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Understanding academic procrastination: A Longitudinal analysis of procrastination and emotions in undergraduate and graduate students

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Abstract

The research presented in this paper examined the relationships between academic procrastination and learning-specific emotions, and how these variables predict one another over time among undergraduate ($n = 354$) and graduate students ($n = 816$). Beyond findings showing expected valences of relations between procrastination and positive emotions (enjoyment, hope, and pride) and negative emotions (anger, anxiety, shame, hopelessness, boredom, and guilt), autoregressive cross-lagged panel analyses showed various directional relations between procrastination and emotions over time. More precisely, specific emotions were found to influence procrastination (e.g., undergraduates: anxiety; graduate students: hope), procrastination was found to influence specific emotions (e.g., undergraduates: guilt; graduate students: boredom), and bidirectional relations between procrastination and learning-related emotions were also observed (e.g., graduate students: enjoyment, anxiety, and guilt). Implications for future research on academic procrastination and remedial procrastination interventions for students are discussed.

Keywords Academic procrastination · Academic emotions · Undergraduate students · Graduate students · Longitudinal

"You cannot escape the responsibility of tomorrow by evading it today".
Abraham Lincoln.

Procrastination is formally defined as the *voluntary and unnecessary delay of a given intended action, despite the expectation of unpleasant and/or negative consequences* (Steel, 2007). Whereas procrastination in general refers to delaying intended tasks in everyday life (e.g., taxes or doctor visits), academic procrastination occurs when students procrastinate specifically on their academic tasks (e.g., writing papers, preparing for exams, and doing weekly readings; Solomon & Rothblum, 1984). Instead of working on academic assignments, students opt to do other activities such as eat, sleep, watch television, or play games (Klassen

et al., 2010; Pychyl et al., 2000). However, the nomological network of procrastination reveals that procrastination is negatively related with positive states and positively related with negative states (van Eerde, 2003). Academic procrastination negatively impacts students' education (e.g., academic performance, Kim & Seo, 2015; Moon & Illingworth, 2005), health (e.g., psychological distress, Peixoto et al., 2021; Sirois & Pychyl, 2013; physical health, Tice & Baumeister, 1997), and emotional well-being (e.g., negative emotions, Ariani & Susilo, 2018; Constantin et al., 2018; Gadosey et al., 2021; Rahimi & Vallerand, 2021; Reinecke et al., 2021; Yang et al., 2021). Therefore, given the significant negative influence of academic procrastination on students' lives, it is important to have a clear understanding of the nature of this behaviour. Negative emotions have been frequently assessed alongside procrastination however the directionality of their associations has yet to be empirically established (e.g., one influencing the other, if they are co-occurring, or if a sequential relationship exists). Thus, the main objective of the present research was to longitudinally assess the associations between academic procrastination and a variety of academic emotions among both undergraduate and graduate students.

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Theoretical perspectives of procrastination

Academic procrastination has been described as a failed "should-want" conflict in which students set an intention to complete a task yet fail to act upon this plan resulting in the *intention-action gap* (Bazerman et al., 1998; Pychyl, 2013). For example, imagine a student who plans to do their homework on Monday (i.e., setting an *intention*) but on Monday goes against their plan and instead watches television thereby needlessly putting off their task (i.e., *failing to act* on their previously set intention). Procrastination has also been theoretically conceptualized as "quintessential self-regulation failure" (Steel, 2007, p. 65, see also Baumeister & Heatherton, 1996; Howell & Watson, 2007). In contrast to effective self-regulation in which students plan, monitor, and adjust their behaviours as necessary, procrastination reflects an inability to regulate one's behaviours, with respect to starting, keeping on track, and completing a given task.

Researchers have posited two explanations as to why this self-regulation failure occurs. The first explanation frames procrastination as a form of *underregulation*, indicative of poor self-regulation skills (Balkis & Duru, 2016; Howell & Watson, 2007; Senécal et al., 1995), wherein students engage in procrastination because they are unable to employ the necessary self-control to do or complete a task. Students who frequently procrastinate are thus assumed to be less able to effectively use cognitive and motivational strategies as compared to students who less frequently procrastinate who are better able to plan, monitor, and evaluate their work (Park & Sperling, 2012). This assumption is also supported by research showing student procrastination to relate to poorer levels of motivation, planning, organization, and execution (Howell & Watson, 2007; Rabin et al., 2011).

In contrast, other researchers have described self-regulation failure as a form of *misregulation* whereby students focus on regulating negative emotions caused by their tasks as opposed to regulating behaviours that are necessary for goal attainment (Balkis & Duru, 2016; Baumeister & Heatherton, 1996; Sirois & Pychyl, 2013). Accordingly, this type of self-regulation failure involves prioritizing emotional regulation and/or mood repair over goal accomplishment (Pychyl & Sirois, 2016). For example, imagine a student who begins to write a paper, but suddenly starts to experience negative emotions (e.g., anxiety). To remedy their affective state (reduce the anxiety) this student stops writing their paper and decides to do something else instead such as watching television.

Understanding how students' emotions relate to their procrastination is of particular interest in that there appears to be an integral paradox (Pychyl et al., 2000). Students use procrastination as a way of regulating negative emotions elicited by undesirable tasks by placing value on short-term mood repair over task completion (Pychyl, 2013). This temporary reduction of negative emotions also results in compromised long-term goals. By engaging in academic procrastination, students are not simply shifting the burden of completing the task and the accompanying stress from the present to a future date, they are also increasing the severity of stress experienced closer to the academic deadline (Tice & Baumeister, 1997). Therefore, not only is procrastination used as a means of avoiding negative emotions, but procrastination may also lead to or exacerbate negative emotions.

Academic emotions

Students' academic emotions are defined as emotions related to achievement activities and/or outcomes (Pekrun, 2006). Such emotions impact the motivational, cognitive, and monitoring processes involved in students' learning and performance, and further influence their psychological well-being and overall life satisfaction (Pekrun, 2006). The role of emotions in educational settings has most explicitly been examined to date as part of the Control-Value Theory of Achievement Emotions (Pekrun, 2006). According to this model, emotions can be subdivided in two ways. First, emotions can be sorted based on valence (positive vs. negative), and activation (action vs. disengaging). In terms of valence, positive emotions refer to more pleasant emotions such as enjoyment, while negative emotions refer to unpleasant emotions such as anxiety. In terms of activation, positive emotions are outlined in this model as either activating (i.e., increase in physiological measures of arousal, such as heart rate when experiencing enjoyment, Pekrun, 2014) or deactivating in nature (i.e., decrease in physiological arousal, such as relaxation when experiencing relief). Positive activating emotions are assumed to draw attention to the learning task, and increase flow, motivation, interest, the use of effective learning strategies, and efficient self-regulated learning (Pekrun, 2014). Similarly, negative emotions may also be either activating (i.e., increased heart rate when experiencing anxiety, anger, or shame) or deactivating (i.e., decreased arousal when experiencing boredom or hopelessness). Both activating and deactivating negative emotions can draw students' attention away from the learning process (e.g., anxiety due to bad grade leading to worry about future failure, boredom leading to daydreaming instead of studying). Negative emotions can also influence subsequent motivation levels, with activating emotions such as anxiety reducing interest and deactivating negative emotions such as boredom reducing persistence (Pekrun, 2014). However, negative emotions

can trigger extrinsic motivation in students who want to avoid failure (Pekrun et al., 2017).

