-, and theft-related stressors were unrelated to health. Given the consistency across stress indices, subsequent analyses utilized total stress severity score as the main stress variable. Greater total lifetime stressor severity was strongly associated with having more mental ($r = .54$, $p < .001$) and physical ($r = .55$, $p < .001$) health symptoms. In contrast to stress, forgiveness was negatively related to mental ($r = -.48$, $p < .001$) and physical health symptoms ($r = -.35$, $p < .001$). Additionally, greater lifetime stress severity was negatively related to forgiveness ($r = -.26$, $p < .01$, and $r = -.33$, $p < .001$, respectively). As expected, participants experiencing more mental health symptoms also experienced more physical health symptoms ($r = .56$, $p < .001$).

Primary analyses

Lifetime stress severity, forgiveness, and mental health. As hypothesized, forgiveness significantly moderated the effects of lifetime stress severity on mental health ($\beta = -.173$, $p < .01$; see Table 1, Mental Health Model 2). Planned simple slopes analyses revealed a graded moderating effect of forgiveness on mental health symptoms. Specifically, participants with low levels of forgiveness (1.5 SD s or more below the mean) showed the strongest associations between lifetime stress severity and mental health symptoms ($\beta = 0.68$, $p < .05$), followed by participants exhibiting moderate amounts of forgiveness (within 1.5 SD s of the mean) ($\beta = 0.41$, $p < .05$), and finally by participants with high levels of forgiveness (1.5 SD s or more above the mean) ($\beta = 0.15$, $p > .05$). This graded interaction effect is depicted graphically in Figure 2. Also as hypothesized, lifetime stressor severity and forgiveness were both uniquely associated with

