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Dynamic and Bidirectional Relation Between Mindfulness and Procrastination Among Female College Students

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Abstract

Objectives Procrastination is a common behavior in our daily life that can lead to detrimental consequences, and previous studies have shown that female college students are more vulnerable to procrastination. Mindfulness-based interventions have been used to reduce procrastination; however, little is known about how mindfulness and procrastination interplay in everyday contexts. Therefore, the main purpose of this study was to explore the dynamic and bidirectional relation between mindfulness and procrastination from a multidimensional perspective.

Method A total of 252 female college students participated in a 34-day diary study, during which they completed daily measures of procrastination and three dimensions of state mindfulness (i.e., acting with awareness, nonjudgmental acceptance, and present-moment attention). Dynamic structural equation modeling was used to analyze the data.

Results We found a bidirectional association of daily procrastination with one dimension of state mindfulness (i.e., acting with awareness), but not with the other two dimensions (i.e., nonjudgmental acceptance, and present-moment attention). Specifically, higher levels of acting with awareness predicted individuals' lower levels of procrastination the next day (β = -0.042, 95% CI [-0.070, -0.019]), which enhanced their subsequent levels of acting with awareness (β = -0.087, 95% CI [-0.113, -0.058]). This indicated a self-perpetuating virtuous cycle between acting with awareness and daily procrastination.

Conclusions Our findings provided valuable insights into mindfulness-based preventions and interventions. This study not only supported the role of mindfulness in reducing procrastination, but more importantly, highlighted the importance of targeting particular dimensions of mindfulness, rather than considering it as a whole, to enhance the effectiveness of mindfulness practices in addressing procrastination.

Preregistration This study is not preregistered.

Keywords Mindfulness · Acting with awareness · Procrastination · Dynamic structural equation modeling · Diary

Procrastination has long been a worldwide concern. It was defined as an irrational, voluntary, and unnecessary delay of intended tasks despite its costs and negative consequences (Ferrari et al., 1995; Simpson & Pychyl, 2009; Steel, 2007). Approximately 95% of people admitted to procrastinating at work (Steel, 2011), and chronic procrastination influenced 26% of people all around the world (Ferrari et al., 2005). For college students, Solomon and Rothblum (1984) found that at least 46% of college students reported to be engaged in procrastination, and Rahimi et al. (2016) noted that 80–95% of college students frequently procrastinated when doing academic assignments. Previous studies showed various negative outcomes of procrastination. It was associated with poorer academic performance (Kim & Seo, 2015). Moreover, it may lead to higher risk of health problems (Kroese, 2014), and more negative emotions such as pressure (Chun Chu & Choi, 2005; Meier et al., 2016), anxiety (Sternberg et al., 2020), and depression (Flett et al., 2016).

Given the prevalence and consequences of procrastination, researchers have examined the underlying mechanisms of procrastinatory behaviors. A widely accepted consensus was that procrastination reflected a failure of self-regulation (Gagnon, 2016; Rebetez et al., 2016; Schouwenburg & Groenewoud, 2001; Steel, 2007). Although individuals had goals and intentions, they voluntarily chose procrastination reflecting a breakdown in their self-regulation (Rebetez

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et al., 2016; Steel, 2007). To explore the reasons for this breakdown, researchers have proposed further explanations from different perspectives. From a motivational perspective, the temporal motivation theory explains why people were not sufficiently motivated to complete tasks until time approaches the deadline (Steel & König, 2006). According to the temporal discounting effect (Loewenstein & Prelec, 1992), the more distant an event was in time, the less impact it has on the present moment. Thus, when a task was not imminent, individuals are less aware of the current behavior. This can lead to a lower motivation to act in the moment, resulting in more procrastination. Another explanation for why people procrastinate is from an emotion-regulation perspective. Sirois and Pychyl (2013) noted that a breakdown in self-regulation often occurred when people are faced with a boring, annoying, or frustrating task. When individuals had uncomfortable thoughts and judgements about a task, they tended to avoid these discomforts by setting aside their current work and engaged in unrelated tasks, which led to procrastination (Sirois & Pychyl, 2013; Tice & Bratslavsky, 2000). Considering that attention to the present moment and awareness of current behavior, and judgements to one's experiences are key components of mindfulness (Bishop et al., 2004), these explanations of procrastination suggested a possible relation between procrastination and mindfulness.

Mindfulness has been defined as a process of bringing attention to the moment-to-moment experience, while being attentive to the present activities in a nonjudgmental and receptive way (Kabat-Zinn, 2010). It could be divided into multiple aspects, including acting with awareness, nonjudging, describing, observing, and nonreactivity (Baer et al., 2006). Mindfulness could be trained and practiced as a specific skill (Baer et al., 2004). According to Monitor and Acceptance Theory (MAT), enhancing one's mindfulness by strengthening their monitor skills on the present moment and acceptance skills could improve their cognitive function and the negative affectivity (Lindsay & Creswell, 2017). Specifically, mindfulness helped individuals disengage from mind wandering and automatic thoughts, and promoted their acceptance of self-critical and negative thoughts (Evans et al., 2009; Jha et al., 2007; Sirois & Tosti, 2012). This helped to identify their current need and interests, and reduced their avoidance of current tasks (Shapiro, 2006), suggesting that mindfulness may facilitate individuals' self-regulation and reduce their tendency to procrastinate (Cheung & Ng, 2019).

In fact, there was a large body of empirical evidence supporting the positive effects of mindfulness on procrastination. Researchers found that dispositional mindfulness was negatively associated with procrastination among undergraduate students (Howell & Buro, 2011) and was predictive of less procrastination and procrastination-related thoughts (Flett et al., 2016). An experimental study also showed that people's procrastination scores dropped significantly after mindfulness practices (Li & Mu, 2020). In addition, lots of mindfulness-based interventions, such as Acceptance and Commitment Therapy, were found to be effective in reducing procrastination (Glick & Orsillo, 2015; Wang et al., 2017).

Previous studies have confirmed the positive effects of mindfulness on procrastination, while some other studies have shown that procrastination in turn affects individuals' levels of mindfulness. For example, Sirois and Tosti (2012) found that procrastination predicted lower levels of mindfulness. In addition, researchers focusing on the effects of procrastination on nonjudgmental acceptance found that procrastinators typically evaluated themselves from a negative perspective and were prone to self-criticism, which led to fewer nonjudgmental thoughts and more use of avoidance strategies (Flett et al., 1995; Sirois & Stout, 2011; Tice et al., 2001). Furthermore, Tice et al. (2001) found that using avoidance strategies, while alleviating the unpleasant feelings and thoughts brought by the current tasks, also resulted in lower levels of attention to the present moment and awareness of their own actions, in other words, impaired levels of mindfulness. This suggested that procrastination had detrimental effects on multiple aspects of mindfulness.