Second, this model differentiates emotions according to the type of academic element the emotion is focused on (learning activity vs. achievement outcome) and their temporal focus (future vs. past). Prospective outcome emotions pertain to future achievement outcomes (e.g., hope, anxiety concerning an upcoming test) and are determined by a students' perceived control over academic outcomes. Retrospective outcome emotions pertain to past achievement outcomes (e.g., guilt or relief after receiving test feedback) and are determined by students' perceptions as to the distinct causes of their performance, specifically if they believe these outcomes to be caused by themselves, or other people (cf. locus of control, Rotter, 1966; causal attributions, Weiner, 1985). Finally, activity emotions are predicted by appraisals of control and value. Activity-related emotions focus on students' learning behaviours rather than outcomes (e.g., boredom or enjoyment while studying; similar to "flow"; Csikszentmihalyi, 2000).

With respect to potential links between Pekrun's Control-Value Theory of Achievement Emotions and procrastination behaviours, students' emotional experiences when studying outside of the classroom (vs. learning in class or taking tests) should be relevant to procrastination given that behaviour is specifically disruptive of the studying/learning process. Maladaptive behaviours such as procrastination should correspond with negative emotions, and positive emotions should also be significantly negatively related to procrastination due to demonstrated links between positive emotions and optimized learning processes. The Control-Value Theory offers a useful starting point for delimiting the types of emotions potentially related to academic procrastination.

The present research

The overarching aim of the present research was to examine the relationships between academic procrastination and academic emotions in both undergraduate and graduate students. As outlined in the preceding introduction section, procrastination has been examined alongside certain emotions (e.g., anxiety, guilt), yet several gaps in the current literature on this topic remain unexplored. First, whereas researchers have commonly described procrastination and emotions in terms of their assumed roles as antecedents or consequences, findings to date have primarily been correlational in nature. Just as a positive correlation between anxiety and academic procrastination may suggest that students engage in procrastination because they have anxiety, it may also suggest that their anxiety is causing procrastination. Second, existing research on academic procrastination in relation to students' emotional experiences is further limited

in that studies have to date explored only a limited range of emotions, with an emphasis on anxiety and related constructs (e.g., stress, worry). Third, most studies focus only on undergraduate students and research on graduate students' procrastination are scant (e.g., Alexander & Onwuegbuzie, 2007; Cao, 2012; Onwuegbuzie, 2000, 2004; Rahimi & Hall, 2021). To remedy these issues, the present research utilized a longitudinal methodological approach wherein the reciprocal linkages between academic procrastination and a range of specific learning-related emotions could be explored with both undergraduate and graduate students.

The first objective of this research was to examine the relationships between students' procrastination and achievement emotions (learning-related emotions, Pekrun, 2006; and guilt, e.g., Oflazian & Borders, 2022; Pychyl et al., 2000; Schraw et al., 2007). With this goal in mind, zero-order correlations between all study variables were investigated. Overall, it was anticipated that positive emotions (i.e., enjoyment, hope, and pride) would be negatively associated with academic procrastination (Hypothesis 1a), whereas negative emotions (i.e., anger, anxiety, shame, hopelessness, boredom, and guilt) would be positively associated with academic procrastination (Hypothesis 1b). Positive emotions were assumed to correlate negatively with procrastination due to previous research showing such results (e.g., positive affect, Rahimi & Vallerand, 2021; enjoyment, positive correlation between task aversiveness and procrastination, Solomon & Rothblum, 1984; hope, Alexander & Onwuegbuzie, 2007; Zhou & Kam, 2016). As no previous studies have examined the correlations between pride and academic procrastination, this emotion was also hypothesized to correlate negatively with academic procrastination given the findings with other positive emotions showing negative associations with procrastination. Negative emotions were assumed to correlate positively with procrastination based on previous research (e.g., negative affect, Rahimi & Vallerand, 2021; anger, Ferrari & Olivette, 1994; anxiety, e.g., Constantin et al, 2018; Glick et al., 2014; Solomon & Rothblum, 1984; writing anxiety, Fritzsche et al., 2003; statistics anxiety, Macher et al., 2012; test and class anxiety, Ariani & Susilo, 2018; Onwuegbuzie, 2000, 2004; Saddler & Buley, 1999; shame, Fee & Tangney, 2000; Martinčeková & Enright, 2018; boredom, Blunt & Pychyl, 1998; Ferrari, 2000; Vodanovich & Rupp, 1999; and guilt, Hensley, 2016; Pychyl et al., 2000; Reinecke et al., 2014; Schraw et al., 2007). Lastly, although no previous studies have examined the correlation between hopelessness and procrastination, hopelessness was hypothesized to positively correlate with academic procrastination given negative relations between procrastination and hope (Alexander & Onwuegbuzie, 2007; Gadosey et al., 2021) and research showing positive relations between academic procrastination and other negative emotions.
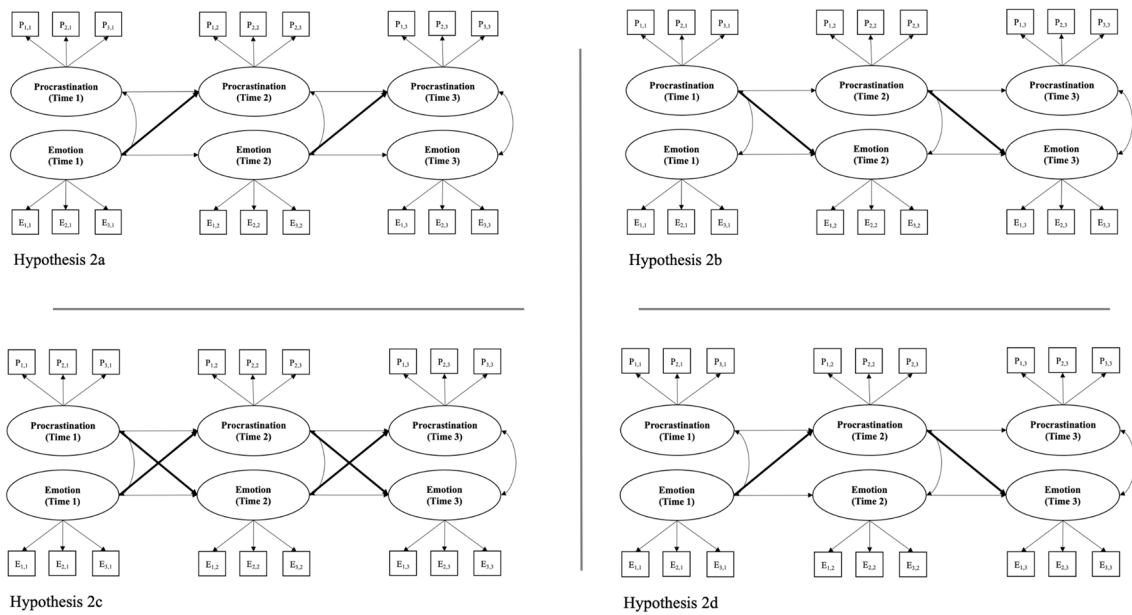
Fig. 1 Hypothesized cross-lagged models showing predictive relationships between academic procrastination and a given emotion

