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RUNNING HEAD: Procrastination, Hypertension, and Cardiovascular Disease

Is Procrastination a Vulnerability Factor for Hypertension and Cardiovascular Disease? Testing an Extension of the Procrastination-Health Model

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Abstract

Personality is an important epidemiological factor for understanding health outcomes. This study investigated the associations of trait procrastination with hypertension and cardiovascular disease (HT/CVD) and maladaptive coping by testing an extension of the procrastination-health model among individuals with and without HT/CVD. Individuals with self-reported HT/CVD (N = 182) and healthy controls (N = 564), from a community sample, completed an online survey including measures of personality, coping, and health outcomes. Logistic regression analysis controlling for demographic and higher order personality factors found that older age, lower education level and higher procrastination scores were associated with HT/CVD. Moderated mediation analyses with bootstrapping revealed that procrastination was more strongly associated with maladaptive coping behaviours in participants with HT/CVD than the healthy controls, and the indirect effects on stress through maladaptive coping were larger for the HT/CVD sample. Results suggest procrastination is a vulnerability factor for poor adjustment to and management of HT/CVD.

Keywords: Procrastination; heart disease; hypertension; coping; personality

Introduction

Burgeoning research on the associations between personality and health has highlighted the significance of personality traits as epidemiological factors for understanding health trajectories and outcomes (Bogg & Roberts, 2013; Hampson, Goldberg, Vogt, & Dubanoski, 2007). In addition to higher order personality factors such as the Big Five taxonomy (John & Srivastava, 1999), theory and research has noted that lower order personality traits can confer risk for poor health and adjustment. Procrastination is one such trait that a growing body of theory and evidence indicates as a vulnerability factor for poor health. Research has found that procrastination as a trait is associated with a range of stress-related acute health problems such as headaches, digestive issues, colds and flus, and insomnia (Sirois, 2007a; Sirois, Melia-Gordon, & Pychyl, 2003; Sirois, Voth, & Pychyl, 2009). Procrastination is also linked to poor self-rated health (Sirois & Tosti, 2012), a reliable indicator and predictor of poor objective health and health-related outcomes such as cortisol responses to stress, morbidity, and mortality (Jylhä, 2009; Kristenson, Olsson, & Kucinskiene, 2005; Mora, Orsak, DiBonaventura, & Leventhal, 2013; Tamayo-Fonseca et al., 2013).

Procrastination is generally defined by researchers as the unnecessary and voluntary delay in the start and/or completion of important, necessary, and intended tasks despite knowing there will be negative consequences for doing so (Ferrari & Tice, 2000; Sirois & Pychyl, 2013). Procrastination is considered a trait-like quality when unnecessary delay and avoidance becomes a frequent response to tasks that are perceived to be aversive (Blunt & Pychyl, 2000; Lay, 1992), or lacking immediate reward (Schouwenburg & Groenewoud, 2001). Indeed a meta-analysis of 14 studies with over 4,300 participants found that trait procrastination was moderately and negatively associated with having a future time-orientation (average r = -.45), and positively

associated with a present time-orientation (average r = .15)(Sirois, 2014a). Supporting this view of procrastination as a relatively stable trait, behavior-genetics research with over 300 same-sex twin pairs has demonstrated that procrastination, as measured with the General Procrastination Scale (Lay, 1986), has a moderate degree of heritability (46%), and is distinct at the phenotypic level from a related trait, impulsivity (Gustavson, Miyake, Hewitt, & Friedman, 2014). Other research demonstrating that procrastination remains stable over a 10-year period when measured as a trait (Steel, 2007) further supports the notion that procrastination can be viewed as a stable personality trait.

Mounting research indicates that trait procrastination may be especially harmful for health-related outcomes and tasks. The linkage of procrastination with poor health-related outcomes has been theoretically and empirically explained by the procrastination-health model (Sirois, 2007a; Sirois et al., 2003). In accordance with models linking personality to health (Friedman, 2000; Smith, 2006; Suls & Rittenhouse, 1990), the procrastination-health model outlined by Sirois and colleagues (2007a; 2003) proposes that procrastination may contribute to poor health outcomes through a direct, stress-related route and an indirect, behavioral route. In the latter route, the avoidant style that characterizes procrastination is posited to result in less frequent practice of health-promoting behaviors, which are often viewed as challenging and aversive. In the direct route, the unnecessary stress arising from procrastination is posited to contribute to stress-related psychophysiological changes and activation of the HPA system which in turn can negatively impact health and increase vulnerability for illness in a variety of ways. For example, stress and chronic stress in particular is implicated in the development and exacerbation of illness and disease through its impact on the immune system and its contributions to the disregulation of inflammatory processes which are known precursors of major chronic diseases (Cohen et al.,

2012; Juster, McEwen, & Lupien, 2010; McEwen, 2007). Insomuch that chronic or trait procrastination is akin to a source of chronic stress, it is likely that procrastination can have both short-term and potentially long-term health consequences which may be further worsened in the context of an ongoing health stressor.

