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## HEALTH PSYCHOLOGY | RESEARCH ARTICLE

# Is procrastination related to sleep quality? Testing an application of the procrastination–health model

Fuschia M. Sirois<sup>1,2\*</sup>, Wendelien van Eerde<sup>3</sup> and Maria Ioanna Argiropoulou<sup>4</sup>

**Abstract:** Despite a growing body of research on the consequences of procrastination for health and well-being, there is little research focused on testing or explaining the potential links between procrastination and sleep quality. Using the procrastination–health model as our guiding conceptual lens, we addressed this gap by examining how and why trait procrastination may be linked to various dimensions of sleep quality across two student samples. In Study 1, procrastination was associated with feeling unrested, but not with sleep disturbance frequency, in a sample of Greek undergraduate students ( $N = 141$ ). In Study 2, bootstrapping analysis of the indirect effects of procrastination on an index of sleep quality through perceived stress in a sample of Canadian students ( $N = 339$ ) was significant, supporting an extended procrastination–health model view of how chronic self-regulation failure may compromise sleep quality. Given the potential for dynamic and reciprocal relations among procrastination, stress, and sleep quality, suggested by the current and other research, the ways in which procrastination may contribute to and be influenced by poor sleep quality warrant further investigation.

**Subjects:** Health Psychology; Personality; Stress in Adults

**Keywords:** procrastination; sleep quality; stress; health; well-being



Fuschia M. Sirois

### ABOUT THE AUTHORS

Fuschia M. Sirois is a reader in the Department of Psychology at the University of Sheffield, and formerly a Canada research chair in Health and Well-being at Bishop's University. For over a decade, her research has examined how and why procrastination is related to health and well-being outcomes, and how stress and emotions play a role in procrastination and its consequences. The research in this paper applies her procrastination–health model to sleep quality.

Wendelien van Eerde is an associate professor at the University of Amsterdam (Amsterdam Business School). Her research interests involve work motivation, with a specific focus on time-related issues such as planning, procrastination, and time management.

Maria Ioanna Argiropoulou is a Clinical Psychologist and Cognitive and Behavioural Therapist, and president of the Association of Clinical Psychologists of Greece. Her research has focused on understanding the volitional breakdown that characterizes procrastination and its consequences for well-being.

### PUBLIC INTEREST STATEMENT

Procrastination is a common and problematic behavior that may confer risk for poor health. The purpose of our research was to extend previous research demonstrating that the stress associated with trait or chronic procrastination accounts for the links with poor health by examining if procrastination was also a risk for poor sleep. We therefore tested a model suggesting that people who habitually procrastinate would have a poor quality of sleep and that their higher levels of stress might explain this association. Our analyses across two student samples supported this hypothesis. We found that chronic procrastinators reported having poor sleep quality, including feeling bad after waking up, having more difficulty staying awake during the day, sleeping less hours at night, and needing medication to help them sleep. The results also supported our proposed model which suggests that higher levels of stress experienced by procrastinators may contribute to their sleep difficulties.

## 1. Introduction

Nothing [is] so fatiguing as the eternal hanging on of an uncompleted task. (William James)

The common sense reflected in James' assertion highlights an important but understudied topic within the procrastination literature. A growing body of research has demonstrated the associations between trait procrastination and a variety of health-related outcomes including health behaviors and health problems (Sirois, 2004, 2007; Sirois, Melia-Gordon, & Pychyl, 2003). Yet, there is little research focused on testing or explaining the potential links between procrastination and fatigue implied by James' statement. This is surprising given the robust links between procrastination and stress (Flett, Blankstein, & Martin, 1995; Sirois, 2007, 2014; Sirois et al., 2003; Sirois & Tosti, 2012; Tice & Baumeister, 1997), and between stress and poor sleep quality and behaviors (Lund, Reider, Whiting, & Prichard, 2010; Morin, Rodrigue, & Ivers, 2003), two reliable predictors of fatigue (Corwin, Klein, & Rickelman, 2002; Kocalevent, Hinz, Brähler, & Klapp, 2011; Thorsteinsson & Brown, 2009). Moreover, recent work has highlighted how a domain-specific form of procrastination, "bedtime procrastination"—putting off going to sleep at the intended time—can contribute to insufficient sleep (Kroese, De Ridder, Evers, & Adriaanse, 2014). Aside from this specific form of procrastination, there is little, if any, research on the role of trait procrastination in how well people sleep. Theoretical perspectives of the procrastination–health relationship implicate stress as an explanatory factor for understanding why procrastination confers risk for poor health-related outcomes (Sirois, 2007; Sirois et al., 2003). If we view this model as including poor sleep and fatigue as likely health-related outcomes of the stress from the habitual delay of important and intended tasks, then it is reasonable to expect that James' insight into procrastination reflects an important truth. The purpose of the current research was to test this hypothesis.