The second objective of the present research was to examine the directionality of the relationship between academic procrastination and academic emotions to ascertain whether students' emotional experiences are best understood as influencing or being influenced by their procrastination, or if a bidirectional relationship exists between these processes. To accomplish this goal, multiple sets of autoregressive cross-lagged panel analyses were examined in which procrastination was evaluated longitudinally alongside a range of specific achievement-related emotions. Four competing hypotheses regarding the directionality of effects were examined (please see Fig. 1 below). With respect to the specific valances implied in each directional hypothesis, negative emotions were hypothesized to positively predict academic procrastination, whereas positive emotions were assumed to negatively predict academic procrastination.

The first directional hypothesis was that emotions could predict academic procrastination (Hypothesis 2a). Moreover, following from the misregulation hypothesis (Balkis & Duru, 2016; Baumeister & Heatherton, 1996; Sirois & Pychyl, 2013), students would be expected to engage in procrastination to relieve their preceding negative emotions, meaning that emotions such as anger, anxiety, shame, hopelessness, boredom, and guilt should precede academic procrastination. Similarly, higher levels of positive emotions (enjoyment, hope, and pride) could also negatively predict subsequent academic procrastination, given findings suggesting that students who engage in procrastination do so because of a lack of interest in their tasks (lack of enjoyment of learning; Solomon & Rothblum, 1984).

It was additionally hypothesized that procrastination could predict emotions (Hypothesis 2b), following mainly from research on academic procrastination that has found procrastination to predict negative emotions, such as anxiety (e.g., regression analyses between procrastination and test anxiety, Saddler & Buley, 1999). Similarly, it is reasonable to anticipate that academic procrastination could lead to other negative emotions such as anger, shame, hopelessness, boredom, or guilt given that they share an underlying negative valence with anxiety. Conversely, higher levels of academic procrastination could also be expected to negatively predict positive learning-related emotions of opposite valence to anxiety (enjoyment, hope, and pride).

Concurrent directional relationships between academic procrastination and emotions were also testable hypotheses, such that the effects of each variable on the other may be observed simultaneously (Hypothesis 2c). This hypothesis was informed by findings from Balkis & Duru (2016) that showed negative affect (e.g., fear, irritability, and nervousness) to be not only predicted by procrastination, but to also predict subsequent procrastination levels. This hypothesis asserts that significant relationships could be expected from procrastination at one assessment (e.g., Time 1) to emotions at the next (e.g., Time 2), and similarly, from emotions at the same initial assessment (e.g., Time 1) to procrastination at the next (e.g., Time 2).

Lastly, sequential relationships between procrastination and emotions were also hypothesized, such that one variable could predict the other at different times throughout the year (mediation hypothesis, Hypothesis 2d). This hypothesis follows from existing literature showing students' anxiety to both

Table 1 Psychometric properties of the study variables

Variable	Undergraduate students									Graduate students								
	M			SD			α			M			SD			α		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
Academic procrastination	3.05	3.07	3.13	0.68	0.67	0.75	.86	.86	.89	2.97	3.01	3.02	0.66	0.66	0.72	.86	.85	.88
Academic emotions																		
Enjoyment	3.32	3.27	3.23	0.79	0.72	0.80	.85	.84	.88	3.47	3.37	3.33	0.73	0.72	0.72	.81	.82	.84
Hope	3.15	3.15	3.14	0.86	0.78	0.89	.83	.83	.88	3.21	3.19	3.21	0.86	0.88	0.84	.82	.85	.85
Pride	3.41	3.41	3.38	0.87	0.84	0.85	.82	.79	.80	3.49	3.42	3.45	0.83	0.85	0.87	.81	.83	.86
Anger	2.24	2.16	2.12	0.89	0.89	0.89	.86	.88	.89	2.04	2.02	1.95	0.85	0.85	0.80	.87	.89	.89
Anxiety	3.02	3.01	2.93	0.95	0.89	1.03	.85	.84	.90	3.02	2.96	2.91	0.94	0.95	0.95	.87	.88	.90
Shame	2.89	2.92	2.92	1.06	1.05	1.15	.91	.91	.94	2.82	2.84	2.75	1.07	1.10	1.10	.91	.92	.94
Hopelessness	2.46	2.43	2.51	1.06	1.09	1.15	.91	.93	.94	2.37	2.39	2.34	1.05	1.09	1.08	.91	.93	.93
Boredom	2.60	2.42	2.37	1.00	0.93	0.95	.91	.93	.94	2.31	2.29	2.21	0.87	0.89	0.86	.89	.92	.92
Guilt	2.81	2.61	2.48	1.10	1.12	1.09	.88	.91	.90	2.89	2.77	2.65	1.06	1.09	1.11	.87	.88	.90

Please note that all psychometric values were calculated using the parcels and not derived from the individual items

predict (Saddler & Buley, 1999) and be predicted by academic procrastination (Solomon & Rothblum, 1984) and is closely derived from research suggesting that whereas procrastination early in the semester may be related to low levels of stress, procrastination later in the term is related to higher levels of stress (Tice & Baumeister, 1997).

Method

Procedures

The present research involved two three-phase longitudinal studies. Undergraduate students and graduate students were recruited online to complete a questionnaire consisting of the following measures: demographic items, academic procrastination (APSI: Academic Procrastination State Inventory, Schouwenburg, 1992), learning-related achievement emotions (AEQ: Achievement Emotions Questionnaire, Pekrun et al., 2002), as well as an assessment of guilt (Harder & Lewis, 1987). Data was collected online with a one-month lag between each assessment (September, October, and November). The study was approved by the first author's institutional Research Ethics Board and participants were asked to provide informed consent before starting the questionnaire. Please see Table 1 for an overview of the psychometric properties of the study variables for both undergraduate and graduate students.

Measures

Academic procrastination

The Academic Procrastination State Inventory (APSI, Schouwenburg, 1992) was used to assess students' academic

procrastination (13 items, academic procrastination frequency subscale, e.g., "Prepared to study at some point of time but did not get any further"). The scale preamble asked students to indicate how frequently last week they engaged in the following behaviors or thoughts on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*always*). One of the items was reverse coded ("Studied the subject matter that you had planned to do").