Both stress and poor health behaviors are implicated in the development and exacerbation of a number of major chronic diseases including hypertension (HT) and cardiovascular disease (CVD; Dimsdale, 2008; Rod, Grønbæk, Schnohr, Prescott, & Kristensen, 2009), two leading causes of death and disability worldwide (World Health Organization; WHO, 2011). It is surprising that to date there is no research into the potential links between trait procrastination and HT/CVD. There is, however, evidence linking related higher order traits from the Big Five model of personality to the development and/or aggravation of chronic disease. For example, low Conscientiousness (acting in an disorganized and undisciplined manner), the five factor trait most strongly related to procrastination (Steel, 2007; Van Eerde, 2003), is also associated with the development of chronic disease (Sutin, Zonderman, Ferrucci, & Terracciano, 2013), self-reported HT (Sutin et al., 2010), and risk of mortality from CVD (Jokela, Pulkki-Råback, Elovainio, & Kivimäki, 2013). A recent review found that poor health behaviours, low stress resilience, and disease and morbidity-related risk factors linked to low Conscientiousness collectively contribute to poor health outcomes including poor cardiovascular health (Bogg & Roberts, 2013). As a mid-level trait, procrastination also relates to low Agreeableness (being untrusting and antagonistic towards others) (Steel, 2007), a personality trait linked to greater risk for CVD (Sutin et al., 2010).

Current theory and evidence linking procrastination to health builds a supportive case for this personality trait as being associated with, and being a vulnerability factor for adjustment to

HT/CVD, two related and serious chronic health conditions. Consistent with the procrastination-health model, research demonstrates that trait procrastination is associated with the practice of fewer wellness-promoting behaviors such as exercising regularly, healthy eating, reducing caffeine intake, getting sufficient sleep, and managing stress in a number of studies (Argiropoulou et al., 2013; Sirois, 2004, 2007a; Sirois et al., 2003; Sirois et al., 2009). Trait procrastination also relates to higher stress cross-sectionally (Sirois, 2004, 2007a, 2014a, 2014b; Sirois et al., 2003; Sirois & Tosti, 2012; Stead, Shanahan, & Neufeld, 2010) and longitudinally (Rice, Richardson, & Clark, 2012; Sirois et al., 2009; Tice & Baumeister, 1997). Importantly, both HT/CVD have stress and poor health habits as modifiable risk factors (Dimsdale, 2008; Organization, 2013; Rod et al., 2009).

A recent extension of the procrastination-health model proposed that the coping repertoire associated with procrastination may account for the poor health outcomes associated with this trait. In a meta-analysis of procrastination and coping strategies across 14 studies (N = 4,201), procrastination was positively associated with maladaptive coping (average r = .32), and negatively associated with adaptive coping (average r = -.23)(Sirois & Kitner, in press). Importantly, a further meta-analysis of the indirect effects of procrastination on stress through coping found that maladaptive but not adaptive coping explained the link between procrastination and stress, indicating that it may be the use of maladaptive coping styles that contributes to the poor health associated with procrastination. This meta-analysis tested how procrastination related to a range of maladaptive coping strategies. However, the majority of the studies included a set of four maladaptive strategies: behavioral disengagement, self-blame coping, denial, and substance abuse coping (Sirois & Kitner, in press). There are theoretical and empirical reasons suggesting that two of these maladaptive coping styles in particular, behavioral

disengagement and self-blame coping, may be linked to procrastination and poor adjustment in the context of HT/CVD. Procrastination is characterized by the avoidance of an intended and important task that is viewed as unpleasant, challenging or aversive (Blunt & Pychyl, 2000; Sirois & Pychyl, 2013). Given the initial unpleasantness of engaging in regular health-promoting behaviors such exercise and healthy eating which are nonetheless important for weight management and behavioral control of HT/CVD (WHO, 2013), it is plausible that procrastination will be associated with greater use of behavioral disengagement coping, a strategy that may interfere with the timely performance of behaviours necessary for managing health (Ferrari & Díaz-Morales, in press).

There is also supportive evidence for links between procrastination and a cognitive maladaptive coping strategy, self-blame coping, and potential detrimental consequences in the context of HT/CVD. Procrastination is associated with a tendency toward negative self-evaluations (Flett, Blankstein, & Martin, 1995; Flett, Stainton, Hewitt, Sherry, & Lay, 2012), including self-depreciating thoughts after procrastinating (McCown, Blake, & Keiser, 2012), self-blame and brooding about past procrastination (Stainton, Lay, & Flett, 2000), and taking a self-critical and judgmental view of oneself in the face of failure which may contribute to greater stress (Sirois, 2014b). With respect to HT/CVD, using a self-blaming style of coping may contribute to greater stress as well as interfere with taking instrumental action towards managing illness, as this style of coping is associated with poor adjustment outcomes in other chronic conditions (Plaufcan, Wamboldt, & Holm, 2012; Voth & Sirois, 2009). Despite this suggestive evidence, there is little if any research on how procrastination relates to maladaptive coping in the context of a chronic health condition such as HT or CVD which can be exacerbated by stress and poor health behaviors.

The Current Study

Building on this theory and empirical evidence, the current study tested whether trait procrastination was associated with HT/CVD, and a vulnerability factor for poor adjustment in the context of HT/CVD. First, the hypothesized link between procrastination and HT/CVD was examined with a logistic regression analysis in individuals with and without HT/CVD controlling for the contributions of relevant demographic factors, and two higher order personality traits related to procrastination and HT/CVD, conscientiousness and agreeableness. Because trait procrastination is considered a mid-level trait that is distinct from yet has significant associations with these two higher order traits, it was important to include these higher order traits in the analyses to rule out the possibility that the proposed associations of procrastination with HT/CVD were explained by Conscientiousness and/or Agreeableness, and to demonstrate the incremental validity of procrastination as a personality variable over and above the effects of the two Big Five Factors.