More importantly, some researchers have simultaneously examined the impact of mindfulness on procrastination as well as the impact of procrastination on mindfulness. For example, Cheung and Ng (2019) collected four waves of data over an 18-month period to explore the longitudinal association between mindfulness and procrastination. Based on a cross-lagged panel model, they found that dispositional mindfulness predicted lower levels of subsequent procrastination, and procrastination predicted lower levels of subsequent mindfulness. This provided direct evidence for a bidirectional relation between mindfulness and procrastination. Similarly, Du et al. (2021) used a 3-wave longitudinal design and found a reciprocal effect between social media self-control failure and mindfulness. Considering that procrastination was essentially a self-regulation failure (Steel, 2007), this finding indirectly supported the bidirectional relation between mindfulness and procrastination.

Although previous studies have found a bidirectional relation between mindfulness and procrastination, most have been cross-sectional (Flett et al., 2016; Sirois & Tosti, 2012), and the few longitudinal studies have collected data at only a few time points, each spanning several months (Cheung & Ng, 2019; Du et al., 2021). One of the main limitations of these studies was that they could not distinguish between traits that remained constant over time and states that fluctuated over time. In recent years, an increasing number of researchers have used dynamic structural equation modeling

(DSEM; Asparouhov et al., 2018; Hamaker et al., 2018) to decompose the between-person and within-person variabilities and thus better understand the dynamic processes within individuals (Hamaker & Wichers, 2017). Researchers noted that both mindfulness (Blanke & Brose, 2017) and procrastination (Bäulke et al., 2021) had state components that changed over time, and some studies have used daily diaries (Isham et al., 2022; Pollack & Herres, 2020) or experience sampling methods (Blanke & Brose, 2017; Gadosey et al., 2021) to investigate individuals' mindfulness and procrastination in everyday contexts. However, there is still a lack of research using dynamic structural equation models to explore how the relation between mindfulness and procrastination unfolds over time within individuals. Thus, the dynamic reciprocal relation between mindfulness and procrastination remains to be tested.

In addition, it should be noted that previous studies typically measured state mindfulness by taking a few items from a unidimensional trait measure of mindfulness (e.g., the Mindful Attention Awareness Scale, MAAS; Brown & Ryan, 2003). However, Blanke and Brose (2017) pointed out that state mindfulness was composed of multiple dimensions. They developed the Multidimensional State Mindfulness Questionnaire (MSMQ), which divided state mindfulness into three dimensions: acting with awareness (i.e., the awareness of own activities), nonjudgmental acceptance (i.e., "the acceptance of experiences without evaluating (e.g., as good or bad) them"), and present-moment attention (i.e., the attention to the present moment beyond own activities). Furthermore, they noted that different dimensions of mindfulness might be associated differently with related constructs and some associations might be more strongly driven by certain dimensions of state mindfulness (Blanke & Brose, 2017). This would have important implications for mindfulness-based prevention and intervention practices. Therefore, whether the bidirectional relation between state mindfulness and state procrastination differs across dimensions of state mindfulness worth further investigation.

The main purpose of the current study was to examine the dynamic and bidirectional relation between mindfulness and procrastination among female college students. Previous studies showed that female college students had a stronger tendency to procrastinate (Cheung & Ng, 2019) and suffered from more severe effects of procrastination (Klibert et al., 2011). For example, Klibert et al. (2011) found that procrastination positively predicted the psychological and physical suicidal proneness of college women, but not men, even after controlling for the effects of depression and self-esteem. This suggested that female college students were more vulnerable to the adverse effects of procrastination and required special attention. Thus, this study conducted a 34-day diary study among female college students to investigate the reciprocal effect between state mindfulness and daily procrastination, and the DSEM approach was used to explore their autoregressive effects and cross-lagged effects. Based on previous findings (Cheung & Ng, 2019; Du et al., 2021), we hypothesized that there was a dynamic and bidirectional relation between mindfulness and procrastination. Specifically, higher levels of mindfulness would predict less procrastination the next day, which subsequently led to higher levels of mindfulness. Furthermore, from a multidimensional perspective, we analyzed the relation between the three dimensions of state mindfulness (i.e., acting with awareness, nonjudgmental acceptance, and present-moment attention) and procrastination, which contributed to a more comprehensive understanding of the longitudinal associations between different components of mindfulness and procrastination. Since existing theoretical and empirical studies did not provide sufficient evidence to predict which dimension of state mindfulness was most critical in the bidirectional relation, we made the same hypotheses for all three dimensions of state mindfulness, and included all dimensions of state mindfulness and daily procrastination in a model to explore which dimension was the primary driver of the bidirectional relation.

Method

Participants

Initially, 308 female college students enrolled in this study and completed the eligibility test (see the Procedure section for inclusion criteria). The final sample included 252 eligible female college students whose ages ranged from 17 to 25 ($M = 20.325$, $SD = 1.474$). They all belonged to the Chinese Han ethnicity.

Procedure

This study was part of a research project on psychological and physical well-being of college students. The study was conducted in Beijing, China. Participants were recruited from social networks. First, they were required to complete a qualification test. The inclusion criteria for subjects in this study were (a) being female college students, (b) going to bed after 11 p.m. every day (as the lights out time in Chinese university dormitories is usually after 11 p.m., the link to the online diary was sent at 11 p.m. each night, considering that sending questionnaires to participants at an early time (e.g., 9:00 p.m.) might systematically miss the data of feelings and behaviors between filling out the questionnaire and going to bed, and that sending questionnaires too late may introduce confounding factors), (c) having access to a

smartphone every day (as participants were asked to complete daily diaries via smartphone), and (d) not being quarantined due to the coronavirus pandemic. Those who met the criteria were invited to participate in this study. Then, eligible participants signed an informed consent form and completed a long (i.e., 20–25 min) questionnaire to collect their basic information. The follow-up assessment phase spanned the same time period for all participants (i.e., from October 18th to November 20th, 2022), during which there was no lockdown in Beijing and participants were in school as usual. Over the next 34 days, participants received a text message at 11 p.m. and answered a short (i.e., 4–5 min) questionnaire each day before going to bed. Overall, participants completed 94.89% (ranging from 52.94 to 100%, $SD = 6.84\%$) of the short questionnaires, indicating high compliance. Incentives were offered to participants based on their completion rate. The average reward per participant was 103.31 yuan.