Academic emotions

Students' academic emotions were assessed using two measures. Academic emotions were evaluated using a subset of 75 items from the *Achievement Emotions Questionnaire* (AEQ; Pekrun et al., 2002), that pertained specifically to learning in academic contexts. The scale preamble was the following: "Below are specific questions about emotions you may experience while studying. Before answering the questions on the following pages, please recall some typical situations of studying which you have experienced during the course of your studies." The following learning-related emotions were assessed: enjoyment (10 items, e.g., "I look forward to studying"), hope (6 items; e.g., "I have an optimistic view toward studying"), pride (6 items, e.g., "I am proud of myself"), anger (9 items, e.g., "I get angry when I have to study), anxiety (11 items, e.g., "When I look at the books I have to read, I get anxious"), shame (11 items, e.g., I feel ashamed"), hopelessness (11 items, e.g., "I feel hopeless when I think about studying), and boredom (11 items, e.g., "The material bores me to death"). All items were answered on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Students were also asked to complete a subset of items from the *Personal Feelings Questionnaire-2*

(PFQ-2; Harder & Lewis, 1987) assessing students' guilt (an emotion not included in the AEQ but examined previously in relation to procrastination; Pychyl et al., 2000). Students were asked to answer 6 items (e.g., "Feeling you deserve criticism for what you did") on a 5-point Likert scale ranging from 1 (*I do not experience the feeling*) to 5 (*I experience the feeling continuously or almost continuously*).

Statistical analyses

The present research examined the cross-lagged effects of academic procrastination and several emotions across three different time points, directly comparable to those of other studies in educational psychology in which cross-lagged relations between motivation and emotion constructs have been investigated (e.g., boredom and achievement in students, Pekrun et al., 2014; teachers' goals and emotions, Wang et al., 2017). A total of 9 cross-lagged models were examined, each including academic procrastination (Times 1–3) and a given emotion (Times 1–3) for each population. To examine the goodness-of-fit of the model, absolute and incremental fit indices were assessed including the Root Mean Square Error of Approximation (RMSEA), the Standardized Root Mean Residual (SRMR; ideal range for our sample size: < 0.08 when CFI is $>/= .92$), the Tucker Lewis Index (TLI), and the Comparative Fit Index, (CFI; ideal range for our sample size: $>/= .92$; Hair et al., 2010). The datasets analysed in this research are not publicly available due to privacy but are available from the corresponding author on reasonable request.

Each emotion variable was evaluated separately in relation to procrastination to reduce the number of parameters estimated in each model (optimize parsimony), and minimize potential multicollinearity between the emotion variables, given that some emotions were highly correlated with one another (e.g., shame and anxiety, $r = .74$). Autoregressive paths between the same latent variable (e.g., procrastination from Time 1 → Time 2, and Time 2 → Time 3) were included to assess construct stability. The error terms were correlated between all parallel manifest parcel variables to control for persistent response bias (e.g., error term of procrastination parcel 1 at Time 1 was correlated with the error term for procrastination parcel 1 at Time 2, and the error term for procrastination parcel 1 at Time 3, Little et al., 2007). Cross-paths from procrastination at Time X to a given emotion at Time X+1 were also modelled to examine the potential influence of one construct on the other accounting for autoregressive paths. Nonsignificant paths are not displayed in the figures below for the sake of parsimony. Covariances between the latent variables assessed at the same time point were also modelled (e.g., Time 1 procrastination < – > Time 1 anxiety). Given that the same procrastination variable was being used in several models (9

in each sample), results should be interpreted with caution when the *p*-value was not equal to or below .001 (indicated with three asterisks).

Participants

The first sample consisted of 354 undergraduate students who were recruited from 57 countries around the world and most of the participants were enrolled full-time (92.4%) from Canadian (17.6%) or American (35.2%) institutions. This sample consisted of 259 females (73.4%), 81 males (22.9%), and 13 gender variant/non-conforming/neutrois individuals (3.7%). Ages ranged from 17 to 45 years old (*M*age = 22.28), 64.9% of the students stated that English was their first language, and 15% identified as an international student. Undergraduate participants reported being mostly single (61.2%) or in a serious relationship (31%), with 4.9% reported having children. Most participants held a high school degree (69.8%), or a bachelor's degree (28.2%), and most participants were in their fourth (30.8%), third (24.3%), or second year (20.6%) of their undergraduate studies.

The second sample consisted of 816 graduate students[1] who were recruited online from 75 countries around the world. Most participants were enrolled full-time (87.1%) at Canadian (13.3%) or American post-secondary institutions (41.2%). The sample consisted of 652 females (80.3%), 140 males (17.2%), and 20 gender variant/non-conforming/agender/unidentified individuals (2.4%). Ages ranged from 20 to 71 years old (*M*age = 29.11), 66.3% of the students stated that English was their first language, and 25.4% identified as an international student. Graduate student participants reported being mostly single (39.8%) or in a serious relationship (34%), and 11.3% reported having children. Most participants held a bachelor's degree (38.2%) or a master's degree (54.5%) and were currently in either their first (15.8%) or second year (22.2%) in their master's program, or PhD (first year, 12.5%; second year, 13.2%).

Data screening and preliminary analyses

In accordance with Tabachnick & Fidell (2007), several steps were taken to ensure that the data were sufficiently cleaned and that underlying assumptions of parametric testing were met prior to conducting analyses. Age and gender were considered as covariates given that these variables have been shown in previous research to correspond with procrastination (e.g., Deemer et al., 2014; Kim & Seo, 2015;

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[1] Participants were deleted from the sample if they indicated being either a postdoctoral student or having already graduated from their graduate program. The final sample was 816.

Table 2 Zero-order correlations among study variables at time 1 for undergraduate students

	1	2	3	4	5	6	7	8	9
1. Procrastination	1								
2. Enjoyment	− .19**	1							
3. Hope	− .29***	.66***	1						
4. Pride	− .24***	.69***	.75***	1					
5. Anger	.44***	− .27***	− .36***	− .19**	1				
6. Anxiety	.35***	.09	− .32***	− .16**	.48***	1			
7. Shame	.32***	.08	− .33***	− .21**	.37***	.76***	1		
8. Hopelessness	.45***	− .06	− .47***	− .36***	.56***	.79***	.79***	1	
9. Boredom	.46***	− .39***	− .25***	− .19**	.72***	.20**	.11	.30***	1
10. Guilt	.39***	.05	− .24***	− .19**	.29***	.59***	.57***	.56***	.11

$^*p < .05$, $^{**}p < .01$, $^{***}p < .001$

Table 3 Zero-order correlations among study variables at time 1 for graduate students

	1	2	3	4	5	6	7	8	9
1. Procrastination	1								
2. Enjoyment	− .28***	1							
3. Hope	− .40***	.64***	1						
4. Pride	− .27***	.68***	.66***	1					
5. Anger	.43***	− .33***	− .37***	− .20***	1				
6. Anxiety	.50***	− .14***	− .47***	− .23***	.54***	1			
7. Shame	.47***	− .15**	− .49***	− .28***	.44***	.74***	1		
8. Hopelessness	.54***	− .30***	− .60***	− .42***	.55***	.76***	.80***	1	
9. Boredom	.40***	− .42***	− .27***	− .18***	.64***	.24***	.22***	.34***	1
10. Guilt	.48***	− .10*	− .35***	− .23***	.34***	.57***	.59***	.62***	.15***

$^*p < .05$, $^{**}p < .01$, $^{***}p < .001$

Prohaska et al., 2000; Steel, 2007; van Eerde, 2003), but no significant associations were found. Latent variable modeling was used to examine hypothesized relations. Parceling was proposed as a method to reduce the number of parameters to be estimated for each model (comparable to other studies, e.g., Hall et al., 2016). Exploratory factor analyses (EFA's) did not provide empirical evidence to inform how parcels should be created, thus it was decided to group items into a small number of indicators (parcels) using the random parceling approach in each model (please see Appendix for more information on parceling).