Next, an extension of the procrastination-health model (Sirois, 2007a; Sirois et al., 2003) highlighting the contribution of procrastination through maladaptive coping for poor health-related outcomes in individuals with HT/CVD was tested. The moderation mediation hypothesis within this model posits that procrastination promotes a tendency to cope with stress by disengaging behaviorally and becoming consumed with self-blame rather taking constructive action, and that this tendency will be more pronounced in the context of HT/CVD (see Figure 1). Thus, it was expected that the associations of procrastination with two maladaptive coping strategies, behavioral disengagement coping and self-blame coping will be stronger in individuals with HT/CVD compared to the healthy controls. The moderated mediation hypothesis of this model posits that the two maladaptive coping strategies associated with

procrastination confer greater vulnerability for individuals with HT/CVD by interfering with the practice of important health-promoting behaviors and promoting greater perceived stress (see Figure 1), as the management and control of HT/CVD requires the regular practice of health-promoting and stress minimizing behaviors (Daskalopoulou et al., 2012; Gulliksson et al., 2011). It was therefore expected the indirect effects of procrastination through behavioral disengagement and self-blame coping on perceived stress and the practice of positive health behaviors would be larger for the HT/CVD sample compared to the healthy controls.

Methods

Participants and Procedure

Two subsamples were drawn from a larger sample of community-dwelling adults who completed an anonymous online survey on personality and health housed on a secure University server. The first 500 participants received a $15 incentive for participation and the remaining participants received a chance to enter a draw for one of several $20 incentives. All participants were from the United States or Canada. Data was carefully screened for duplicates, random responding, incomplete surveys (i.e., missing 20 percent or more of the responses), and suspicious or incomplete cases were identified and removed from the overall data set, leaving a final sample of 980. Individuals who indicated that they had received a diagnosis from a medical professional of cardiovascular disease (CVD) and/or hypertension (HT) on the medical checklist (N = 182) were selected for the HT/CVD sample.

To obtain a healthy control subsample to compare with the HT/CVD sample, the remaining sample (N = 798) was screened for the presence of other chronic health conditions. Anyone indicating that they had been medically diagnosed with one or more chronic illnesses, including cancer, diabetes, arthritis, fibromyalgia, multiple sclerosis, liver disease, lung disease, kidney disease, inflammatory bowel disease, irritable bowel syndrome, or chronic fatigue

syndrome, was removed (N = 234). This left 564 healthy controls. Table 1 includes an overview of the basic demographic composition of the two samples.

Measures

Participants completed a survey that included basic demographic questions (sex, age, education level), and a medical history checklist (Sirois & Gick, 2002) which included a list of twelve different chronic health problems including hypertension and CVD which were listed as one item. Participants indicated which health issues they had received a formal diagnosis for from a medical doctor. Descriptives for each measure are presented in Table 2.

Procrastination. Lay's General Procrastination scale (Lay, 1986), is a widely used, well-validated 20-item measure of trait procrastination, which assesses general tendencies towards procrastination across a range of tasks. Items such as "I am continually saying I'll do it tomorrow" and "In preparing for some deadlines, I often waste time by doing other things" are scored on a 5-point Likert-type scale ranging from 1 (false of me) to 5 (true of me), assess the global tendency to delayed intended and important tasks. The scale includes 10 reverse-scored items, and the mean of all items yields a single score with high values indicating a greater tendency to procrastinate. Importantly, the GPS has been linked to behavioural indicators of procrastination including time taken to complete a task and non-completion of required tasks (Ferrari, 1992; Lay, 1986), and a tendency towards task avoidance in favour of more pleasurable activities (Dewitte & Schouwenburg, 2002; Ferrari & Tice, 2000). Although trait procrastination as measured by the GPS is negatively related to Conscientiousness (Steel, 2007; Van Eerde, 2003), the GPS is a better predictor of dilatory behaviors than Conscientiousness (Lay, 1997), supporting the discriminant validity of the GPS and that procrastination is a distinct trait from this Big Five personality factor. The GPS has demonstrated good internal consistency previously (α = .82; Lay, 1986), and in the current study (α = .91).

Big Five Personality Factors. Conscientiousness (9 items) and Agreeableness (9 items) were assessed with the 44-item Big Five Inventory (John & Srivastava, 1999). A list of characteristics is presented after the statement "I see myself as someone who …" and respondents rate how much they agree with each characteristic on a 5- point Likert scale ranging from 1 (Disagree strongly) to 5 (Agree strongly). Mean scores for each personality factor are calculated with higher scores reflect greater identification with that particular personality factor. The internal consistencies of the Conscientiousness ($\alpha = .85$) and Agreeableness scales ($\alpha = .79$). were acceptable in the current study.

Coping. Behavioral disengagement coping and self-blame coping were assessed with the Brief COPE (Carver, 1997), a shortened version of the original COPE scale (Carver, Scheier, & Weintraub, 1989), that contains 28 items that assess 14 different coping strategies The frequency that each type of coping style is used to deal with stressors is rated on a 4-point Likert scale ranging from 1 (I usually don't do this at all) to 4 (I usually do this a lot), and the mean score calculated reflects higher use of the coping style. Both the self-blame ($\alpha = .80$) and behavioral disengagement coping ($\alpha = .76$) subscales had adequate internal consistency in the current study.