### 1.1. Procrastination, stress, and health-related outcomes

At the heart of James' statement is the notion that procrastination, the failure to act on intended and important tasks in a timely manner, may be fatiguing. We propose that the veracity of this statement may be best understood from the lens of the procrastination–health model (Sirois, 2007; Sirois et al., 2003). As the only validated model on this topic to date, the procrastination–health model provides a theoretically based account of the routes through which procrastination may confer risk for poor health-related outcomes such as sleep quality. Grounded in general models of personality and health (Friedman, 2000; Smith, 2006; Suls & Rittenhouse, 1990), this model posits that habitual procrastination can have cumulative and deleterious effects on health via both direct or stress-mediated pathways, or indirect, behavioral pathways. The stress-related pathways include health effects via immune system suppression, as well as vulnerability for stress-related acute health issues such as muscle tension, headaches, insomnia, and digestive issues (Sirois et al., 2003). The behavioral pathway involves the disruption of the health behaviors necessary for the maintenance and promotion of health (Sirois, 2004), as well as engaging in health risky behaviors (Sirois & Pychyl, 2002).

Whether viewed as a health outcome or health behavior, sleep is an important but understudied health variable that can be adversely affected by stress (Lund et al., 2010). Research to date, testing the procrastination–health model (Sirois, 2007; Sirois et al., 2003), has not focused specifically on sleep quality or behaviors. However, several studies have examined the relations of procrastination to general assessments of health problems and behaviors that included sleep-related outcomes. For example, in one study, stress mediated the association between trait procrastination and health problems which included insomnia (Sirois, 2007; Sirois et al., 2003). Other research has examined the links between procrastination and an inventory assessing the practice of a range of health behaviors which included getting a restful, uninterrupted night's sleep. In both cross-sectional (Sirois, 2007) and longitudinal studies (Sirois, Voth, & Pychyl, 2009), procrastination was negatively associated with the overall inventory, and stress mediated the link to poor health behaviors. Taken together, this research provides some support for the proposition that the link between procrastination and poor sleep may be explained by greater perceived stress.

### 1.2. Procrastination and sleep quality: a role for stress?

The procrastination–health model when applied to sleep quality as a health-related outcome provides an appropriate conceptual framework for understanding how stress may explain the contributions of trait procrastination to poor sleep. There is also empirical support for the role of stress as a disruptive factor in sleep quality. For example, in a population-based study of college students, tension and stress accounted for 24% of the variance in sleep quality, whereas other disruptive health behaviors such as alcohol and caffeine consumption did not account for any significant variance (Lund et al., 2010). Other evidence suggests that it may be how stressors are perceived and responded to that is key for understanding the potential disruptive influence of stress on sleep quality. A daily diary study comparing adults with insomnia to good sleepers found that although both groups reported the same number of minor stressful life events, those with insomnia rated minor stressful events as more intense and stressful (Morin et al., 2003). Moreover, these associations were explained by a greater use of maladaptive coping strategies in the insomnia group.