Measures

State Procrastination

Daily procrastination was measured based on 6 items from the procrastination scale of Tuckman (1991), and we adjusted these items to capture the daily dynamics of procrastination. An example item was "Today, I needlessly delayed finishing jobs, even when they were important". The English version of the procrastination scale was first independently translated into Chinese by two graduate students in psychology, and inconsistency in the translation was discussed with a psychology professor until agreement was reached. Participants were asked to rate the extent to which they agreed with each item from 1 (*strongly disagree*) to 7 (*strongly agree*). We calculated the average score of 6 items. Higher scores indicated higher levels of procrastination.

A multilevel confirmatory factor analysis was conducted to test the psychometric properties of the measure of state procrastination. The 1-factor model both at the between- and within-person level adequately fit the data: $\chi^2(18) = 470.552$, comparative fit index (CFI) = 0.948, the Tucker-Lewis index (TLI) = 0.914, root mean square error of approximation (RMSEA) = 0.056, standardized root mean square residual (SRMR) = 0.031 (within) / 0.016 (between). According to Geldhof et al. (2014), level-specific reliabilities were estimated by calculating McDonald's ω, which showed excellent reliabilities ($\omega = 0.892$ at the within-person level; $\omega = 0.982$ at the between-person level).

State Mindfulness

The Multidimensional State Mindfulness Questionnaire (MSMQ; Blanke & Brose, 2017) was used to measure the state mindfulness. The Chinese version of the MSMQ (Zhou et al., 2021) was used in this study. It consists of three dimensions: acting with awareness (3 items; example item: "I did tasks automatically without being aware of what I'm doing", reverse scored), nonjudgmental acceptance (3 items; example item: "I thought some of my thoughts/feelings were slightly off", reverse scored), and present-moment attention (3 items; example item: "I focused my attention on the present moment"). All items were preceded by a statement: "Since waking up this morning…" and participants were asked to rate how much they agreed with the description of each item from 1 (*not at all*) to 7 (*very much*). The average score of the items in each dimension was calculated. Higher scores represent higher levels of state mindfulness.

To test the factor structure of the 9 items assessing three-dimensional state mindfulness, a multilevel confirmatory factor analysis was conducted, which suggested a good model fit: $\chi^2(48) = 450.972$, CFI = 0.953, TLI = 0.930, RMSEA = 0.032, SRMR = 0.036 (within) / 0.067 (between). According to Geldhof et al. (2014), level-specific reliabilities were estimated by calculating McDonald's ω, which indicated acceptable reliabilities ($\omega = 0.704$ for acting with awareness, $\omega = 0.693$ for nonjudgmental acceptance, and $\omega = 0.729$ for present-moment attention at the within-person level; $\omega = 0.923$ for acting with awareness, $\omega = 0.889$ for nonjudgmental acceptance, and $\omega = 0.930$ for present-moment attention at the between-person level).

Data Analyses

First, the descriptive statistics and correlations were calculated in R version 4.2.2 by using *psych* (Revelle, 2017) package. Then, data were fit to a dynamic structural equation model in Mplus version 8.8 (Muthén & Muthén, 2017), with days (within-person level) nested within persons (between-person level). A visual presentation of the model is depicted in Fig. 1. First, observed variables were decomposed into within- and between-person components. At the within-person level, the person-specific autoregressive effects of and cross-lagged effects between the three dimensions of state mindfulness and procrastination were estimated. The contemporaneous residuals among the four variables were correlated. At the between-person level, correlations between the random intercepts (i.e., person means of all variables), but not random slopes (i.e., person-specific autoregressive and cross-lagged effects) were estimated. The model was run using a Bayesian estimator with noninformative priors and Markov chain Monte Carlo (MCMC) algorithm. We set

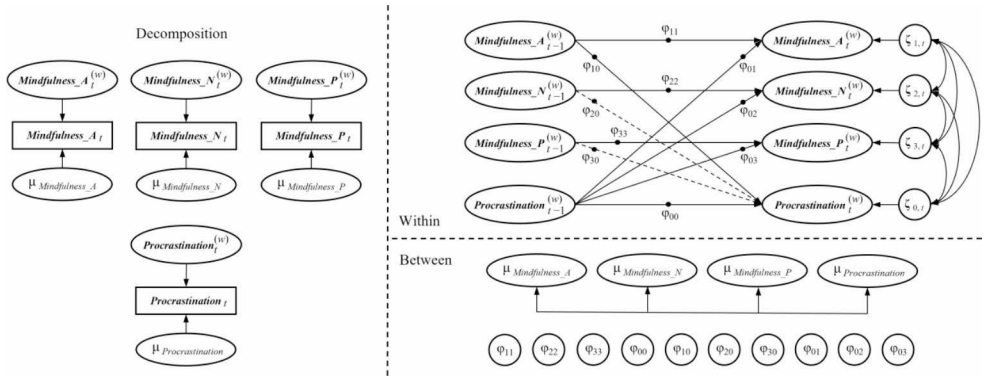

Fig. 1 Dynamic structural equation model for daily procrastination and state mindfulness. Notes: Mindfulness_A = Acting with awareness; Mindfulness_N = Nonjudgmental acceptance; Mindfulness_P = Present-moment attention. Black dots indicate person-specific autoregressive and cross-lagged effects. Solid lines with arrows indicate statistically significant effects, while dashed lines with arrows indicate effects that were estimated in the model but not statistically significant

Table 1 Descriptive statistics and correlations between mindfulness and procrastination

	M (*SD* within, *SD* between)	ICC	Correlations				
			1	2	3	4	5
1 Procrastination	3.677 (1.498, 1.136)	0.562	–	-0.517***	-0.253***	-0.382***	-0.541***
2 Mindfulness_A	4.669 (1.304, 0.995)	0.574	-0.794***	–	0.263***	0.401***	0.787***
3 Mindfulness_N	4.149 (1.365, 1.058)	0.588	-0.575***	0.546***	–	0.085***	0.661***
4 Mindfulness_P	4.532 (1.042, 0.716)	0.457	-0.602***	0.606***	0.144*	–	0.671***
5 Mindfulness	4.450 (0.938, 0.734)	0.607	-0.830***	0.911***	0.774***	0.668***	–

Notes: Mindfulness_A = Acting with awareness; Mindfulness_N = Nonjudgmental acceptance; Mindfulness_P = Present-moment attention. ICC = Intraclass correlation. Between-person correlations are represented below the diagonal, and within-person correlations are presented above the diagonal. $^{*}p < 0.05$, $^{***}p < 0.001$.

the number of iterations as 50,000 and the thinning value as 10 (i.e., only 1 in every 10 iterations was used for the estimation) to get more stable results (for more details please refer to Asparouhov et al., 2018; Hamaker et al., 2018). The model convergence was determined by using the potential scale reduction (PSR; Asparouhov & Muthén, 2010).