Stress. Participants completed a10-item version the Perceived Stress Scale (PSS; Cohen & Williamson, 1988), a widely used empirically established index of general perceived stress. Items such as "In the last month, how often have you felt nervous and stressed" are rated on a 5-point scale with response options ranging from "never" to very "often". Items are averaged into a mean score with higher values indicating higher perceived stress. The PSS has demonstrated adequate internal consistency in previous research (Cohen & Williamson, 1988), and good internal consistency in in the current study ($\alpha = .89$).

Health behaviors. The practice of positive, health-promoting behaviors was assessed with

the Wellness Behaviors Inventory (WBI; Sirois, 2001), a previously validated 10-item measure of the frequency of practicing common health-related behaviors (e.g., Sirois, 2007a). Items such as "I eat healthy, well-balanced meals" and "I exercise for 20 continuous minutes or more, to the point of perspiration" are rated on a 5-point scale with possible responses ranging from 1 (*less than once a week or never*) to 5 (*every day of the week*). The mean of all items is calculated to obtain a total score, with higher scores reflecting more frequent performance of health behaviors. The WBI has demonstrated good convergent and criterion-related validity in previous research in which it was positively associated with medical care-seeking behaviours (Sirois, 2007a) and household safety behaviors (Sirois, 2007b), and negatively associated with stress (Sirois, 2007a). A recent meta-analysis using the WBI suggests that it has adequate internal consistency with Cronbach alphas ranging from .66 to .74 (Sirois, Kitner, & Hirsch, in press). The WBI demonstrated adequate reliability in the current study ($\alpha = .73$).

Statistical Analyses

The first set of analyses focused on understanding the association of trait procrastination to self-reported HT/CVD using a comparison sample of healthy controls. Demographic differences between the two samples were tested with chi-square tests for sex and education level, and a *t*-test for age. Potential differences in trait procrastination, conscientiousness, and agreeableness scores between the HT/CVD sample and the healthy controls were tested with an independent samples *t* test. The independent association of procrastination with HT/CVD was assessed with a binomial logistic regression with demographic factors (age, sex, education level, ethnicity) entered in the first step, Conscientiousness and Agreeableness, two higher order personality factors known to be linked to both CVD/HT and procrastination, entered in the second step, and trait procrastination entered last. Participant sex was chosen as a covariate for

the logistic regression analysis as previous research has indicated that procrastination scores tend to be higher in males compared to females (Van Eerde, 2003), and noted gender differences in the way that trait procrastination is associated with other variables (Pychyl, Coplan, & Reid, 2002). In addition, age was chosen as a covariate as trait procrastination scores tend to decrease slightly with age (Van Eerde, 2003), whereas HT/CVD incidence increases with age (WHO, 2013). Similarly, higher rates of HT/CVD are associated with lower education level and non-White ethnicity (Christensen, Mogelvang, Heitmann, & Prescott, 2011; 2013; CDC, 2013). Accordingly, both education level and ethnicity were included as covariates. The healthy control sample was the reference group for this analysis.

The next set of analyses examined the hypothesis that procrastination was a vulnerability factor for people coping with HT/CVD by testing a revised procrastination-health model and the indirect effects of two maladaptive coping strategies, self-blame and maladaptive coping, on two health-related outcomes, perceived stress and the frequency of positive health behaviors, as a function of self-reported HT/CVD (see Figure 1). First, bivariate correlation and descriptive analyses were first conducted among all the model variables, stratified by health status sample. Next, moderated multiple mediation models were tested for each of the two health-related outcomes, controlling for any demographic variables found to be significantly correlated with the outcome or mediator variables. Using a moderated multiple mediation approach permitted simultaneous testing the hypothesis that the association between procrastination and maladaptive coping was stronger for the HT/CVD sample compared to the healthy controls, and that the indirect effects of procrastination through coping were more strongly linked to poor health outcomes in the HT/CVD sample. Mediation was tested following the Preacher and Hayes (2008) procedure which uses bootstrapping rather than Sobel tests to estimate the significance of

indirect effects. This procedure involves resampling with bootstrapped samples drawn from the data to estimate the indirect effect for each of the resampled data sets (Preacher & Hayes, 2004). The moderated multiple mediation analyses for behavioral disengagement and self-blame coping were conducted using the Hayes macro PROCESS (Hayes, 2013) with 10,000 bootstrapping resamples and bias corrected 95 percent confidence intervals for each of the indirect effects calculated. Moderation of the action path or *a* path between procrastination and each of the maladaptive coping strategies was tested with health status sample (healthy control versus HT/CVD) as the moderator. Significant moderation of any of the paths of the indirect effects indicates that the mediation is moderated, so long as the indirect effects are significant (Fairchild & MacKinnon, 2009; Hayes, 2013). All analyses were conducted using IBM SPSS Statistics v20 software. Statistical significance for all tests was set at $p < .05$.

Results

Associations of Personality With HT/CVD

With respect to ethnicity, the overall sample was predominantly White (72.5%), with the HT/CVD subsample (79.4%) having significantly larger proportion of White participants compared to the healthy control subsample (70.3%), χ^2 (1, N = 744) = 5.99, $p < .05$. Compared to the HT/CVD sample, the healthy control subsample were significantly younger, t (743) = -9.95, $p < .001$, and had a higher level of education, χ^2 (1, N = 744) = 6.06, $p < .05$. However, the proportion of males and females in each sample was not significantly different, χ^2 (1, N = 744) = 2.71, $p = .10$. Trait procrastination scores in the HT/CVD sample were significantly higher than in the healthy control sample, t (744) = -2.24, $p = .025$, d = -.164, [-.25, -.02]. However, there was no difference between the HT/CVD sample and the healthy control sample on either Conscientiousness, t (744) = 1.16, $p = .25$, d = .09, [-.05, .19], or Agreeableness, t (744) = 0.19, p

= .85, *d* = .01, [-.10, .12].