With respect to procrastination, there are several studies confirming not only the link to increased stress, but also the reasons why procrastination and trait procrastination, in particular, may contribute to stress (see Sirois & Pychyl, 2013 for a review). Clearly, last-minute rushing to complete important tasks can be stressful, as can the consequences of not meeting deadlines on time (e.g. Fee & Tangney, 2000; Ferrari, Harriott, & Zimmerman, 1999). Research has also demonstrated that procrastinators hold negative cognitions and self-judgments about themselves and their own past and current procrastination of necessary tasks that further contributes to the elevated stress levels they report (Flett, Stainton, Hewitt, Sherry, & Lay, 2012; Sirois, 2014; Sirois & Tosti, 2012; Stainton, Lay, & Flett, 2000). Moreover, a meta-analysis of 14 studies and over 4,000 participants found that greater use of maladaptive coping strategies explained the association of procrastination to stress (Sirois & Kitner, *in press*).

### 1.3. The current research

Building on this theoretical and empirical work, and inspired by James' common sense assertion about the consequences of procrastination, we sought to conduct a first test of an extended procrastination–health model (Sirois, 2004, 2007; Sirois et al., 2003) that included sleep quality as the health-related outcome (see Figure 1). We chose sleep quality as our focal outcome, as it is considered a multi-dimensional construct comprised of several subjective and objective components including sleep duration, subjective sleep quality, sleep latency, sleep disturbance, and daytime drowsiness (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). Combined, these different aspects of sleep-related behavior provide a comprehensive profile of sleep health and related fatigue. Across two student samples (one Greek and one Canadian) and using different measures of sleep quality, we expected that procrastination would be related to poor sleep quality (Study 1 and 2), and that high levels of perceived stress would mediate this association (Study 2).

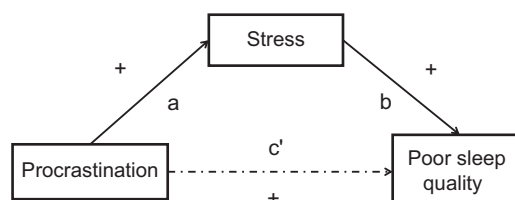
## 2. Study 1

### 2.1. Methods

#### 2.1.1. Participants and procedure

Study 1 analyzed data from a sample of 141 Greek undergraduate students (Mean age = 24.27, SD = 1.07, 57.4% female) collected as part of a larger program of research investigating the links

**Figure 1. Procrastination–health model showing the hypothesized indirect effects of trait procrastination on sleep quality through perceived stress.**



between procrastination, health behaviors, and well-being. Participants completed a paper survey on health behaviors and procrastination using snowball sampling technique. Ethical clearance for the data collection was sought from the Institutional Review Board prior to data collection, and participation was voluntary and anonymous.

## 2.2. Measures

In addition to basic demographic measures, participants completed the following measures.

### 2.2.1. Procrastination

Participants completed Lay's General Procrastination scale (GPS; Lay, 1986), a 20-item measure of trait procrastination, that is the tendency to procrastinate across a range of tasks and life domains. Items such as "I generally delay before starting work I have to do" are scored on a five-point Likert-type scale ranging from 1 (not at all true) to 5 (totally true of me). Ten reverse-scored items are included, with the sum of all items yielding a single score with high values, indicating a greater tendency to procrastinate. The GPS has demonstrated good internal consistency previously ( $\alpha = .82$ ; Lay, 1986) and in the current study ( $\alpha = .87$ ).

### 2.2.2. Sleep behaviors and quality

For the purpose of present study, we examined two subscales of the sleep section of the Greek version of the Fragebogen zur Erfassung des Gesundheitsverhaltens (Health Behaviour Questionnaire, Dlugosch and Krieger (1995), adjusted in Greek by Sofianopoulou & Kalantzi-Azizi, 2012), which related to sleep quality. The first scale included three items assessing the frequency of sleep disturbances (difficulties falling asleep, frequency of waking up at night, and difficulties falling back to sleep after waking up) on a five-point Likert scale ranging from 1 = never to 5 = very often. The scale demonstrated low to acceptable internal consistency ( $\alpha = .65$ ). The second scale consisted of six items assessing the frequency of negative feelings when waking up including questions such as "When I wake up in the morning I feel exhausted" on a five-point Likert scale ranging 1 = never to 5 = very often. Two items were reversely coded. The reliability of the scale in this study was good ( $\alpha = .84$ ). Items for each subscale were summed with a maximum score of 15 for the sleep disturbances subscale, and a maximum score of 30 for the feeling bad upon waking subscale. However, the two scales were not correlated ( $r = .15$ , ns).