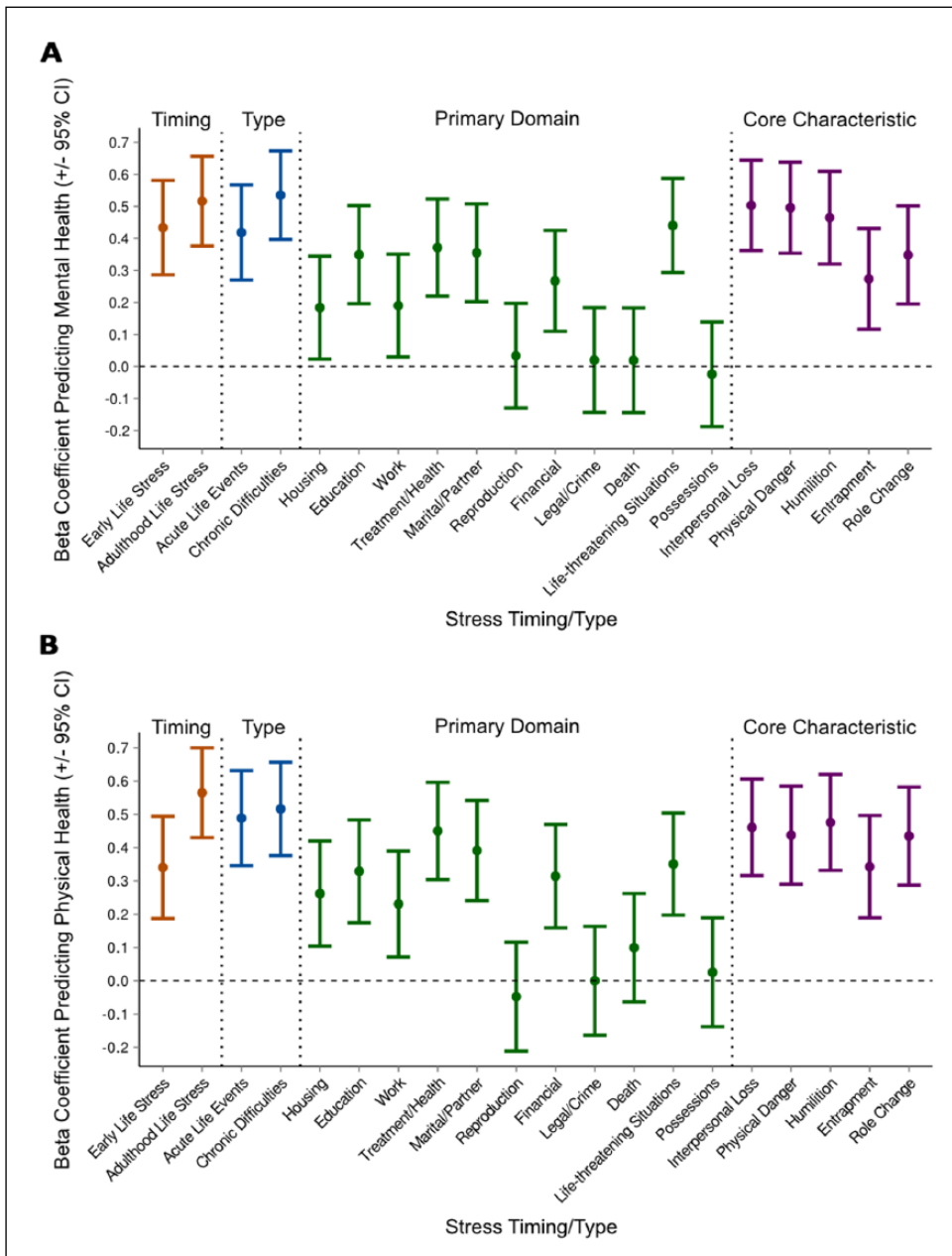


Figure 1. Associations between severity of lifetime stress exposure and (a) mental and (b) physical health symptoms, categorized by stressor timing, type, primary domain, and core social-psychological characteristic. Error bars represent 95 percent confidence intervals ($N = 148$).

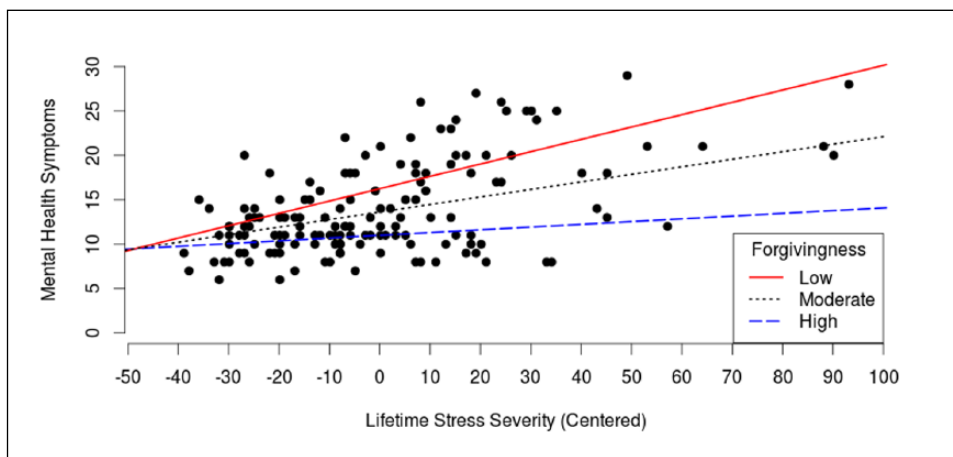
mental health symptoms, with greater lifetime stress severity predicting more mental health symptoms ($\beta = 0.42$, $p < .001$) and higher levels

of forgiveness predicting fewer mental health symptoms ($\beta = -0.34$, $p < .001$) (see Table 1, Mental Health Model 1).

Table 1. Hierarchical regression analysis examining direct and interactive effects of lifetime stress severity and forgiveness on mental and physical health symptoms.

Predictor	Mental health						Physical health					
	Model 1			Model 2			Model 1			Model 2		
	B	SE B	β	B	SE B	β	B	SE B	β	B	SE B	β
Lifetime Stress Severity	0.09	0.01	0.42***	0.29	0.07	0.42***	0.22	0.03	0.49***	0.27	0.17	0.49***
Forgivingness	-2.14	0.43	-0.34***	-0.33	0.76	-0.34**	-2.58	0.96	-0.19**	-2.11	1.76	-0.19**
Lifetime Stress Severity \times Forgivingness				-0.043	0.02	-0.17**				-0.01	0.04	-0.02
R ²	.39***			.42***			.34***			.34***		
F for ΔR^2	46.63***			8.11**			36.96***			0.10		

SE: standard error.