Results

The descriptive statistics and Pearson correlations between state mindfulness and state procrastination are shown in Table 1. The intraclass correlations for procrastination, mindfulness and its three dimensions ranged from 0.457 to 0.607, suggesting that approximately half of their variance was within-person. Both at the between- and within-person levels, procrastination was negatively associated with mindfulness as well as its three dimensions, and the three dimensions of mindfulness were positively associated with each other.

The dynamic and bidirectional relations between the three dimensions of state mindfulness and state procrastination were examined by fitting the data to a dynamic structural equation model. The unstandardized and standardized estimates for the fixed and random effects, and their 95% credible intervals are shown in Table 2. The results showed significant and positive autoregressive effects of all four variables. The positive autoregressive effects of the three dimensions of state mindfulness ranged from 0.164 to 0.188, which indicated that state mindfulness one day predicted state mindfulness the next day. In contrast, the positive autoregressive effect of procrastination ($\beta = 0.272$) was stronger than those of mindfulness, suggesting relatively higher carryover or "inertia" of procrastination. When individuals had higher/lower levels of procrastination one day, they tended to have higher/lower levels of procrastination the following day.

More importantly, according to the results of the cross-lagged effects, the dynamic interaction patterns between the three dimensions of state mindfulness and procrastination were different. A bidirectional relation was found between acting with awareness and procrastination. Specifically, higher levels of acting with awareness predicted less procrastination the next day (β = -0.042), which subsequently led to higher levels of acting with awareness (β = -0.087). In contrast, present-moment attention and nonjudgmental acceptance were only unidirectionally related to procrastination. Specifically, procrastination predicted lower levels of nonjudgmental acceptance (β = -0.036) and present-moment attention (β = -0.076) the next day, but the

Table 2 Results of the dynamic structural equation model

	Notation	Unstandardized estimates	Standardized estimates
Autoregressive effects			
Mindfulness_A → Mindfulness_A	φ_{11}	**0.189 [0.155, 0.220]**	**0.188 [0.164, 0.215]**
Mindfulness_N → Mindfulness_N	φ_{22}	**0.175 [0.142, 0.216]**	**0.175 [0.149, 0.201]**
Mindfulness_P → Mindfulness_P	φ_{33}	**0.163 [0.132, 0.203]**	**0.164 [0.142, 0.192]**
Procrastination → Procrastination	φ_{00}	**0.270 [0.239, 0.307]**	**0.272 [0.240, 0.304]**
Cross-lagged effects			
Mindfulness_A → Procrastination	φ_{10}	**-0.054 [-0.088, -0.020]**	**-0.042 [-0.070, -0.019]**
Mindfulness_N → Procrastination	φ_{20}	-0.017 [-0.051, 0.015]	-0.013 [-0.039, 0.009]
Mindfulness_P → Procrastination	φ_{30}	0.009 [-0.012, 0.032]	0.008 [-0.011, 0.028]
Procrastination → Mindfulness_A	φ_{01}	**-0.073 [-0.096, -0.052]**	**-0.087 [-0.113, -0.058]**
Procrastination → Mindfulness_N	φ_{02}	**-0.027 [-0.052, -0.007]**	**-0.036 [-0.063, -0.011]**
Procrastination → Mindfulness_P	φ_{03}	**-0.066 [-0.091, -0.045]**	**-0.076 [-0.103, -0.055]**
Random variances			
Autoregressive effects			
Mindfulness_A → Mindfulness_A	–	0.020 [0.014, 0.027]	–
Mindfulness_N → Mindfulness_N	–	0.029 [0.020, 0.039]	–
Mindfulness_P → Mindfulness_P	–	0.030 [0.020, 0.046]	–
Procrastination → Procrastination	–	0.022 [0.014, 0.032]	–
Cross-lagged effects			
Mindfulness_A → Procrastination	–	0.013 [0.005, 0.021]	–
Mindfulness_N → Procrastination	–	0.015 [0.007, 0.025]	–
Mindfulness_P → Procrastination	–	0.005 [0.001, 0.010]	–
Procrastination → Mindfulness_A	–	0.002 [0.001, 0.005]	–
Procrastination → Mindfulness_N	–	0.005 [0.002, 0.010]	–
Procrastination → Mindfulness_P	–	0.006 [0.002, 0.011]	–
Explained variance (R^2)			
Mindfulness_A	–	–	0.083 [0.069, 0.099]
Mindfulness_N	–	–	0.075 [0.061, 0.091]
Mindfulness_P	–	–	0.077 [0.063, 0.094]
Procrastination	–	–	0.134 [0.116, 0.156]

Notes: Table shows the unstandardized and standardized estimates and their 95% credible intervals (CIs). Mindfulness_A = Acting with awareness; Mindfulness_N = Nonjudgmental acceptance; Mindfulness_P = Present-moment attention. Bold values indicate significant effects (zero is not within the 95% credible interval).

predictive effects of levels of nonjudgmental acceptance (β = -0.013) and present-moment attention (β = 0.008) on subsequent procrastination were nonsignificant.

Discussion

In this study, we collected 34-day diary data to further explore how mindfulness and procrastination influence one another within individuals from a multidimensional perspective. A novel modeling approach, DSEM, was used to examine the dynamic reciprocal relation between the three dimensions of state mindfulness and daily procrastination. The results showed that mindfulness and procrastination could predict their own levels the next day, respectively, suggesting their carry-over effects from day to day. More importantly, we found a bidirectional relation between a particular dimension of state mindfulness (i.e., acting with awareness) and daily procrastination. Our findings reveal different within-person dynamic processes between different dimensions of mindfulness and procrastination, which provides valuable insights for mindfulness-based preventions and interventions targeting procrastination.

In line with previous findings (Cheung & Ng, 2019; Sirois & Tosti, 2012), our study showed that procrastination had detrimental effects on all three dimensions of state mindfulness, including acting with awareness, nonjudgmental acceptance, and present-moment attention. Researchers noted that procrastinators were prone to self-criticism and rumination (Gort et al., 2021), which may lead to more critical judgements. Moreover, these negative repetitive thoughts of past events reduced individuals' attention resources (Lyubomirsky & Tkach, 2003), possibly resulting in more actions without awareness and less attention to the present moment. Therefore, the cross-lagged effect of procrastination on all three dimensions of state mindfulness

further confirmed the adverse effects of procrastination on people's well-being.