## 2.3. Results and discussion

The mean score for sleep disturbances subscale was at the mid-point ( $M = 7.05$ ,  $SD = 2.8$ ), whereas the feeling bad upon waking subscale mean score was just above the mid-point ( $M = 17.6$ ,  $SD = 5.2$ ), indicating that on average, students experienced sleep difficulties related to their waking states. Correlational analysis revealed that trait procrastination was unrelated to the frequency of sleep disturbances ( $r = .04$ , ns), but was significantly associated with frequently feeling bad upon waking ( $r = .19$ ,  $p < .05$ ).

That procrastination was significantly associated with feeling bad upon waking but not the sleep disturbances is somewhat counterintuitive. However, there may be several reasons for this. First, the two aspects of sleep quality were not significantly correlated, suggesting that in this sample, students may not have recalled waking and falling back to sleep, whereas feeling bad upon waking may have come to memory more readily. From a methodological perspective, it is also possible that the low internal consistency of this scale contributed in part to these findings. However, from a conceptual perspective, it may also be that feeling unrested or "bad" upon waking is an indicator of non-restorative sleep, a common and peripheral symptom of insomnia that is not necessarily accompanied by sleep disturbances or lack of sleep (Stone, Taylor, McCrae, Kalsekar, & Lichstein, 2008; Wilkinson & Shapiro, 2012). Thus, procrastinators may apparently not have a lack of sleep, but because the quality of their sleep is poor without necessarily being accompanied by frequent waking, they feel unrested upon waking.

### 3. Study 2

In this study, we tested an application of the procrastination–health model to sleep quality in which stress is proposed to explain the link between procrastination and sleep quality (Figure 1). Because procrastination is associated with mental health issues such as anxiety and depression (Haycock, McCarthy, & Skay, 1998; Lay, Edwards, Parker, & Endler, 1989; Martin, Flett, Hewitt, Krames, & Szanto, 1996; Senécal, Koestner, & Vallerand, 1995), which can in turn impact sleep quality (Bourdet & Goldenberg, 1994; Tsuno, Besset, & Ritchie, 2005), we included mental health as a covariate as an incremental test of the role of procrastination in sleep quality.

The Study 2 sample comprised of 339 undergraduate psychology students (Mean age = 21.68, SD = 4.93, 81.7% female) who completed an online survey for extra course credit. Data for this sample were from a published paper that did not analyze the association of procrastination with sleep quality (Sirois & Tosti, 2012); full methods are presented in the original paper.

#### 3.1. Measures

##### 3.1.1. Sleep quality

Participants completed the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989), a widely used and well-validated measure of seven different aspects of sleep quality (see Table 1). The PSQI global sleep quality score is derived by summing each of the seven subscales, which each have a maximum value of 3. Thus, the maximum score for the PSQI is 21, with higher scores indicating poorer sleep quality. However, scores over 5 indicate poor sleep quality. Items such as “During the last month, how often have you had trouble sleeping because you wake up in the middle of the night or early morning?” are scored on a four-point scale (0–3) or by reporting time related to sleep. All items are rated with respect to the last month. The PSQI has demonstrated good internal consistency previously ( $\alpha = .83$ ; Buysse et al., 1989) and in the current study ( $\alpha = .79$ ).

##### 3.1.2. Stress

Participants completed the Perceived Stress Scale (PSS; Cohen & Williamson, 1988), a 10-item version of the widely used empirically established index of general perceived stress which measures the perceived stressfulness of events experienced within the past month. Items such as “In the last month, how often have you felt nervous and stressed” are rated on a five-point scale with response options ranging from “never” to very “often”. The PSS has demonstrated adequate internal consistency (Cohen & Williamson, 1988) previously, and in the current study ( $\alpha = .84$ ).