In the adjusted binomial logistic regression analyses individuals self-reporting HT/CVD were more likely to be older and have a lower education level compared to the healthy control sample (see Table 1). Trait procrastination was also significantly associated with having HT/CVD after controlling for the effects of demographics and the other personality factors. Overall, the model combining all of these variables accounted for 20 percent of the variance in determining who did and did not have HT/CVD. Neither Conscientiousness nor Agreeableness was significant in the final model. However, prior to entering procrastination in the model, low Conscientiousness was a significant predictor in the model, *OR* = .71 [.54, 92], $p < .05$.

Bivariate Analyses of Procrastination-Health Model Variables

Procrastination was significantly correlated in the expected directions with each of the coping and health outcome variables in both healthy controls and the HT/CVD sample, all *p*'s < .01 (see Table 2). The proposed mediators, self-blame and behavioral disengagement coping were also correlated in the expected directions with each of the health-related outcome variables, perceived stress and health behaviors (all *p*'s < .01), indicating that the proposed moderated mediation analyses was warranted.

Correlational analyses of the model variables with the demographic variables for the entire sample revealed that age was negatively associated with procrastination ($r = -.15$, $p < .001$), and behavioral disengagement coping ($r = -.13$, $p < .01$), whereas education level was significantly correlated with health behaviors ($r = .23$, $p < .001$), perceived stress ($r = -.10$, $p < .01$), and self-blame coping ($r = -.08$, $p < .05$). Ethnicity was significantly associated with both health behaviors ($r = .08$, $p < .05$), and behavioral disengagement coping ($r = .10$, $p < .01$), and sex was correlated with health behaviors ($r = -.11$, $p < .01$), perceived stress ($r = .14$, $p < .001$),

and self-blame coping ($r = .15$, $p < .001$).

Indirect Effects of Procrastination on Health-Related Outcomes Through Coping

The first step in demonstrating moderated mediation is testing the indirect effects. The multiple mediation analyses for each of the health-related outcomes was first inspected for the significance of the indirect effects (c' path) of each coping strategy while controlling for the effects of the other. The analyses were conducted controlling for the demographic variables that were significantly correlated with the outcome and mediator variables (i.e., sex, age, ethnicity, and education level). The a_1 path from procrastination to self-blame coping did not reach significance (see Table 3), although the total model for this path, which included the interaction term, explained a significant amount of variance (13 percent) in self-blame coping. For behavioral disengagement coping, the a_1 path was significant and explained 23 percent of the variance in this form of coping. The b_1 path from self-blame coping and behavioral disengagement coping to perceived stress was significant and explained 43 percent of the variance in perceived stress. However, as Hayes (2013) notes, the significance of the individual paths is not pertinent for assessing the significance of the indirect effects through intervening variables. Importantly, the total indirect effects of procrastination through self-blame and behavioral disengagement coping (c' path) were significant for perceived stress, as the confidence intervals (CI) did not cross 0, supporting the hypothesis that both coping styles mediated the effects of trait procrastination on stress. For health behaviors, the indirect effects of procrastination through the two coping strategies were not significant, as each set of CI crossed 0 (Table 4).

Moderated Mediation Analyses of Procrastination, Coping, and Health-Related Outcomes

For both health behaviors (Table 5) and perceived stress (Table 4), the moderation

portion of the moderated multiple mediation analyses (*m* paths), revealed a significant interaction effect of HT/CVD status for both self-blame coping, and behavioral disengagement coping, such that procrastination was more strongly associated with each coping strategy in the HT/CVD sample compared to the healthy controls.

However, for moderated mediation to be supported, the indirect effects must also be significant. Only the indirect effects for perceived stress were significant indicating significant moderated mediation of the *a* paths for each coping strategy for stress but not health behaviors. An inspection of the relative sizes of the indirect effects obtained for behavioral disengagement coping and self-blame coping for perceived stress revealed that the indirect effects for the HT/CVD sample were larger than those obtained for the healthy controls, suggesting that the effects of procrastination on perceived stress through the two coping styles were larger for those with HT/CVD.

Discussion

This study is the first to test and find that trait procrastination may be a vulnerability factor for those living with a chronic and life threatening health condition. Procrastination was associated with self-reported HT/CVD after controlling for the contributions of age, sex, ethnicity, education level, and importantly, two higher-order personality traits well known to be associated with HT/CVD. In addition, the moderated mediation analyses revealed the associations of procrastination with behavioral disengagement coping and self-blame coping were significantly stronger in participants with HT/CVD compared to healthy controls. This latter finding echoes those from other research which found that a related trait, perfectionism, was associated with maladaptive coping responses among cardiac rehabilitation patients (Shanmugasegaram et al., 2013). Although the indirect effects of procrastination through

maladaptive coping on the practice of health behaviors were non-significant, the significant moderated indirect effects on perceived stress provided preliminary support for the hypothesis that the maladaptive coping associated with trait procrastination is particularly harmful for individuals with HT/CVD.