Results

Correlations

For undergraduate students, zero-order correlations (Table 2) showed academic procrastination to be negatively correlated with enjoyment, hope, and pride, and positively correlated with anger, anxiety, shame, hopelessness, boredom, and guilt. Among the positive emotions, hope and pride were strongly related to one another, whereas for negative emotions, anxiety had the strongest correlation with hopelessness and shame. For graduate students, zero-order correlations between all study variables (Table 3) showed academic procrastination to be significantly negatively related to enjoyment, hope, and pride, and positively related to anger, anxiety, shame, hopelessness, boredom, and guilt. Concerning the correlations between the positive emotions, enjoyment, hope, and pride were all positively related to one another. In addition, all negative emotions were positively related to one another, with the strongest correlations observed between anxiety and shame and anxiety and hopelessness. Also, positive emotions were all negatively related to negative emotions (e.g., enjoyment and anger, hope and anxiety).

Main analyses

Factorial invariance was assessed using a longitudinal confirmatory factor analysis approach where equality constraints are placed on the parameters of each model (i.e., configural invariance: equivalence of model form; metric (weak) invariance: equivalence of the factor loadings, and scalar (strong) invariance: equivalence of the item intercepts, Little, 2013;

Table 4 Model fit indices (undergraduate students)

Model	χ^2 (df)	p	CFI	TLI	SRMR	RMSEA [90% CI]
Undergraduate students						
Enjoyment	143.275(122)	= .09	.990	.987	.075	.023 [.000−.038]
Hope	168.646(122)	< .01	.978	.972	.062	.035 [.021−.047]
Pride	166.778(122)	< .01	.977	.971	.068	.034 [.020−.046]
Anger	201.355(122)	< .01	.966	.958	.060	.045 [.034−.056]
Anxiety	167.643(122)	< .01	.981	.976	.067	.034 [.020−.046]
Shame	135.884(122)	= .18	.995	.993	.052	.019 [.000−.035]
Hopelessness	236.326(122)	< .01	.961	.951	.067	.054 [.044−.064]
Boredom	174.604(122)	< .01	.981	.976	.054	.037 [.024−.049]
Guilt	127.061(122)	= .36	.998	.997	.049	.011 [.000−.030]

Table 5 Model fit indices (graduate students)

Model	χ^2 (df)	p	CFI	TLI	SRMR	RMSEA [90% CI]
Graduate students						
Enjoyment	224.069(122)	< .01	.982	.977	.050	.033 [.026−.039]
Hope	198.060(122)	< .01	.987	.984	.045	.028 [.021−.035]
Pride	238.117(122)	< .01	.979	.974	.063	.035 [.028−.042]
Anger	292.002(122)	< .01	.973	.967	.056	.042 [.036−.049]
Anxiety	212.759(122)	< .01	.986	.982	.040	.031 [.024−.038]
Shame	200.328(122)	< .01	.990	.987	.040	.029 [.021−.036]
Hopelessness	270.841(122)	< .01	.981	.976	.049	.040 [.033−.046]
Boredom	260.173(122)	< .01	.980	.975	.047	.038 [.032−.045]
Guilt	187.908(122)	< .01	.989	.986	.042	.026 [.019−.034]

Fig. 2 Cross-lagged results for procrastination and hope in undergraduate students. *p < .05, **p < .01, ***p < .001. Nonsignificant paths are not displayed for parsimony
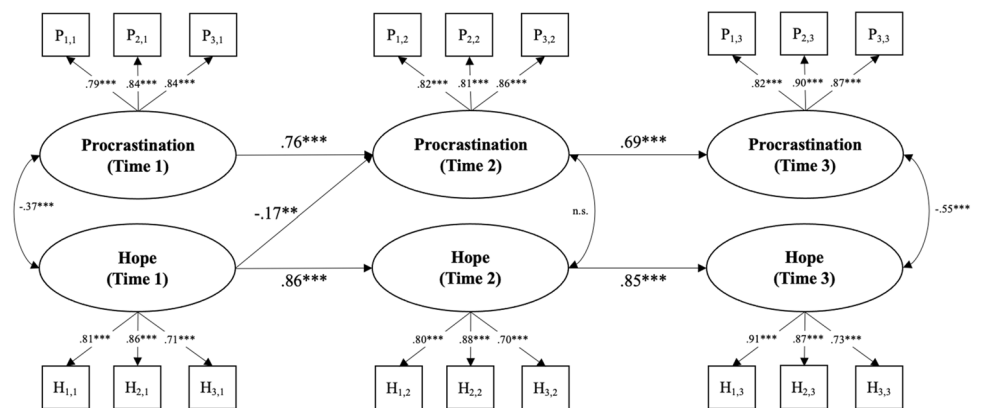
Putnick & Bornstein, 2016). Factorial invariance was supported for all models with a loss in fit ΔCFI < -0.010 (Cheung & Rensvold, 2002). Given that invariance was found, the scalar (strong) models were used as baselines for the main cross-lagged analyses (see Appendix for invariance tables).

Positive emotions

Please see Tables 4 and 5 for fit indices. For undergraduate students, hope at Time 1 significantly negatively predicted procrastination at Time 2 (Fig. 2). No significant results were found for enjoyment or pride. For graduate students, significant results were found for enjoyment, hope, and pride. More specifically, a lack of enjoyment at Time 1 predicted procrastination at Time 2, which negatively predicted enjoyment at Time 3 (Fig. 3). Hope at Time 1 significantly negatively predicted procrastination at Time 2 and hope at Time 2 significantly negatively predicted procrastination at Time 3 (Fig. 4). Pride at Time 2 significantly negatively predicted procrastination at Time 3 (Fig. 5).