In addition, our results showed that higher levels of acting with awareness predicted fewer procrastinatory behaviors the next day. One possible explanation was based on delay gratification. Previous research found that acting with awareness was associated with better abilities to resist temptation and delay gratification (MacDonald, 2021). When faced with an aversive task, individuals with poor abilities to delay gratification tended to engage in unintended activities in order to, for example, regulate short-term emotions (Sirois & Pychyl, 2013; Tice & Bratslavsky, 2000), which may lead to more procrastination. Thus, people who were more aware of their behavior may be more capable of resisting current temptations and working for long-term goals, and thus having less procrastination. Another possible explanation was that higher levels of acting with awareness efficiently increased an individual's psychological flexibility and psychological capital, which helped reduce the frequency of procrastination (Glick & Orsillo, 2015; Li & Mu, 2020). Nevertheless, the mechanism underlying the predictive effect of a particular dimension of state mindfulness (i.e., acting with awareness) on subsequent procrastinatory behaviors within individuals still needs empirical investigation in the future.

More importantly, we found a dynamic and bidirectional relation between acting with awareness and procrastination. Specifically, individuals who acted with awareness had less procrastination the next day, which further facilitated them to act with awareness the next day. This suggests that if we strengthen individuals' levels of acting with awareness through relevant interventions, we can expect them to engage in less procrastination the next day. Furthermore, less procrastination would further promote them to take more conscious actions the following day, which ultimately contributed to a self-perpetuating virtuous cycle between acting with awareness and procrastination. This dynamic process was related to the upward spiral process in mindfulness practice (Garland et al., 2010), in which state mindfulness and positive emotions promoted each other and finally helped people cope with stressful events and achieve flourishing in mental health. Considering that procrastination was easily triggered by negative emotions (Tice & Bratslavsky, 2000; Wohl et al., 2010) and that it was a strategy to regulate short-term negative emotions by avoiding the current tiresome task (Tice et al., 2001), higher levels of acting with awareness may reduce individuals' subsequent procrastination by alleviating their negative emotions. In addition, some researchers noted that when college students procrastinate on current tasks, they were often engaged in some mindless smartphone activities (Aydın & Aydın, 2022; Meier et al., 2016) such as browsing social media. These activities were accompanied by habitual and automatic responses that interfered with awareness of current behaviors (Grimes, 2018; Hao & Jin, 2020). This suggests that the mindless activities that college students engage in when procrastinating may provide some explanation for the unique role of the acting with awareness dimension of state mindfulness in procrastination.

In contrast to the dimension of acting with awareness, there were no bidirectional relations between the other two dimensions of state mindfulness (i.e., present-moment attention and nonjudgmental acceptance) and daily procrastination. For present-moment attention, researchers noted the difference between it and acting with awareness: present-moment attention referred to attention to the present moment beyond one's behaviors, whereas acting with awareness exactly stressed individuals' awareness of their own actions (Blanke & Brose, 2017). Considering that procrastination was essentially a voluntary and irrational delay of an individual's intended activities (Simpson & Pychyl, 2009; Steel, 2007), it was the individual's awareness of his or her own actions, rather than attention on the current moment, that may influence subsequent procrastinatory behavior. For nonjudgmental acceptance, Blanke and Brose (2017) argued that awareness and attention played an important role in a variety of situations in our daily lives, whereas nonjudgmental acceptance had an impact mainly in burdensome situations. Previous studies also found that nonjudgmental acceptance was significantly associated with negative affect (Eisenlohr-Moul et al., 2016), but not with positive affect (Schroevers & Brandsma, 2010). Considering that nonjudgmental acceptance may be particularly influential in adverse situations while our study was conducted in everyday contexts, we did not find its significant reciprocal effects with daily procrastination. Still, whether this dynamic reciprocal relation exists in particular situations (e.g., preparing for final exams) may worth further exploration.

Taken together, this study revealed that daily procrastination had a dynamic and bidirectional relation with one dimension of state mindfulness (i.e., acting with awareness), but not with the other two dimensions (i.e., nonjudgmental acceptance, and present-moment attention), which had important theoretical and practical implications. First, we examined the relation between daily procrastination and state mindfulness from a multidimensional perspective. Our findings suggested that state mindfulness, as a multidimensional construct, showed different longitudinal associations with daily procrastination on different dimensions, contributing to a better understanding on their relations. Since most previous studies only investigated the predictive effects of state mindfulness from a unidimensional perspective (Bowlin & Baer, 2012; Cheung & Ng, 2019; Howell & Buro,

2011), while researchers have pointed out that mindfulness is actually a complex construct with distinguishable aspects that may have different predictive effects on relevant outcomes (Schroevers & Brandsma, 2010; Cash & Whittingham, 2010), the multidimensional approach used in this study was strongly recommended in future research on state mindfulness.

In addition, our findings also provided valuable insights to mindfulness-based intervention designs. First, the bidirectional relation between acting with awareness and daily procrastination found in this study further supported the effectiveness of mindfulness-based interventions for procrastination. Specifically, we found a self-perpetuating virtuous cycle between acting with awareness and daily procrastination; enhanced acting with awareness led to less procrastination the next day, which then contributed to more actions with awareness the following day. This suggested that mindfulness practice for procrastination could be an effective trigger of the virtuous cycle between mindfulness and procrastination, and it may also have long-term effect on procrastination through this self-perpetuating cycle. More importantly, we found that different dimensions of state mindfulness had different associations with daily procrastination. This suggested that instead of considering mindfulness as a whole, mindfulness-based interventions should consider the multiple dimensions of mindfulness and be designed according to the impact of each dimension on the target problem. For example, for procrastination, more efforts were needed to strengthen individuals' levels of acting with awareness to optimize the effectiveness of procrastination interventions.

Limitations and Future Research

The present study had several limitations. First, we only included female college students in this study, and identified "female" based on their biological sex only, without considering more inclusive gender identities (e.g., "cisfemale", "cismale", "transfemale", and "transmale"; Burgund, 2021; Richards et al., 2016), which may limit the generalizability of our findings. However, it should be noted that female college students were found to be engaged in more procrastination behaviors (Cheung & Ng, 2019) and suffer more negative influences of procrastination, such as higher suicide proneness (Klibert et al., 2011). In addition, many previous studies have focused on female college students to examine the relation between procrastination and mindfulness (Bonamo et al., 2015; Cheung & Ng, 2019; MacDonald & Baxter, 2017). Therefore, we believed that special attention on female college students is warranted. Nevertheless, whether our findings still hold in a broader population remains to be investigated in the future.

Additionally, we selected participants who went to bed after 11 p.m., but previous findings suggested that regular sleep patterns may be a confounding factor. Empirical studies found that preferences for the timing of sleep and wake were correlated with procrastination (Choi et al., 2021), and that later chronotypes tended to report more bedtime procrastination than earlier chronotypes (Kühnel et al., 2018). Therefore, we encourage future research to further explore the reciprocal relation between state mindfulness and procrastination after controlling for the effects of regular sleep patterns.