* $p < .05$, ** $p < .01$, *** $p < .001$, two-tailed ($N = 148$).**Figure 2.** Associations between severity of lifetime stress exposure, forgiveness, and mental health. As hypothesized, greater lifetime stress severity uniquely predicted more mental health symptoms, and higher levels of forgiveness uniquely predicted fewer mental health symptoms. In addition, there was a strong graded Lifetime Stress Severity \times Forgivingness interaction effect, demonstrating that forgiveness significantly buffers the effects of lifetime stress severity on mental health ($N = 148$).

Lifetime stress severity, forgiveness, and physical health. Next, the effects of lifetime stress severity and forgiveness on physical health symptoms were examined. Contrary to our hypothesis, forgiveness did not moderate the effects of cumulative lifetime stress severity on physical health ($\beta = -0.02$, $p > .05$; see Table 1, Physical Health Model 2). As hypothesized, lifetime stressor severity and forgiveness were both uniquely associated with physical health symptoms, with greater lifetime stress

severity predicting more physical health symptoms ($\beta = 0.49$, $p < .001$) and higher levels of forgiveness predicting fewer symptoms ($\beta = -0.19$, $p < .01$; see Table 1, Physical Health Model 1).

Discussion

Although early and adulthood life stress are known to be strongly associated with a broad range of mental and physical health problems

(Cohen et al., 2007; Conway et al., 2014; Slavich and Irwin, 2014; Taylor, 2010), few studies have actually measured the severity of lifetime exposure to stress and examined its effects on health. Moreover, the coping styles that might moderate such effects remain unclear. We addressed these important issues by studying 148 young adults who were well characterized with respect to their lifetime stress exposure history, tendency to employ the coping style of forgiveness, and recent mental and physical health symptoms. Consistent with prior work on early and adulthood life stress and health (Cohen et al., 2007; Graham et al., 2006; Lupien et al., 2009; Pearlin et al., 2005), we found that greater stress exposure severity over the lifespan was associated with poorer mental and physical health. These effects were robust while controlling for mental health symptoms in the physical health models, and vice versa, and were present for most of the 20 different stress severity indices that we calculated using the STRAIN.

Hypotheses regarding relations between forgiveness and mental and physical health were based on research showing that people with coping styles involving forgiveness have better overall health (Toussaint and Webb, 2005; Worthington et al., 2007). The present data are consistent with this research, but show for the first time that forgiveness is a strong, independent predictor of mental and physical health while controlling for the effects of lifetime stress severity on health. Prior research has shown that associations between forgiveness and health are substantially attenuated or eliminated while controlling for perceptions of stress (Lawler et al., 2005). However, it is possible that a side effect of higher forgiveness is reduced perceptions of stress. By measuring actual lifetime stress severity and not merely levels of general perceived stress, the present findings offer new insight into how the effects of stress might be offset by the *independent* effects of forgiveness.

That forgiveness predicts mental and physical health over and above stress severity dovetails with intervention work showing that

facilitating experiences of forgiveness improves mental and physical health (Baskin and Enright, 2004; Wade et al., 2005; Waltman et al., 2009). As such, personally cultivating this emotion-focused coping style may offer health benefits independent of the life stressors that an individual might face. To the extent that forgiveness training can promote a more forgiving coping style, then these interventions may help reduce stress-related disease and improve human health. Such interventions may be particularly beneficial when delivered as a prevention strategy in early life, before individuals are exposed to major adulthood life stressors and before disease processes have begun to take hold.