The linkage of trait procrastination to HT/CVD extends current research and theory on the epidemiological role of personality in health, and more specifically the procrastination-health model (Sirois, 2007a; Sirois et al., 2003) in several important ways. This conceptual model posits that trait procrastination confers greater risk for the development of health problems through both behavioral and stress reactivity pathways, which over time contribute to the development of health issues in vulnerable individuals. Several studies have provided evidence for this model in terms of acute health issues such as headaches, flus/colds, and digestive issues (Sirois & Pychyl, 2013). The current study is the first to provide suggestive evidence that this model may also apply to more serious and chronic health conditions by finding that procrastination is associated with HT/CVD, conditions for which poor health behaviors and increased stress reactivity are known modifiable risk factors (Daskalopoulou et al., 2012).

The extension of the procrastination-health model (Sirois, 2007a; Sirois et al., 2003) to HT/CVD highlighting the role of maladaptive coping in health-related outcomes for procrastinators is another noteworthy contribution of the current research. Apart from the current study, to date no other research has examined how or why procrastination may confer vulnerability for individuals with ongoing health challenges such as HT/CVD. The results of the moderation analyses suggest that procrastination promotes a tendency to cope with stress by engaging in negative, self-blaming thinking, and disengaging from taking constructive action, tendencies that are more pronounced in the context of HT/CVD. Taken together with the

significant indirect effects for stress, this evidence further suggests that these maladaptive coping strategies may contribute to greater stress for procrastinators with HT/CVD. That self-blame coping partially explained the association between procrastination and stress is in accord with previous research noting that critical, self-judgemental thinking links procrastination to higher stress (Sirois, 2014b; Sirois & Tosti, 2012). With respect to disengagement coping, it is likely that avoiding taking action to deal with stressors is linked to higher stress, simply because it does not promote taking action to deal with the stressor, a finding that is consistent with previous research on procrastination and avoidant coping (Sirois & Kitner, in press). Finally, although the indirect effects on health behaviors were not significant, the stronger associations with stress via coping may still have deleterious implications for individuals with HT/CVD. For example, there is some evidence that higher perceived stress is causally linked to negative changes in health behaviors and cardiac risk factors (Rod et al., 2009), suggesting that the maladaptive coping and stress linked to procrastination may nonetheless interfere with timely engagement in important health behaviours for managing HT/CVD.

Strengths and Limitations

This study has several strengths and limitations worth mentioning. Noteworthy strengths include the use of a large, healthy control sample as a comparison group, and accounting for the contributions of higher order personality factors associated with both HT/CVD and procrastination. Participants self-reported their diagnosis HT/CVD, which may be less reliable than using medical records to verify. However, several studies that suggest that self-reports of HT/CVD show a high degree of agreement with medical records (Alonso, Beunza, Delgado-Rodriguez, & Martinez-Gonzalez, 2005; Dal Grande, Fullerton, & Taylor, 2012; Giles, Croft, Keenan, Lane, & Wheeler, 1995; Joshi & Turnbull, 2009), which increases confidence in the

external validity of the sample. Nonetheless, future research on this topic should also focus on and assess HT and CVD separately rather than together as in the current study, and use older samples as both the HT/CVD and healthy control samples were relatively young and may therefore include more people with HT than CVD. Given that trait procrastination scores may decrease slightly with increasing age (Van Eerde, 2003), future research with an older population is needed to verify the generalizability of these results to other adult populations.

The cross-sectional nature of the study precludes any conclusions about the directionality of the relationship between procrastination and HT/CVD, or between procrastination, coping, and stress. However, the proposed links between procrastination and stress are informed by theory and longitudinal research (Rice et al., 2012; Sirois et al., 2003; Tice & Baumeister, 1997). As previous research has shown that living with a chronic disease can contribute to modest changes in personality over time (Sutin et al., 2013), it is also possible that living with HT/CVD contributes to procrastination tendencies perhaps due to the difficulties in engaging in the health behaviors necessary for disease management (Artinian et al., 2010). However, as previously discussed, recent behavior-genetics research supports the relative stability of procrastination as a personality trait as evidenced by its moderate degree of heritability (46%; Gustavson et al., 2014), suggesting a potential role for procrastination in the development of HT/CVD that longitudinal research should elaborate upon. Finally, given the link between procrastination and modifiable risk factors involved in a variety of chronic health conditions, future research should extend the question of the vulnerability associated with procrastination to other relevant illness groups, and to other types of health behaviors such as health risk behaviors.

Conclusions and Implications

The question of causality aside, the present findings are the first to suggest that trait

procrastination may be a vulnerability factor for hypertension and cardiovascular disease by demonstrating a link between trait procrastination and HT/CVD, and a greater use of, and negative consequences from, maladaptive coping behaviours in the context of HT/CVD relative to healthy adults. Although preliminary, the current findings provide suggestive evidence for the importance of identifying individuals with HT/CVD who chronically procrastinate for interventions to address the self-critical and avoidant coping styles that may contribute to further health risks. Therapeutic strategies to cultivate self-compassion (Germer & Neff, 2013), a tendency to be kind to oneself in times of challenge (Neff, 2003), may be one way to facilitate translational application of these findings into practice. Such strategies may particularly effective for targeting the harsh self-critical thoughts that consume procrastinators and disrupt adaptive coping, as research has shown that procrastination is linked to low self-compassion (Sirois, 2014b), and that self-compassion relates to adaptive coping (Allen & Leary, 2010), lower stress, and positive health behaviors (Sirois et al., in press). Such considerations could assist health-care professionals and inform secondary and tertiary prevention interventions to help minimize the burden of this personality trait on stress-related outcomes for individuals with HT/CVD.