In addition, we only examined general procrastination in this study. Since previous studies have also focused on some specific types of procrastination that are prevalent among college students, such as academic procrastination and bedtime procrastination (Jung & Song, 2018; Wolters, 2003), future research could further investigate how mindfulness and specific types of procrastination interact within individuals in their daily life.

Another limitation of this study is related to the time interval between two consecutive measurements. The present study used the daily diary method to measure individuals' state mindfulness and procrastination; therefore, the results of the present study should be interpreted and understood on a daily basis and could not be generalized to more intensive time intervals. Considering that mindfulness and procrastination may also have valuable fluctuations throughout the day, future studies could further explore the bidirectional relation with more intensive sampling frequency (e.g., multiple assessments a day).

Finally, our research did not yield strict causal relations, but revealed Granger causality (Granger, 1969). Based on DSEM, we found the cross-lagged effects between state mindfulness and daily procrastination. However, we did not manipulate either of these variables to explore whether a change in one variable actually led to a corresponding change in the other. Thus, no causal inference can be made between state mindfulness and daily procrastination, and experimental studies including manipulation of the variables are needed to draw causal conclusions.

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Data Availability The datasets are available from the corresponding author upon reasonable request.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethics Approval This study was approved by the Institutional Review Board of Beijing Normal University (IRB #: 202204120046).

Informed Consent Every participants signed an informed consent in our study. Informed consent was included on the first page of the long questionnaire, and only those who agreed with the informed consent completed the remainder of the long questionnaire and particiapanted in the diary study that followed.

Use of Artificial Intelligence We did not use AI tools in this study.

References

Asparouhov, T., Hamaker, E. L., & Muthén, B. (2018). Dynamic structural equation models. *Structural Equation Modeling*, *25*(3), 359–388. https://doi.org/10.1080/10705511.2017.1406803.

Asparouhov, T., & Muthén, B. (2010). *Bayesian analysis using Mplus: Technical implementation*. http://www.statmodel.com/download/Bayes2.pdf

Baer, R. A., Smith, G. T., & Allen, K. B. (2004). Assessment of mindfulness by self-report: The Kentucky Inventory of Mindfulness Skills. *Assessment*, *11*(3), 191–206. https://doi.org/10.1177/1073191104268029.

Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment*, *13*(1), 27–45. https://doi.org/10.1177/1073191105283504.

Bäulke, L., Daumiller, M., & Dresel, M. (2021). The role of state and trait motivational regulation for procrastinatory behavior in academic contexts: Insights from two diary studies. *Contemporary Educational Psychology*, *65*, 101951. https://doi.org/10.1016/j.cedpsych.2021.101951.

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., & Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*, *11*, 230–241. https://doi.org/10.1093/clipsy.bph077.

Blanke, E. S., & Brose, A. (2017). Mindfulness in daily life: A multidimensional approach. *Mindfulness*, *8*(3), 737–750. https://doi.org/10.1007/s12671-016-0651-4.

Bonamo, K. K., Legerski, J. P., & Thomas, K. B. (2015). The influence of a brief mindfulness exercise on encoding of novel words in female college students. *Mindfulness*, *6*(3), 535–544. https://doi.org/10.1007/s12671-014-0285-3.

Bowlin, S. L., & Baer, R. A. (2012). Relationships between mindfulness, self-control, and psychological functioning. *Personality and Individual Differences*, *52*(3), 411–415. https://doi.org/10.1016/j.paid.2011.10.050.

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, *84*(4), 822–848. https://doi.org/10.1037/0022-3514.84.4.822.

Burgund, E. D. (2021). Task-domain and hemisphere-asymmetry effects in cisgender and transmale individuals. *PLoS ONE*, *16*(12), e0260542. https://doi.org/10.1371/journal.pone.0260542.

Cash, M., & Whittingham, K. (2010). What facets of mindfulness contribute to psychological well-being and depressive, anxious, and stress-related symptomatology? *Mindfulness*, *1*(3), 177–182. https://doi.org/10.1007/s12671-010-0023-4.

Cheung, R. Y., & Ng, M. C. (2019). Being in the moment later? Testing the inverse relation between mindfulness and procrastination. *Personality and Individual Differences*, *141*, 123–126. https://doi.org/10.1016/j.paid.2018.12.015.

Choi, S. J., Jo, H., Kim, D., & Joo, E. Y. (2021). Sleep-wake pattern, sleep quality and daytime status in fixed day-shift hospital workers. *Journal of Sleep Medicine*, *18*(3), 167–174. https://doi.org/10.13078/jsm.210021.

Chun Chu, A. H., & Choi, J. N. (2005). Rethinking procrastination: Positive effects of active procrastination behavior on attitudes and performance. *The Journal of Social Psychology*, *145*(3), 245–264. https://doi.org/10.3200/SOCP.145.3.245-264.

Du, J., Kerkhof, P., & van Koningsbruggen, G. M. (2021). The reciprocal relationships between social media self-control failure, mindfulness and wellbeing: A longitudinal study. *PLoS ONE*, *16*(8), e0255648. https://doi.org/10.1371/journal.pone.0255648.

Eisenlohr-Moul, T. A., Peters, J. R., Pond, R. S., & DeWall, C. N. (2016). Both trait and state mindfulness predict lower aggressiveness via anger rumination: A multilevel mediation analysis. *Mindfulness*, *7*(3), 713–726. https://doi.org/10.1007/s12671-016-0508-x.

Evans, D. R., Baer, R. A., & Segerstrom, S. C. (2009). The effects of mindfulness and self-consciousness on persistence. *Personality and Individual Differences*, *47*(4), 379–382. https://doi.org/10.1016/j.paid.2009.03.026.

Ferrari, J. R., Johnson, J. L., & McCown, W. G. (1995). *Procrastination and task avoidance: Theory, research, and treatment*. Springer Science & Business Media.

Ferrari, J. R., O'Callaghan, J., & Newbegin, I. (2005). Prevalence of procrastination in the United States, United Kingdom, and Australia: Arousal and avoidance delays among adults. *North American Journal of Psychology*, *7*(1), 1–6. https://link.gale.com/apps/doc/A159922620/AONE.

Flett, A. L., Haghbin, M., & Pychyl, T. A. (2016). Procrastination and depression from a cognitive perspective: An exploration of the associations among procrastinatory automatic thoughts, rumination, and mindfulness. *Journal of Rational-Emotive and Cognitive-Behavior Therapy*, *34*(3), 169–186. https://doi.org/10.1007/s10942-016-0235-1.

Flett, G. L., Blankstein, K. R., & Martin, T. R. (1995). Procrastination, negative self-evaluation, and stress in depression and anxiety: A review and preliminary model. In J. R. Ferrari, J. H. Johnson, & W. G. McCown (Eds.), *Procrastination, and task avoidance: Theory, research, and treatment* (pp. 137–167). Plenum.