This study also examined whether forgiveness moderates the effects of lifetime stress severity on health. Existing research in this area has evaluated whether perceived stress mediates the effects of forgiveness on health, and how forgiveness mediates the relation between stress and health. Additionally, both theory and research suggest that forgiveness may *moderate* the effects of stress on health by acting as an important coping style (Strelan and Covic, 2006; Worthington, 2003; Worthington and Scherer, 2004). To our knowledge, however, no studies to date have examined whether forgiveness moderates the effects of stress on health. Here, we demonstrated for the first time that forgiveness does buffer the negative effects of lifetime stress severity on mental health, and that this moderation occurs in a graded fashion. Specifically, we found that lifetime stress severity was unrelated to mental health for persons who were highest in forgiveness, significantly associated with poorer mental health for persons exhibiting moderate levels of forgiveness, and most strongly related to poorer mental health for participants exhibiting the lowest levels of forgiveness.

The present data do not reveal *how* forgiveness buffers the effects of lifetime stress severity on mental health, but several explanations are possible. First, more forgiving individuals may have a more adaptive or extensive repertoire of coping strategies that mitigate the negative effects of stress on health. Consistent

with this possibility, research has shown that people with higher levels of forgiveness also have a greater tendency to use problem-focused coping and cognitive restructuring, and are less likely to use rumination, emotional expression, and wishful thinking (Ysseldyk and Matheson, 2008). Second, forgiveness may dampen emotional, physiologic, or genomic components of the stress response that lead to poor health (Slavich and Cole, 2013; Strelan and Covic, 2006; Worthington, 2003; Worthington and Scherer, 2004). Finally, forgiveness may facilitate healthier behaviors in the aftermath of major life stress or may prompt a more active approach to dealing with stress that involves addressing the aspects of stress that are controllable (Webb et al., 2010, 2013). Additional research is needed to evaluate how these different factors influence the effects of stress and forgiveness on health.

Contrary to our hypothesis, forgiveness did not moderate the effects of lifetime stress severity on physical health. This may have occurred because the sample included healthy young adults. However, the average level of physical health symptoms was well above the minimum score for the scale and the standard deviation was also relatively large, indicating a moderate level of somatic complaints and notable individual variability. Also, bivariate scatter plots (not shown) did not indicate skew or range restriction. Finally, both stress exposure and forgiveness levels predicted significant amounts of variability in physical health symptoms. In short, the fact that forgiveness did not moderate the effects of stress on physical health was not likely due to statistical issues.

Another possible reason for the contrasting pattern of results for mental and physical health may involve the fact that although participants experienced approximately 13 different stressors (on average), these stressors may not exert effects on physical health that are readily mitigated by forgiveness. This possibility is consistent with the “goodness of fit” hypothesis, which suggests that a person’s coping style must be relevant and useful for dealing with the type of stress experienced for the method to

confer health benefits (Forsythe and Compas, 1987). In the present study, the most frequently reported stressors involved dealing with educational demands, death of a close friend or loved one, isolation and loneliness, relationship difficulties, and financial problems. These stressors may well exert an immediate impact on mental health processes (e.g. increased anger, frustration, or rumination) that are buffered by forgiveness, but have an effect on physical health processes (e.g. increased inflammatory activity) that are not as strongly influenced by forgiveness (Berry et al., 2005; Finan et al., 2011; Michl et al., 2013; Slavich et al., 2010). In short, the time-course of forgiveness-based health benefits may differ for mental and physical health with the latter being more protracted. Indeed, previous research has documented delayed cardiovascular benefits of forgiveness (Waltman et al., 2009). Additional research is thus needed to identify the types of stress that best fit the forgiveness coping style and that in turn benefit physical health. Given that the STRAIN is a relatively comprehensive measure of lifetime stress exposure, it is unlikely that we failed to assess major types or dimensions of stress that could have interacted with forgiveness to affect health. Nevertheless, this presents an interesting challenge for future studies—namely, to determine if there are specific types of stress for which forgiveness is an ideal coping style that has physical health benefits.