Conflict of Interest Statement

Author(s) declare(s) that s/he has no conflicts of interest.

Ethical Statement

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all participants for being included in the study.

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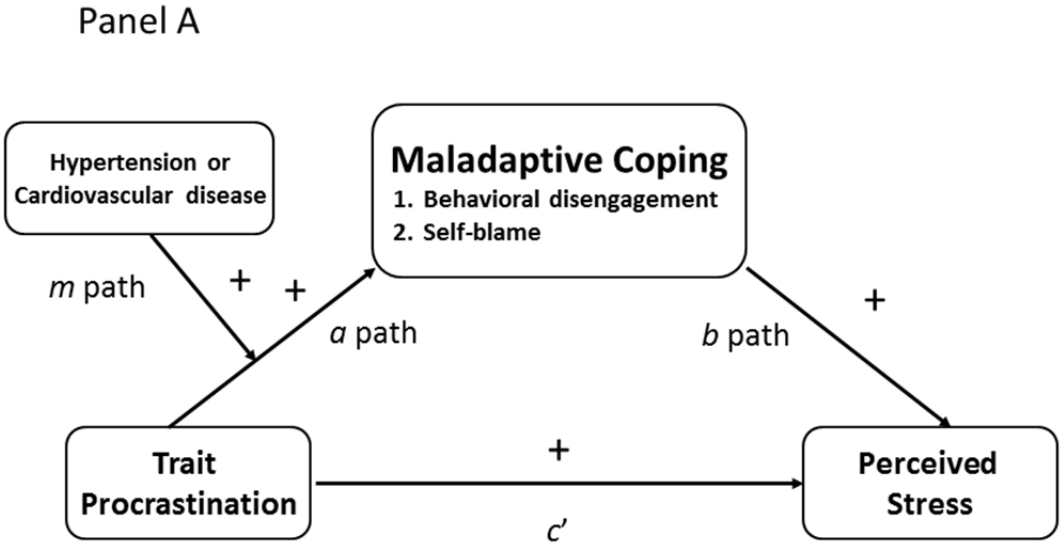
Panel A
Hypertension or Cardiovascular disease
Maladaptive Coping
1. Behavioral disengagement
2. Self-blame
m path
+
+
a path
b path
+
Trait Procrastination
+
c'
Perceived Stress

Panel B

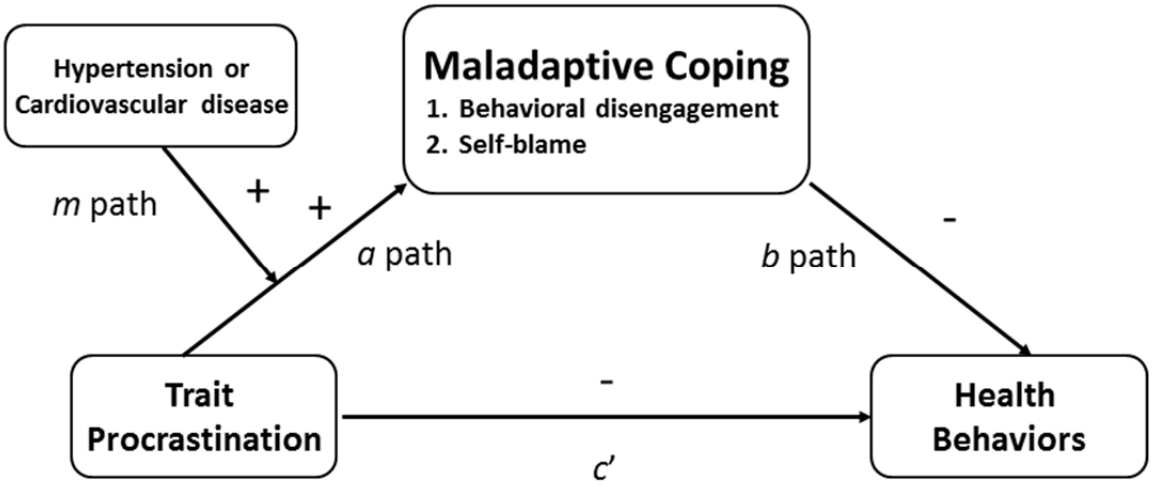
Hypertension or Cardiovascular disease
Maladaptive Coping
1. Behavioral disengagement
2. Self-blame
m path
+
+
a path
b path
-
Trait Procrastination
-
c'
Health Behaviors

Figure 1. Revised procrastination-health model showing the hypothesized moderated indirect (*ab*) effects of trait procrastination on perceived stress (Panel A), and positive health behaviors (Panel B), through behavioral disengagement and self-blame coping as a function of self-reported hypertension/cardiovascular disease.