Gadosey, C. K., Schnettler, T., Scheunemann, A., Fries, S., & Grunschel, C. (2021). The intraindividual co-occurrence of anxiety and hope in procrastination episodes during exam preparations: An experience sampling study. *Learning and Individual Differences*, *88*, 102013. https://doi.org/10.1016/j.lindif.2021.102013.

Gagnon, J., Dionne, F., & Pychyl, T. A. (2016). Committed action: An initial study on its association to procrastination in academic settings. *Journal of Contextual Behavioral Science*, *5*(2), 97–102. https://doi.org/10.1016/j.jcbs.2016.04.002.

Garland, E. L., Fredrickson, B., Kring, A. M., Johnson, D. P., Meyer, P. S., & Penn, D. L. (2010). Upward spirals of positive emotions counter downward spirals of negativity: Insights from the broaden-and-build theory and affective neuroscience on the treatment of emotion dysfunctions and deficits in psychopathology. *Clinical Psychology Review*, *30*(7), 849–864. https://doi.org/10.1016/j.cpr.2010.03.002.

Geldhof, G. J., Preacher, K. J., & Zyphur, M. J. (2014). Reliability estimation in a multilevel confirmatory factor analysis framework. *Psychological Methods*, *19*(1), 72–91. https://doi.org/10.1037/a0032138.

Glick, D. M., & Orsillo, S. M. (2015). An investigation of the efficacy of acceptance-based behavioral therapy for academic

procrastination. *Journal of Experimental Psychology General*, *144*(2), 400–409. https://doi.org/10.1037/xge0000050.

Gort, C., Marcusson-Clavertz, D., & Kuehner, C. (2021). Procrastination, affective state, rumination, and sleep quality: Investigating reciprocal effects with ambulatory assessment. *Journal of Rational-Emotive and Cognitive-Behavior Therapy*, *39*(1), 58–85. https://doi.org/10.1007/s10942-020-00353-4.

Granger, C. W. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica: Journal of the Econometric Society*, *37*(3), 424–438. https://doi.org/10.2307/1912791.

Grimes, B., Heisterkamp, B., Halfmann, A., & Vorderer, P. (2018). Trait mindfulness and problematic smartphone use. In D. Grimes, Q. Wang, & H. Lin (Eds.), *Empirical Studies of Contemplative Practices* (Chapter 8). Nova Science Publishers.

Hamaker, E. L., Asparouhov, T., Brose, A., Schmiedek, F., & Muthén, B. (2018). At the frontiers of modeling intensive longitudinal data: Dynamic structural equation models for the affective measurements from the COGITO study. *Multivariate Behavioral Research*, *53*(6), 820–841. https://doi.org/10.1080/00273171.2018.1446819.

Hamaker, E. L., & Wichers, M. (2017). No time like the present: Discovering the hidden dynamics in intensive longitudinal data. *Current Directions in Psychological Science*, *26*(1), 10–15. https://doi.org/10.1177/0963721416666518.

Hao, & Jin, L. (2020). Alexithymia and problematic mobile phone use: A moderated mediation model. *Frontiers in Psychology, 11*, 541507. https://doi.org/10.3389/fpsyg.2020.541507.

Howell, A. J., & Buro, K. (2011). Relations among mindfulness, achievement-related self-regulation, and achievement emotions. *Journal of Happiness Studies*, *12*(6), 1007–1022. https://doi.org/10.1007/s10902-010-9241-7.

Isham, A. E., Watson, L. A., & Dritschel, B. (2022). Sad reflections of happy times: Depression vulnerability and experiences of sadness and happiness upon retrieval of positive autobiographical memories. *Memory*, *30*(10), 1288–1301. https://doi.org/10.1080/09658211.2022.2105364.

Jha, A. P., Krompinger, J., & Baime, M. J. (2007). Mindfulness training modifies subsystems of attention. *Cognitive Affective & Behavioral Neuroscience*, *7*(2), 109–119. https://doi.org/10.3758/CABN.7.2.109.

Jung, & Song, H. (2018). The mediating effects of smartphone overuse in relation between existential vacuum and bedtime procrastination. *The Journal of Humanities and Social Sciences*, *21*(4), 441–456. https://doi.org/10.22143/HSS21.9.4.33.

Kabat-Zinn, J. (2010). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology Science & Practice*, *10*(2), 144–156. https://doi.org/10.1093/clipsy/bpg016.

Kim, K. R., & Seo, E. H. (2015). The relationship between procrastination and academic performance: A meta-analysis. *Personality and Individual Differences*, *82*, 26–33. https://doi.org/10.1016/j.paid.2015.02.038.

Klibert, J., Langhinrichsen-Rohling, J., Luna, A., & Robichaux, M. (2011). Suicide proneness in college students: Relationships with gender, procrastination, and achievement motivation. *Death Studies*, *35*(7), 625–645. https://doi.org/10.1080/07481187.2011.553311.

Kroese, F. M., De Ridder, D. T., Evers, C., & Adriaanse, M. A. (2014). Bedtime procrastination: Introducing a new area of procrastination. *Frontiers in Psychology*, *5*, 661. https://doi.org/10.3389/fpsyg.2014.00611.

Kühnel, Syrek, C. J., & Dreher, A. (2018). Why don't you go to bed on time? A daily diary study on the relationships between chronotype, self-control resources and the phenomenon of bedtime procrastination. *Frontiers in Psychology*, *9*, 77. https://doi.org/10.3389/fpsyg.2018.00077.

Li, L. I., & Mu, L. I. (2020). Effects of mindfulness training on psychological capital, depression, and procrastination of the youth demographic. *Iranian Journal of Public Health*, *49*(9), 1692–1700. https://doi.org/10.18502/ijph.v49i9.4086.

Lindsay, E. K., & Creswell, J. D. (2017). Mechanisms of mindfulness training: Monitor and Acceptance Theory (MAT). *Clinical Psychology Review*, *51*, 48–59. https://doi.org/10.1016/j.cpr.2016.10.011.

Loewenstein, G., & Prelec, D. (1992). Anomalies in intertemporal choice: Evidence and an interpretation. *The Quarterly Journal of Economics*, *107*(2), 573–597. https://doi.org/10.2307/2118482.

Lyubomirsky, S., & Tkach, C. (2003). The consequences of dysphoric rumination. *Depressive Rumination: Nature Theory and Treatment*, 21–41. https://doi.org/10.1002/9780470713853.

MacDonald, H. Z. (2021). Associations of five facets of mindfulness with self-regulation in college students. *Psychological Reports*, *124*(3), 1202–1219. https://doi.org/10.1177/0033294120937438.