Limitations of this study should also be noted. First, this is a cross-sectional, correlational study and, as such, conclusions about directionality and causality cannot be made. At the same time, recent longitudinal research has shown that forgiveness predicts health symptoms but that health symptoms do not predict forgiveness (Seawell et al., 2014), making reverse causation less likely. Second, although we focused on major life stressors, other forms of stress may also be relevant for mental and physical health and may be buffered by forgiveness, including daily hassles, role strain, and traumatic life stress. Third, health was self-reported, and although the measures we used were psychometrically sound, objective measures of health status should also

be investigated. Fourth, we did not examine potentially important sex differences, and future studies with larger samples might address this question. Finally, this study utilized a convenience sample. Additional research is thus needed to examine the generalizability of the findings.

Notwithstanding these limitations, the present data are the first to demonstrate that lifetime stress severity and forgivingness both have unique, independent effects on mental and physical health. Moreover, they are the first to show that forgivingness significantly moderates the effects of lifetime stress severity on mental health. Knowing that forgivingness buffers the relation between stress and poor health may provide a unique opportunity for reducing stress-related disease by developing programs that help individuals cultivate greater forgivingness. More broadly, these findings address the important question of how key risk and resilience factors interact to influence mental and physical health problems that cause substantial morbidity and mortality.

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Notes

1. The stressor count and severity correlation exceeds .95. This occurs because stressor severity scores are based in part on how many stressors participants experience. Severity was used as the stress measure in this study, although results are virtually identical using stress count or severity.
2. Mental health was controlled for in models of physical health and vice versa. Results remained virtually unchanged as a result of inclusion/exclusion of the covariate.

References

- Baskin TW and Enright RD (2004) Intervention studies on forgiveness: A meta-analysis. *Journal of Counseling & Development* 82(1): 79–90.
- Berry JW, Worthington EL, O'Connor LE, et al. (2005) Forgivingness, vengeful rumination, and affective traits. *Journal of Personality* 73(1): 183–226.
- Berry JW, Worthington EL, Parrott L III, et al. (2001) Dispositional forgivingness: Development and construct validity of the transgression narrative test of forgivingness (TNTF). *Personality and Social Psychology Bulletin* 27(10): 1277–1290.
- Bower JE, Crosswell AD and Slavich GM (2014) Childhood adversity and cumulative life stress: Risk factors for cancer-related fatigue. *Clinical Psychological Science* 2(1): 108–115.
- Cohen J, Cohen P, West SG, et al. (2003) *Applied Multiple Regression/Correlation for the Behavioral Sciences* (3rd edition). New York: Routledge.
- Cohen S, Janicki-Deverts D and Miller GE (2007) Psychological stress and disease. *Journal of the American Medical Association* 298(14): 1685–1687.
- Conway CC, Slavich GM and Hammen C (2014) Daily stress reactivity and serotonin transporter gene (5-HTTLPR) variation: Internalizing responses to everyday stress as a possible transdiagnostic phenotype. *Biology of Mood & Anxiety Disorders* 4(1): 2.
- Enright RD, Freedman S and Rique J (1998) The psychology of interpersonal forgiveness. In: Enright RD and North J (eds) *Exploring Forgiveness*. Madison, WI: University of Wisconsin Press, pp. 46–62.
- Finan PH, Zautra AJ and Wershba R (2011) The dynamics of emotion in adaptation to stress. In: Contrada RJ and Baum A (eds) *The Handbook of Stress Science: Biology, Psychology, and Health*. New York: Springer, pp. 209–220.
- Forsythe CJ and Compas BE (1987) Interaction of cognitive appraisals of stressful events and coping: Testing the goodness of fit hypothesis. *Cognitive Therapy and Research* 11(4): 473–485.
- Friedberg JP, Suchday S and Shelov DV (2007) The impact of forgiveness on cardiovascular reactivity and recovery. *International Journal of Psychophysiology* 65(2): 87–94.
- Graham JE, Christian LM and Kiecolt-Glaser JK (2006) Stress, age, and immune function: Toward