Table 1. *Demographic and Personality Characteristics Across the Hypertension/Cardiovascular Disease and the Healthy Control Samples, and Adjusted Odds Ratios (ORs) and 95% Confidence Intervals (95% CI) of the Factors Independently Associated With Self-Reported Hypertension and/or Cardiovascular Disease.*

	Unadjusted Means (SD)		Adjusted Odds Ratios (*OR*)		
Variable	Healthy controls (*N* = 564)	HT/CVD sample (*N* = 182)	*OR*	95% *CI*	*p*-value
Age	29.99 (8.3)	37.70 (11.1)	1.09	1.07 – 1.11	0.000
Sex					
Female (%)	39.8	33.0	0.95	0.64 – 1.40	0.793
Ethnicity (% White)	70.3	79.4	1.08	0.67 – 1.68	0.728
Education level			0.68	0.49 – 0.93	0.017
High school	10.1	15.4			
College/University	63.8	65.4			
Graduate school	26.1	19.2			
Five factor traits					
Conscientiousness	3.58 (.73)	3.51 (.69)	0.98	0.68 – 1.42	0.921
Agreeableness	3.66 (.64)	3.64 (.70)	0.95	0.71 – 1.26	0.703
Procrastination	2.69 (.69)	2.82 (.68)	1.62	1.10 – 2.39	0.001

NOTE: HT/CVD = Hypertension/cardiovascular disease; SD = Standard deviation

Table 2: *Descriptives and Pearson Correlations among Procrastination, Coping Strategies, and Health-Related Outcomes for Healthy Controls (N = 564) and People With Hypertension or Cardiovascular Disease, HT/CVD (N = 182).*

Variable	1	2	3	4	5
1. Trait procrastination	---	.29**	.42**	.45**	-.26**
2. Self-blame coping	.46**	---	.40**	.51**	-.12**
3. Behavioral disengagement coping	.55**	.42**	---	.49**	-.17**
4. Perceived stress	.54**	.52**	.54**	---	-.37**
5. Health-promoting behaviors	-.27**	-.25**	-.21**	-.30**	---
Healthy controls					
Mean	2.69	2.37	1.57	2.80	3.27
Standard deviation	.69	.84	.70	.71	.64
HT/CVD group					
Mean	2.82	2.54	1.75	3.02	3.02
Standard deviation	.68	.84	.77	.67	.63

Note: $*p < .05$, $**p < .01$; Correlations above the diagonal are for the healthy controls and correlations below the diagonal are for the HT/CVD group.

Table 3.

Indirect Effects From a Moderated Multiple Mediation Model of Procrastination (PRO) on Perceived Stress (PS) Through Self-Blame Coping (SBC) and Behavioral Disengagement Coping (BDC) Controlling for Sex, Age , Ethnicity, and Education Level for Healthy Controls and Individuals With Hypertension or Cardiovascular Disease (HT/CVD).

			Indirect effects by sample					
			Healthy controls (N = 564)		HT/CVD (N = 182)			
Path	B (*SE*)	*t*	Indirect effect, c' (SE)	BCA CIs	Indirect effect, c' (SE)	BCA CIs	Model R^2	*F* (*df*)
PRO – SBC (a_1)	.18 (.13)	1.46						
PRO X group for a_1 (m_1)	.19 (.09)	2.04*					(a_1) .15	22.04** (5, 740)
SBC – PS (b_1)	.26 (.03)	8.63**					($b_{1,2}$) .43	86.20** (5, 740)
PRO – PS (c)	.27 (.04)	7.46**						
PRO – SBC– PS (c_1')			.09 (.02)	[.07, .13]	.14 (.03)	[.10, .20]		
PRO – BDC(a_2)	.24 (.10)	2.29*						
PRO X HT/CVD for a_2 (m_2)	.18 (.08)	2.29*					(a_2) .24	32.44** (5, 740)
BDC – PS (b_2)	.25 (.03)	7.57**					. ($b_{1,2}$) .43	86.20** (5, 740)
PRO – PS (c)	.27 (.04)	7.46**						
PRO – BDC – PS (c_2')			.11 (.02)	[.07, .14]	.15 (.03)	[.11, .20]		

Note: BCA CI = Bias corrected and accelerated 95 percent confidence intervals; Boot strapping analyses was conducted with 10,000 resamples; all indirect effects are unstandardized; *p < .05, **p < .01.

Table 4.

Indirect Effects From a Moderated Multiple Mediation Model of Procrastination (PRO) on Health Behaviors (HB) Through Self-Blame Coping (SBC) and Behavioral Disengagement Coping (BDC) Controlling for Sex, Age, Ethnicity, and Education Level for Healthy Controls and Individuals With Hypertension or Cardiovascular Disease (HT/CVD).

			Indirect effects by sample					
			Healthy controls (N = 564)		HT/CVD (N = 182)			
Path	B (*SE*)	*t*	Indirect effect, c' (SE)	BCA CIs	Indirect effect c'(SE)	BCA CIs	Model R^2	*F* (*df*)
PRO – SBC (a_1)	.42 (.04)	9.61**						
PRO X group for a_1 (m_1)	.19 (.09)	2.04*					(a_1) .16	22.04** (5,740)
SBC – HB (b_1)	-.02 (.03)	-0.67					($b_{1,2}$) .15	17.84** (5,740)
PRO – HB (c)	-.22 (.04)	-5.51**						
PRO – SBC – HB(c'$_1$)			-.01 (.01)	[-.03, .02]	-.01 (.02)	[-.05, .02]		
PRO – BDC(a_2)	.46 (.04)	12.94**						
PRO X HT/CVD for a_2 (m_2)	.18 (.08)	2.29*					(a_2) .24	32.43** (5,740)
BDC – HB (b_2)	-.07 (.04)	-1.89*					($b_{1,2}$) .15	17.84** (5,740)
PRO – HB(c)	-.22 (.04)	-5.51**						
PRO – BDC – HB(c'$_2$)			-.03 (.02)	[-.06, .00]	-.04 (.02)	[-.09, .00]		

Note: BCA CI = Bias corrected and accelerated 95 percent confidence intervals; Boot strapping analyses was conducted with 10,000 resamples; all indirect effects are unstandardized; *p < .05, **p < .01.