**Table 1. Descriptive statistics for procrastination, perceived stress, and sleep quality for Study 2 (N = 339)**

Variable	M	SD	1	2
Procrastination	2.68	.55	–	–
Perceived stress	2.96	.55	.32**	–
PSQI sleep latency	1.77	.76	.12*	.22**
PSQI daytime dysfunction	2.20	.64	.22**	.36**
PSQI sleep quality	1.12	.39	–.07	.07
PSQI medication to sleep	1.40	.65	.22*	.21**
PSQI sleep efficiency	.53	.91	.04	.18**
PSQI sleep duration	.43	.76	.16**	.14**
PSQI sleep disturbance	2.22	.43	.05	.26**
PSQI total score	9.06	2.19	.13*	.27**

Note: SD = standard deviation; PSQI = Pittsburg Sleep Quality Index.

\* $p < .05$ .

\*\* $p < .01$ .



### 3.1.3. Mental health

Participants indicated whether they had been diagnosed with a mental health issue by responding “yes” or “no”. Those that answered “yes” were prompted to list their medically diagnosed mental health issues in an open-ended follow-up question.

### 3.2. Results and discussion

Only 11.2% of the participants reported being diagnosed with a mental health issue, with depression and anxiety being the most frequently reported mental health issues. Among the individual sleep quality subscales, students scored highest on the daytime dysfunction (e.g. “During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?”) and sleep disturbance (e.g. “During the past month, how often have you had trouble sleeping because you wake up in the middle of the night or early morning?”) dimensions of sleep quality (see Table 1). Students scored lowest on the sleep efficiency (e.g. “When have you usually gone to bed, and when have you usually gotten up in the morning?”) and the sleep duration (“How many hours of actual sleep do you get at night?”) subscales.

Similar to Study 1, trait procrastination was unrelated to the sleep disturbances, sleep efficiency, and general sleep quality (e.g. “During the past month, how would you rate your sleep quality overall?”) subscales of the PSQI (see Table 1). However, procrastination was significantly related to the remaining four subscales of the PSQI as well as the overall PSQI composite index score. Consistent with previous research (Sirois, 2007, 2014; Sirois et al., 2003; Sirois & Tosti, 2012), perceived stress was significantly associated with procrastination. It was also significantly related to the overall PSQI index and all but one of the PSQI subscales (see Table 1).

To test the procrastination–health model applied to sleep quality, the indirect effects of procrastination on the composite PSQI sleep quality index through stress were assessed using the SPSS macros INDIRECT (Preacher & Hayes, 2008). This technique uses a bootstrapping resampling procedure and drawing *k* bootstrapped samples from the data in to estimate the effects and their confidence intervals (CI). A summary of the indirect effects analysis which used 5,000 bootstrapping resamples and bias corrected 95% CI for the indirect effects is presented in Table 2.

The analysis revealed significant indirect effects of procrastination on sleep quality through stress. However, the *c'* path was not significant after accounting for the effects of stress, suggesting that stress explained a substantial proportion of the relationship between procrastination and sleep quality. The effects of procrastination on sleep quality through perceived stress were moderate and significant (see Table 2). Overall, the model explained 7% of the variance in the total PSQI sleep quality index.

Similar to Study 1, procrastination was not related to the sleep disturbance subscale, but was significantly associated with the daytime dysfunction subscale. This supports the notion that trait procrastination may be linked more to nonrestorative sleep than to frequent waking. Taken with the results from the indirect effects analysis, these findings are consistent with the notion that stress impairs the sleep quality of procrastinators in ways that are not always obvious, but that nonetheless

**Table 2. Indirect effects of procrastination (PRO) on sleep quality (SLQ) through stress (ST) controlling for mental health issues, in Study 2**

N	Path	b	t	Indirect effect (SE)	BCA CIs	Model R <sup>2</sup>	F (df)
339	PRO–ST (a)	.30	5.87**			.08	10.00**
	ST–SLQ (b)	.96	4.32**				
	PRO–SLQ (c)	.18	.82				
	PRO–ST–SLQ (c')	.18	.82	.29 (.08)	.15; .48		

Notes: BCA CI = Bias Corrected and accelerated 95% CI; Boot strapping analysis was conducted with 5,000 resamples.