Fig. 3 *Cross-lagged results for procrastination and enjoyment in graduate students.* *p < .05, **p < .01, ***p < .001. Nonsignificant paths are not displayed for parsimony
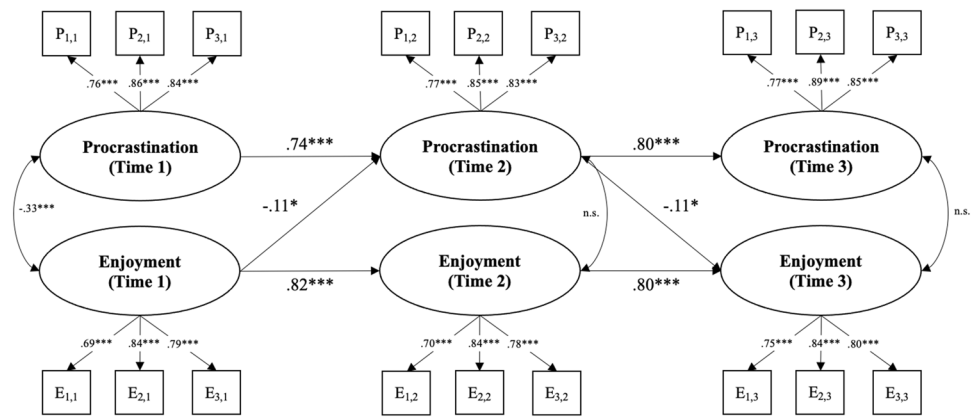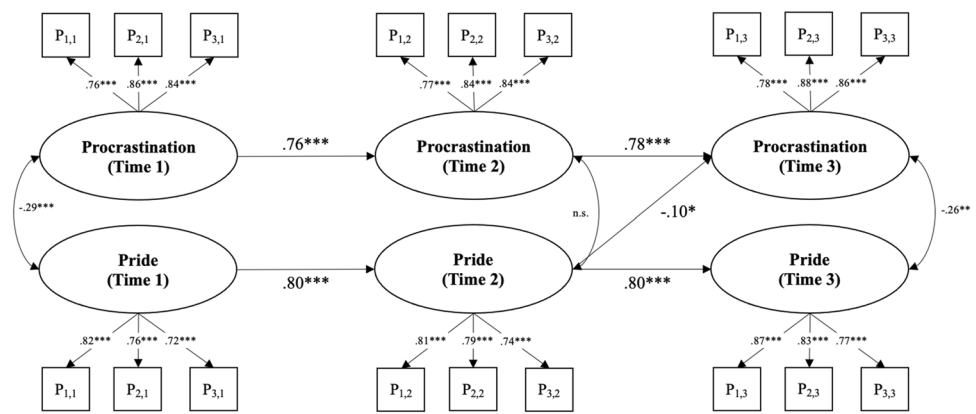

Fig. 4 *Cross-lagged results for procrastination and hope in graduate students.* *p < .05, **p < .01, ***p < .001. Nonsignificant paths are not displayed for parsimony
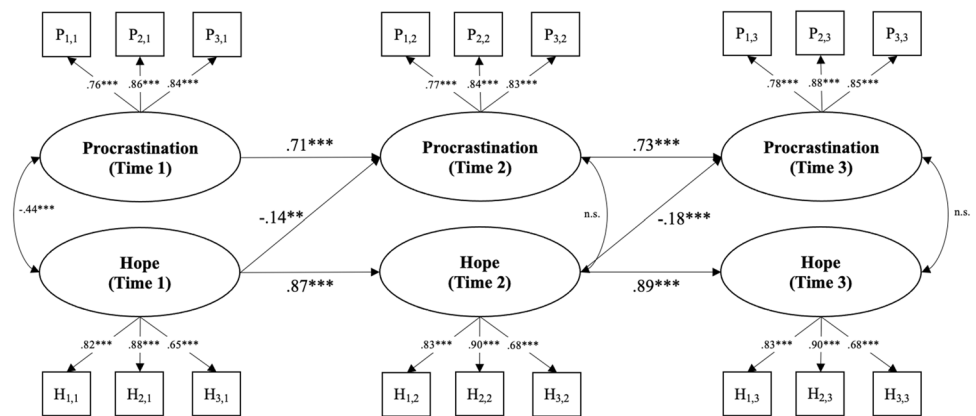
Fig. 5 *Cross-lagged results for procrastination and pride in graduate students.* *p < .05, **p < .01, ***p < .001. Nonsignificant paths are not displayed for parsimony

Negative emotions

For undergraduate students, significant results were found for anxiety, shame, hopelessness, and guilt. Anxiety at Time 1 significantly positively predicted procrastination at Time 2, and anxiety at Time 2 significantly positively predicted procrastination at Time 3 (Fig. 6). Shame and hopelessness at Time 1 significantly positively predicted procrastination at Time 2 (Figs. 7 and 8). Academic procrastination positively predicted later levels of guilt consistently (Time 1 to 2, Time 2 to 3; Fig. 9). For graduate students, significant results were found for anger, anxiety, shame, hopelessness, boredom, and guilt. More specifically, shame and hopelessness at Time 2 positively predicted procrastination at Time 3 (Figs. 10 and 11, respectively). Procrastination at Time 1 was also found to positively influence successive anger and boredom at Time 2 (Figs. 12 and 13, respectively). Procrastination at Time 1 negatively predicted subsequent anxiety and guilt at Time 2 that, in turn, negatively predicted procrastination at Time 3 (Figs. 14 and 15, respectively). However, for anxiety, there was an additional significant path between anxiety at Time 1 and procrastination at Time 2.

Fig. 6 *Cross-lagged results for procrastination and anxiety in undergraduate students.* *p < .05, **p < .01, ***p < .001. Nonsignificant paths are not displayed for parsimony

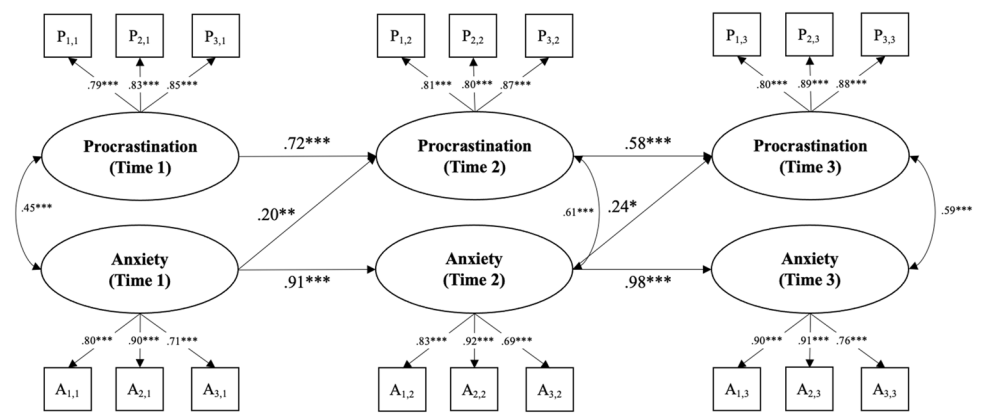**Fig. 7** *Cross-lagged results for procrastination and shame in undergraduate students.* *p < .05, **p < .01, ***p < .001. Nonsignificant paths are not displayed for parsimony