- a lifespan approach. *Journal of Behavioral Medicine* 29(4): 389–400.
- Green M, DeCourville N and Sadava S (2012) Positive affect, negative affect, stress, and social support as mediators of the forgiveness-health relationship. *Journal of Social Psychology* 152(3): 288–307.
- Hirsch JK, Webb JR and Jeglic EL (2011) Forgiveness, depression, and suicidal behavior among a diverse sample of college students. *Journal of Clinical Psychology* 67(9): 896–906.
- Holt-Lunstad J, Smith TB and Layton JB (2010) Social relationships and mortality risk: A meta-analytic review. *PLoS Medicine* 7(7): e1000316.
- Kessler RC, Andrews G, Colpe LJ, et al. (2002) Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological Medicine* 32(6): 959–976.
- Kessler RC, Green JG, Gruber MJ, et al. (2010) Screening for serious mental illness in the general population with the k6 screening scale: Results from the WHO World Mental Health (WMH) survey initiative. *International Journal of Methods in Psychiatric Research* 19(S1): 4–22.
- Krause N and Hayward RD (2013) Self-forgiveness and mortality in late life. *Social Indicators Research* 111(1): 361–373.
- Kurtzman L, O'Donovan A, Koslov K, et al. (2012) Sweating the big stuff: Dispositional pessimism exacerbates the deleterious effects of life stress on metabolic health. *European Journal of Psychotraumatology* 3: 1.
- Lawler KA, Younger JW, Piferi RL, et al. (2003) A change of heart: Cardiovascular correlates of forgiveness in response to interpersonal conflict. *Journal of Behavioral Medicine* 26(5): 373–393.
- Lawler KA, Younger JW, Piferi RL, et al. (2005) The unique effects of forgiveness on health: An exploration of pathways. *Journal of Behavioral Medicine* 28(2): 157–167.
- Lazarus RS and Folkman S (1984) *Stress Appraisal, and Coping*. New York: Springer.
- Lin W-F, Mack D, Enright RD, et al. (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(6): 1114–1121.
- Lupien SJ, McEwen BS, Gunnar MR, et al. (2009) Effects of stress throughout the lifespan on the brain, behaviour and cognition. *Nature Reviews Neuroscience* 10(6): 434–445.
- Michl LC, McLaughlin KA, Shepherd K, et al. (2013) Rumination as a mechanism linking stressful life events to symptoms of depression and anxiety: Longitudinal evidence in early adolescents and adults. *Journal of Abnormal Psychology* 122(2): 339–352.
- Orcutt HK, Pickett SM and Pope EB (2005) Experiential avoidance and forgiveness as mediators in the relation between traumatic interpersonal events and posttraumatic stress disorder symptoms. *Journal of Social and Clinical Psychology* 24(7): 1003–1029.
- Pearlin LI, Schieman S, Fazio EM, et al. (2005) Stress, health, and the life course: Some conceptual perspectives. *Journal of Health and Social Behavior* 46(2): 205–219.
- Pedersen AF, Bovbjerg DH and Zachariae R (2011) Stress and susceptibility to infectious disease. In: Contrada RJ and Baum A (eds) *The Handbook of Stress Science: Biology, Psychology, and Health*. New York: Springer, pp. 425–445.
- Roberts RC (1995) Forgiveness. *American Philosophical Quarterly* 32(4): 289–306.
- Ryan RB and Kumar VK (2005) Willingness to forgive: Relationships with mood, anxiety and severity of symptoms. *Mental Health, Religion & Culture* 8(1): 13–16.
- Schat ACH, Kelloway EK and Desmarais S (2005) The physical health questionnaire (PHQ): Construct validation of a self-report scale of somatic symptoms. *Journal of Occupational Health Psychology* 10(4): 363–381.
- Seawell AH, Toussaint LL and Cheadle ACD (2014) Prospective associations between unforgiveness and physical health and positive mediating mechanisms in a nationally representative sample of older adults. *Psychology & Health* 29: 375–389.
- Slavich GM and Epel ES (2010) *The Stress and Adversity Inventory (STRAIN): An Automated System for Assessing Cumulative Stress Exposure*. Los Angeles, CA: University of California, Los Angeles.
- Slavich GM and Epel ES (in preparation) STRAIN, an automated measure of cumulative life stress: Associations with psychological and physical health.
- Slavich GM and Cole SW (2013) The emerging field of human social genomics. *Clinical Psychological Science* 1(3): 331–348.