\*\**p* < .001.

can cause a significant amount of daytime dysfunction, fatigue, and impairment. Importantly, these effects were found after accounting for the presence of diagnosed mental health conditions.

#### 4. General discussion

Across two studies, the current research found support for James' common sense assertion about the consequences of procrastination for fatigue. In both Canadian and Greek students, trait procrastination was associated with indicators of poor sleep quality including not feeling rested after sleep, and an overall, well-validated index of sleep-related behavior and outcomes. In Study 2, mediation analysis supported an explanatory role for stress, with stress fully mediating the procrastination–sleep relationship. These findings not only extend applications of the procrastination–health model (Sirois, 2007; Sirois et al., 2003), but also build on emerging research on “bedtime procrastination” (Kroese et al., 2014) by highlighting the multiple ways in which procrastination is related to sleep quality and behaviors.

Sleep is an important health-related outcome that is increasingly being recognized as having links to personality traits. For example, recent research has noted that the two Big Five traits most closely associated with procrastination, low Conscientiousness and high Neuroticism (Van Eerde, 2003), are the best predictors of poor sleep indicators such as poor sleep hygiene, low sleep quality, and increased sleepiness (Duggan, Friedman, McDevitt, & Mednick, 2014; Hintsanen et al., 2014). However, this recent work did not explore the reasons for these associations. The current findings are consistent with these results but also go beyond them. Procrastination is a mid-level trait which reflects the combinations of these higher order traits, Conscientiousness (low) and Neuroticism (high). As such, it can provide important insights into the personality–sleep relationship by highlighting the explanatory role of stress which is not evident from the association of either of these higher order traits alone. Trait procrastination may therefore be more informative for understanding why personality traits such as Conscientiousness and Neuroticism are linked to poor sleep quality as it capitalizes on the greater explanatory specificity and fidelity that can be afforded using mid-level as opposed to higher order traits (John, Hampson, & Goldberg, 1991).

By demonstrating that the procrastination–health model can be applied to understand sleep-related outcomes, the current findings contribute to a growing literature on the potential implications of procrastination for health. In addition to tests of the original model, which noted that stress explained the link between procrastination and poor health (Sirois, 2007; Sirois et al., 2003), research with the procrastination–health model has also examined the potential sources of stress that may confer risk for poor health among procrastinators. Several studies have found that the procrastination–stress link is explained in part by maladaptive coping (Sirois & Kitner, *in press*), low self-compassion (Sirois, 2014), and low mindfulness (Sirois & Tosti, 2012). When taken together with the current findings, this research suggests possible approaches for reducing stress among procrastinators which may also improve sleep quality and reduce fatigue, and thereby improve health and well-being. Efforts to reduce stress through improving coping and enhancing mindfulness and self-compassion may have ameliorative effects on sleep quality and reduce nonrestorative sleep for those who chronically procrastinate. For example, research that measured sleep quality after instructing persons to think about emotional stressors found individual differences with regard to action orientation. That is, action-oriented people, who do not tend to ruminate, slept well after receiving instructions to think about an emotional stressor, whereas state-oriented individuals' sleep was negatively affected by such an instruction (Giesemann, Ophey, Jong-Meyer, & Pietrowsky, 2012). Given that trait procrastination is associated with having a state orientation (Blunt & Pychyl, 1998), that is a tendency to focus on emotional states rather than instrumental action, it is possible that efforts to reduce procrastinators' rumination over negative events through enhancing their emotional coping capacities may also help improve their sleep quality.