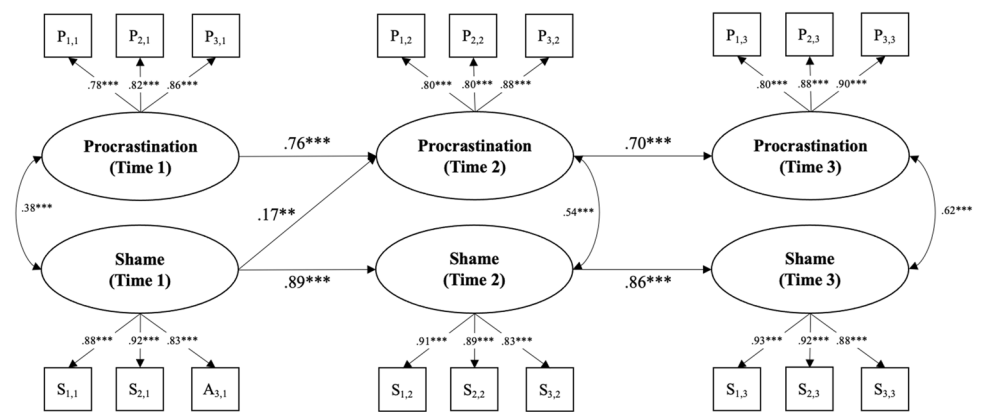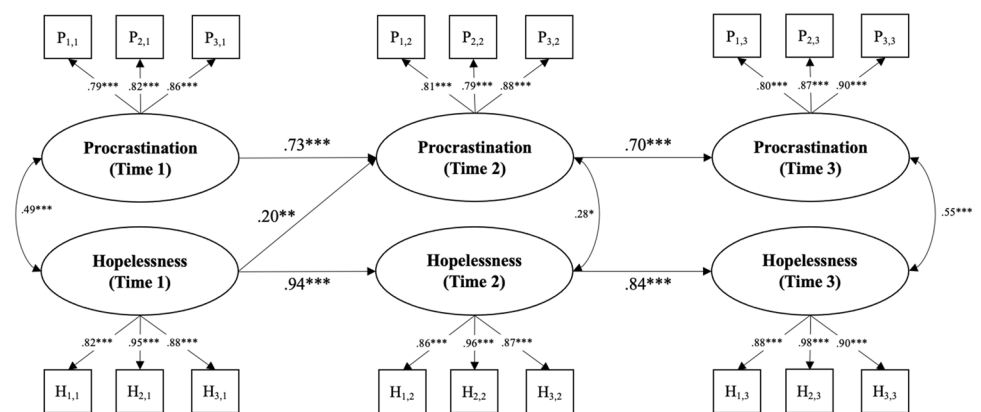**Fig. 8** *Cross-lagged results for procrastination and hopelessness in undergraduate students.* *p < .05, **p < .01, ***p < .001. Nonsignificant paths are not displayed for parsimony

Discussion

The overarching aim of the present research was to investigate the relationships between academic procrastination and academic emotions in both undergraduate and graduate students. The first objective of the present research was to examine the basic relationships between students' academic procrastination and academic emotions. The second objective was to examine the directionality of the relationship between academic procrastination and academic emotions to ascertain whether students' emotional experiences are best understood as influencing or being influenced by their procrastination, or if bidirectional/sequential relationships exist between these constructs. Overall, the study hypotheses were mostly supported with novel findings obtained with respect to the directionality of associations between these variables.

Hypothesis 1 Valence of Procrastination-Emotion Relations.

Fig. 9 *Cross-lagged results for procrastination and guilt in undergraduate students.* *p < .05, **p < .01, ***p < .001. Nonsignificant paths are not displayed for parsimony
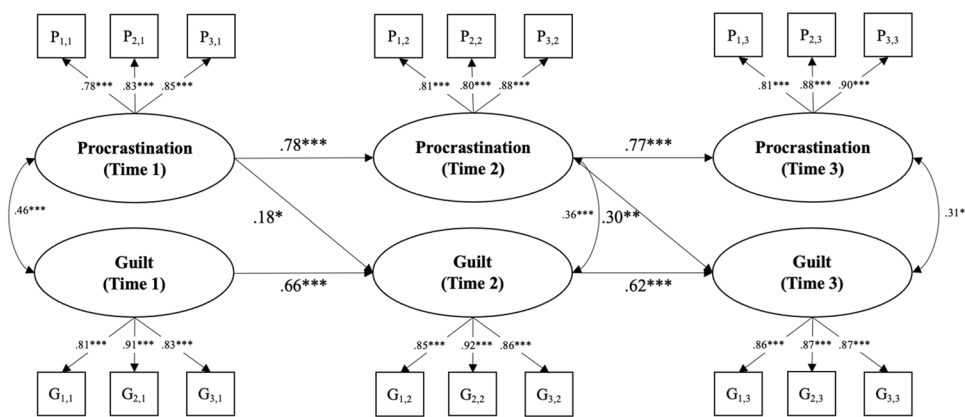

Fig. 10 *Cross-lagged results for procrastination and shame in graduate students.* *p < .05, **p < .01, ***p < .001. Nonsignificant paths are not displayed for parsimony
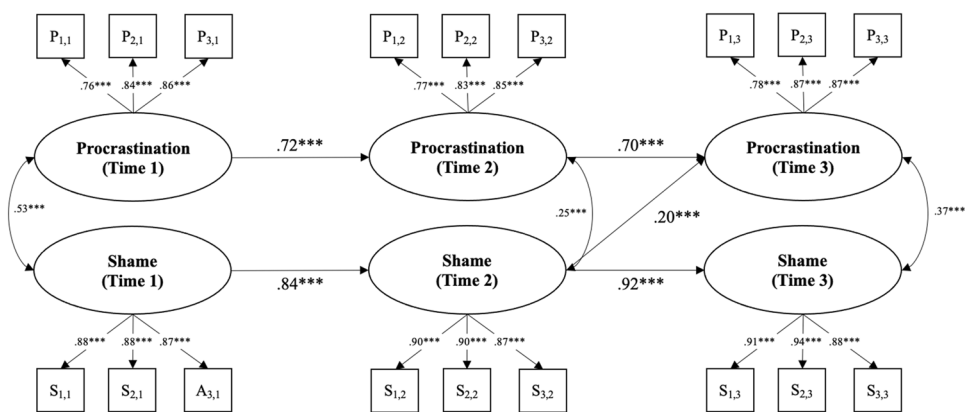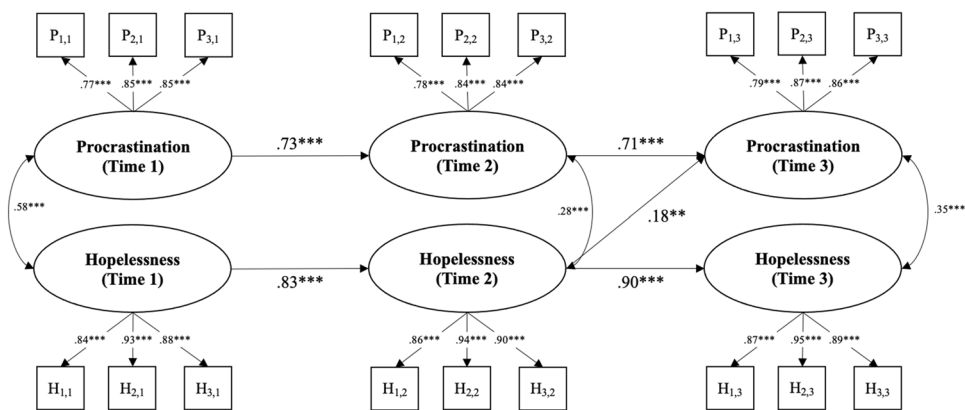