MacDonald, H. Z., & Baxter, E. E. (2017). Mediators of the relationship between dispositional mindfulness and psychological well-being in female college students. *Mindfulness*, *8*(2), 398–407. https://doi.org/10.1007/s12671-016-0611-z.

Meier, A., Reinecke, L., & Meltzer, C. E. (2016). Facebocrastination? Predictors of using Facebook for procrastination and its effects on students' well-being. *Computers in Human Behavior*, *64*, 65–76. https://doi.org/10.1016/j.chb.2016.06.011.

Muthén, L. K., & Muthén, B. O. (2017). *Mplus user's guide* (8th ed.). Muthén & Muthén.

Pollack, S., & Herres, J. (2020). Prior day negative affect influences current day procrastination: A lagged daily diary analysis. *Anxiety Stress and Coping*, *33*(2), 165–175. https://doi.org/10.1080/10615806.2020.1722573.

Rahimi, S., Hall, N. C., & Pychyl, T. A. (2016). Attributions of responsibility and blame for procrastination behavior. *Frontiers in Psychology*, *7*, 1179. https://doi.org/10.3389/fpsyg.2016.01179.

Rebetez, M. M. L., Rochat, L., Barsics, C., & van der Linden, M. (2016). Procrastination as a self-regulation failure: The role of inhibition, negative affect, and gender. *Personality and Individual Differences*, *101*, 435–439. https://doi.org/10.1016/j.paid.2016.06.049.

Revelle, W. R. (2017). *psych: Procedures for personality and psychological research.* https://www.scholars.northwestern.edu/en/publications/psych-procedures-for-personality-and-psychological-research

Richards, C., Bouman, W. P., Seal, L., Barker, M. J., Nieder, T. O., & Sjoen, T., G (2016). Non-binary or genderqueer genders. *International Review of Psychiatry*, *28*(1), 95–102. https://doi.org/10.3109/09540261.2015.1106446.

Schouwenburg, H. C., & Groenewoud, J. (2001). Study motivation under social temptation: Effects of trait procrastination. *Personality and Individual Differences*, *30*, 229–240. https://doi.org/10.1016/S0191-8869(00)00034-9.

Schroevers, M. J., & Brandsma, R. (2010). Is learning mindfulness associated with improved affect after mindfulness-based cognitive therapy? *The British Journal of Psychology*, *101*(1), 95–107. https://doi.org/10.1348/000712609X424195.

Shapiro, S. L., Carlson, L. E., Astin, J. A., & Freedman, B. (2006). Mechanisms of mindfulness. *Journal of Clinical Psychology*, *62*(3), 373–386. https://doi.org/10.1002/jclp.20237.

Simpson, W. K., & Pychyl, T. A. (2009). In search of the arousal procrastinator: Investigating the relation between procrastination, arousal-based personality traits and beliefs about procrastination motivations. *Personality and Individual Differences*, *47*(8), 906–911. https://doi.org/10.1016/j.paid.2009.07.013.

Sirois, F. M., & Stout, D. (2011). *When knowing better doesn't mean doing better: Understanding the roles of procrastination and self-blame in the health and well-being of nurses*

Sirois, F. M., & Tosti, N. (2012). Lost in the moment? An investigation of procrastination, mindfulness, and well-being. *Journal of Rational-Emotive and Cognitive-Behavior Therapy*, *30*(4), 237–248. https://doi.org/10.1007/s10942-012-0151-y.

Sirois, F., & Pychyl, T. (2013). Procrastination and the priority of short-term mood regulation: Consequences for future self. *Social and Personality Psychology Compass*, *7*(2), 115–127. https://doi.org/10.1111/spc3.12011.

Solomon, L. J., & Rothblum, E. D. (1984). Academic procrastination: Frequency and cognitive-behavioral correlates. *Journal of Counseling Psychology*, *31*, 503–509. https://doi.org/10.1037/0022-0167.31.4.503.

Steel, P. (2007). The nature of procrastination: A meta-analytic and theoretical review of quintessential self-regulatory failure. *Psychological Bulletin*, *133*(1), 65–94. https://doi.org/10.1037/0033-2909.133.1.65.

Steel, P. (2011). *The procrastination equation: How to stop putting things off and start getting stuff done* (2nd ed.). Harper.

Steel, P., & König, C. J. (2006). Integrating theories of motivation. *The Academy of Management Review*, *31*(4), 889–913. https://doi.org/10.5465/AMR.2006.22527462.

Sternberg, N., Luria, R., Chandhok, S., Vickers, B., Kross, E., & Sheppes, G. (2020). When facebook and finals collide-procrastinatory social media usage predicts enhanced anxiety. *Computers in Human Behavior*, *109*, 106358. https://doi.org/10.1016/j.chb.2020.106358.

Tice, D. M., & Bratslavsky, E. (2000). Giving in to feel good: The place of emotion regulation in the context of general self-control. *Psychological Inquiry*, *11*(3), 149–159. https://doi.org/10.1207/S15327965PLI1103_03.

Tice, D. M., Bratslavsky, E., & Baumeister, R. F. (2001). Emotional distress regulation takes precedence over impulse control: If you feel bad, do it. *Journal of Personality and Social Psychology*, *80*, 53–67. https://doi.org/10.1037/0022-3514.80.1.53.

Tuckman, B. W. (1991). The development and concurrent validity of the procrastination scale. *Educational and Psychological Measurement*, *51*(2), 473–480. https://doi.org/10.1177/0013164491512022.

Wang, S., Zhou, Y., Yu, S., Ran, L. W., Liu, X. P., & Chen, Y. F. (2017). Acceptance and commitment therapy and cognitive–behavioral therapy as treatments for academic procrastination: A randomized controlled group session. *Research on Social Work Practice*, *27*(1), 48–58. https://doi.org/10.1177/1049731515577890.

Wohl, M. J., Pychyl, T. A., & Bennett, S. H. (2010). I forgive myself, now I can study: How self-forgiveness for procrastinating can reduce future procrastination. *Personality and Individual Differences*, *48*(7), 803–808. https://doi.org/10.1016/j.paid.2010.01.029.

Wolters, C. A. (2003). Understanding procrastination from a self-regulated learning perspective. *Journal of Educational Psychology*, *95*(1), 179–187. https://doi.org/10.1037/0022-0663.95.1.179.

Zhou, J., Song, X., & Liao, Q. (2021). The Chinese Version of the Multidimensional State Mindfulness Questionnaire. *Chinese Journal of Applied Psychology*, *27*(4), 358–367. https://doi.org/10.3969/j.issn.1006-6020.2021.04.008.