There is also suggestive evidence that there may be dynamic and reciprocal relationships between procrastination and sleep quality which could have implications beyond taking ameliorative measures to improve well-being. Building on research suggesting a link between diminished resources and self-control (e.g. Muraven, Tice, & Baumeister, 1998), one study of working adults found that fatigue at Time 2 predicted procrastination at Time 3 (DeArmond, Matthews, & Bunk, 2014). The researchers argued that increased workload depletes available self-control resources leading to fatigue which in turn predicts a greater tendency to procrastinate. However, procrastination was measured with a short six-item version of Lay's (1986) trait procrastination scale that was not administered at each time point. Given the relative stability of trait procrastination in behavioral genetic studies (Gustavson, Miyake, Hewitt, & Friedman, 2014), it could also be that procrastination predicts fatigue, and the temporal order of the proposed relationship was arbitrary as baseline levels of procrastination were not controlled for in the analyses. Nonetheless, the notion that circumstances such as poor sleep may cause fatigue, deplete self-regulatory resources, and thus further contribute to procrastination is intriguing and warrants further investigation with longitudinal designs. Indeed, there is some evidence that sleep sufficiency and practicing consistent sleep behaviors can increase self-regulatory strength (Barber & Munz, 2011), suggesting that poor sleep quality may contribute to self-regulation failure such as procrastination. Further research would help provide key insights not only into the development of procrastination as a personality trait, but could also help identify a potential new subtype of procrastinators that is characterized by fatigue, as research on procrastination subtypes has largely been inconsistent, controversial, and atheoretical (e.g. Ferrari, 1992; Simpson & Pychyl, 2009; Steel, 2010).

The current research has several limitations and strengths to consider when interpreting the results. Both samples used a cross-sectional design which precludes any strong conclusion about causality or directionality among the variables, despite the theoretical framework of the procrastination–health model, suggesting certain directional relationships. Thus, regardless of the significant indirect effects of procrastination on sleep quality through stress, found in Study 2, reciprocal and dynamic relations among these variables are also possible. In addition to the potentially complex relations between procrastination and sleep quality previously discussed, there is also experimental evidence that sleep deprivation, an indicator of sleep quality, can lower the psychological threshold for perceiving stress in response to mild stressors (Minkel et al., 2012). Assessing procrastination, stress, and sleep quality at multiple time points to understand their potential reciprocal relations is therefore an important future research objective. Nonetheless, the proposed links of sleep quality to procrastination in the current research are informed by theory (Sirois, 2007; Sirois et al., 2003).

In the current studies, we also only examined stress as an explanatory factor for understanding how trait procrastination may relate to poor sleep quality. The effects may also be cognitive, as demonstrated by early psychologists: interrupted or unfinished tasks stay on the mind more concretely, are easier to remember, and may thus consume more energy (Zeigarnik, 1927), and accordingly impair sleeping (Syrek & Antoni, 2014). The potential interplay of cognitive–affective reactions to unfinished tasks and its links to sleep quality are therefore a potentially fruitful area for future research.

Other issues include the use of student samples which limit the generalizability of the findings. Poor sleep quality is common among college/university students and is known to take a toll on academic performance (e.g. Gaultney, 2010). Although the current findings highlight the potential role of procrastination for further compromising student performance via poor sleep, it is unknown whether procrastination presents a similar vulnerability for poor sleep quality among nonstudent, adult populations. This limitation is especially notable given that the mean scores on the PSQI for the Study 2 sample were well above the cut-off point for clinically poor sleep quality. Despite these limitations, we found that procrastination was linked to sleep quality using different measures of sleep quality, and in both Canadian and Greek samples. This multiple, cross-cultural sample, multiple measure approach allowed for a replication and cross-validation of the findings which increases confidence in the associations found.

In addressing the question posed by the title of this article, and the veracity of James' common sense assertion regarding the consequences of procrastination, the current research found that trait procrastination was associated with indices of poor sleep quality among college students. From the lens of the procrastination–health model (Sirois, 2007; Sirois et al., 2003), higher stress appears to play a role in explaining this association. However, given the potential for dynamic, complex, and reciprocal relations among procrastination, stress, and sleep quality suggested by the current and other research, the ways in which procrastination may contribute to and be influenced by poor sleep quality warrant further investigation.

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#### Competing interests

The authors declare no competing interest.

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