- Slavich GM and Irwin MR (2014) From stress to inflammation and major depressive disorder: A social signal transduction theory of depression. *Psychological Bulletin* 140(3): 774–815.
- Slavich GM, O'Donovan A, Epel ES, et al. (2010) Black sheep get the blues: A psychobiological model of social rejection and depression. *Neuroscience and Biobehavioral Reviews* 35(1): 39–45.
- Spence JT, Helmreich RL and Pred RS (1987) Impatience versus achievement strivings in the type A pattern: Differential effects on students' health and academic achievement. *Journal of Applied Psychology* 72(4): 522–528.
- Strelan P and Covic T (2006) A review of forgiveness process models and a coping framework to guide future research. *Journal of Social and Clinical Psychology* 25(10): 1059–1085.
- Taylor SE (2010) Mechanisms linking early life stress to adult health outcomes. *Proceedings of the National Academy of Sciences of the United States of America* 107(19): 8507–8512.
- Thompson LY, Snyder CR, Hoffman L, et al. (2005) Dispositional forgiveness of self, others, and situations. *Journal of Personality* 73(2): 313–359.
- Toussaint L and Cheadle A (2009a) Unforgiveness and lifetime prevalence of psychopathology: Findings from an epidemiological study of United States adults. In: Evans MT and Walker ED (eds) *Religion and Psychology*. New York: Nova Publishers, pp. 97–134.
- Toussaint L and Cheadle A (2009b) Unforgiveness and the broken heart: Unforgiving tendencies, problems due to unforgiveness, and 12-month prevalence of cardiovascular health conditions. In: Evans MT and Walker ED (eds) *Religion and Psychology*. New York: Nova Publishers, pp. 135–170.
- Toussaint L and Webb JR (2005) Theoretical and empirical connections between forgiveness and mental health and well-being. In: Worthington EL (ed.) *Handbook of Forgiveness*. New York: Brunner-Routledge, pp. 349–362.
- Toussaint LL, Owen AD and Cheadle A (2012) Forgive to live: Forgiveness, health, and longevity. *Journal of Behavioral Medicine* 35(4): 375–386.
- Toussaint LL, Williams DR, Musick MA, et al. (2008) The association of forgiveness and 12-month prevalence of major depressive episode: Gender differences in a probability sample of U.S. adults. *Mental Health, Religion & Culture* 11(5): 485–500.
- Wade NG, Worthington EL and Meyer JE (2005) But do they really work: A meta analysis of group interventions to promote forgiveness. In: Worthington EL (ed.) *Handbook of Forgiveness*. New York: Brunner-Routledge, pp. 423–440.
- Waltman MA, Russell DC, Coyle CT, et al. (2009) The effects of a forgiveness intervention on patients with coronary artery disease. *Psychology & Health* 24(1): 11–27.
- Webb JR, Hirsch JK, Visser PL, et al. (2013) Forgiveness and health: Assessing the mediating effect of health behavior, social support, and interpersonal functioning. *Journal of Psychology* 147(5): 391–414.
- Webb JR, Toussaint L, Kalpakjian CZ, et al. (2010) Forgiveness and health-related outcomes among people with spinal cord injury. *Disability and Rehabilitation* 32(5): 360–366.
- Worthington EL (2003) *Forgiving and Reconciling: Bridges to Wholeness and Hope*. Downers Grove, IL: InterVarsity Press.
- Worthington EL and Scherer M (2004) Forgiveness is an emotion-focused coping strategy that can reduce health risks and promote health resilience: Theory, review, and hypotheses. *Psychology & Health* 19(3): 385–405.
- Worthington EL, Witvliet CVO, Pietrini P, et al. (2007) Forgiveness, health, and well-being: A review of evidence for emotional versus decisional forgiveness, dispositional forgivingness, and reduced unforgiveness. *Journal of Behavioral Medicine* 30(4): 291–302.
- Ysseldyk R and Matheson K (2008) Forgiveness and coping. In: Malcolm W, DeCourville N and Belicki K (eds) *Women's Reflections on the Complexities of Forgiveness*. New York: Taylor & Francis, pp. 143–163.