Fig. 11 *Cross-lagged results for procrastination and hopelessness in graduate students.* *p < .05, **p < .01, ***p < .001. Nonsignificant paths are not displayed for parsimony

For both undergraduate and graduate students, academic procrastination was significantly negatively related to the positive emotions of enjoyment, hope, and pride based on zero-order correlations and the valences of cross-lagged paths in the structural equation models (Hypothesis 1a). These findings are consistent with previous research in which academic procrastination has been examined in relation to positive emotions (e.g., hope, Alexander & Onwuegbuzie, 2007; Gadosey et al., 2021; Zhou & Kam, 2016) and contributes to the larger literature on procrastination-emotion relations that to date has focused mainly

on procrastination and students' negative emotional experiences. As our findings demonstrate, positive emotions represent important affective variables to be examined as correlates of procrastination in educational settings. Students who reported higher levels of hope in their abilities to learn and, to a lesser extent, greater enjoyment and pride in their academic work, were less likely to postpone their academic tasks, presumably due to anticipating successful task completion as well as positive experiences when learning.

Academic procrastination was also positively related to a range of negative emotions for undergraduate and graduate

Fig. 12 *Cross-lagged results for procrastination and anger in graduate students. *p < .05, **p < .01, ***p < .001. Nonsignificant paths are not displayed for parsimony*
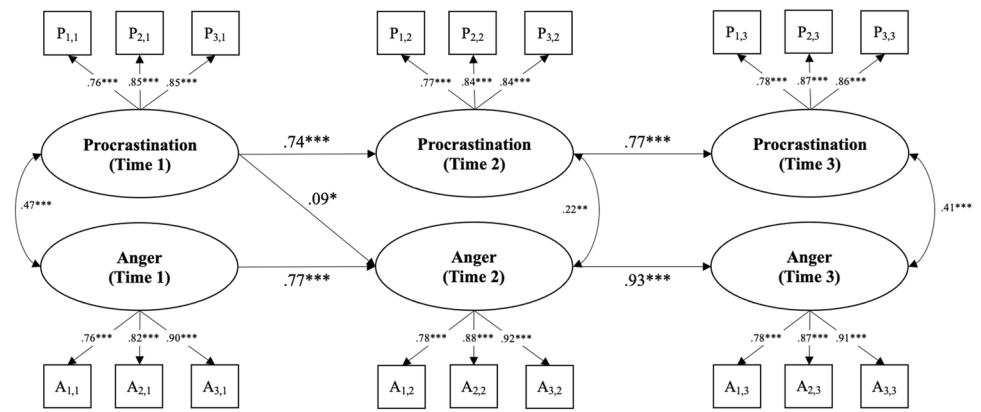
Fig. 13 *Cross-lagged results for procrastination and boredom in graduate students. *p < .05, **p < .01, ***p < .001. Nonsignificant paths are not displayed for parsimony*
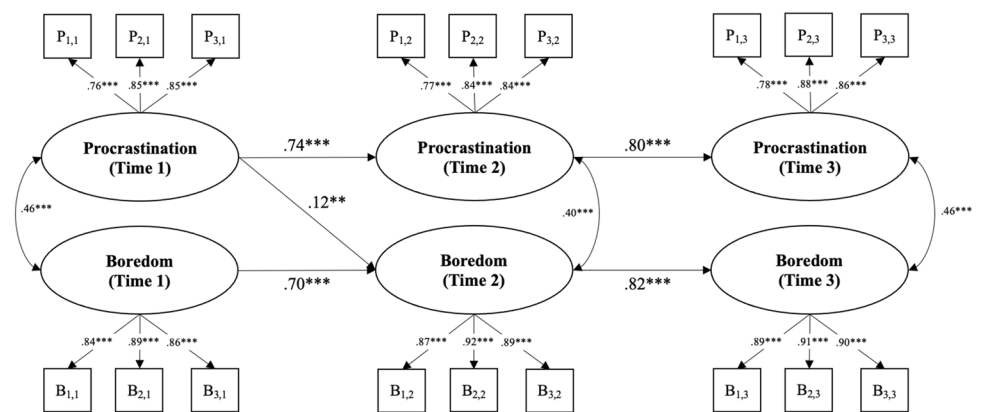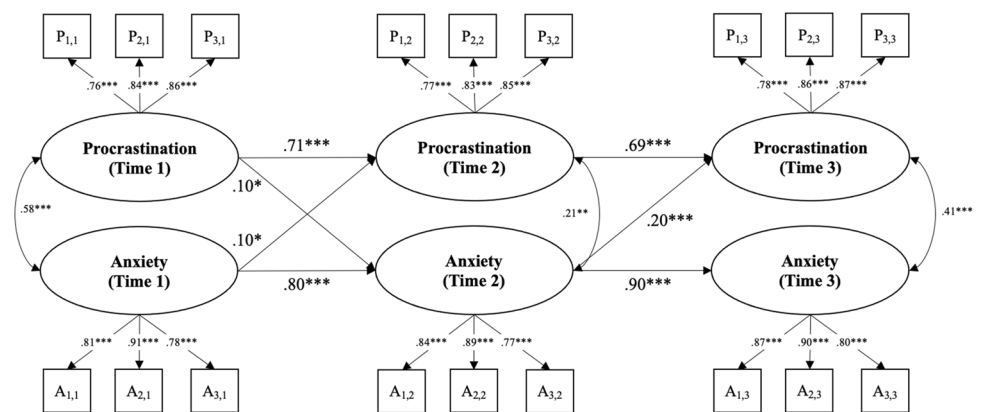
Fig. 14 *Cross-lagged results for procrastination and anxiety in graduate students. *p < .05, **p < .01, ***p < .001. Nonsignificant paths are not displayed for parsimony*

students (Hypothesis 1b). These findings are directly consistent with previous research examining relations between procrastination and negative emotions (e.g., anger, anxiety, shame, boredom; Blunt & Pychyl, 1998; Fee & Tangney, 2000; Klassen et al., 2008; Martinčeková & Enright, 2018; Onwuegbuzie, 2000, 2004; Solomon & Rothblum, 1984). However, a notable difference between previous empirical conclusions and those of the present study is the specificity of the negative emotions examined, in that none of the aforementioned studies examined academic procrastination alongside emotions specific to learning experiences.

Academic procrastination was related to various emotions for all students, however, the relative strength of the magnitudes of these associations was consistently weaker for undergraduates compared to graduate students across the emotions assessed. It is possibly because emotion variables may explain less variance in undergraduates' procrastination behaviour than other, more stable psychological traits previously observed to explain substantial variance in academic procrastination for undergraduates (e.g., personality traits, perceptions of competence, etc.). It is also possible that graduate students may experience greater correspondence

Fig. 15 *Cross-lagged results for procrastination and guilt in graduate students. *p < .05, **p < .01, ***p < .001. Nonsignificant paths are not displayed for parsimony*
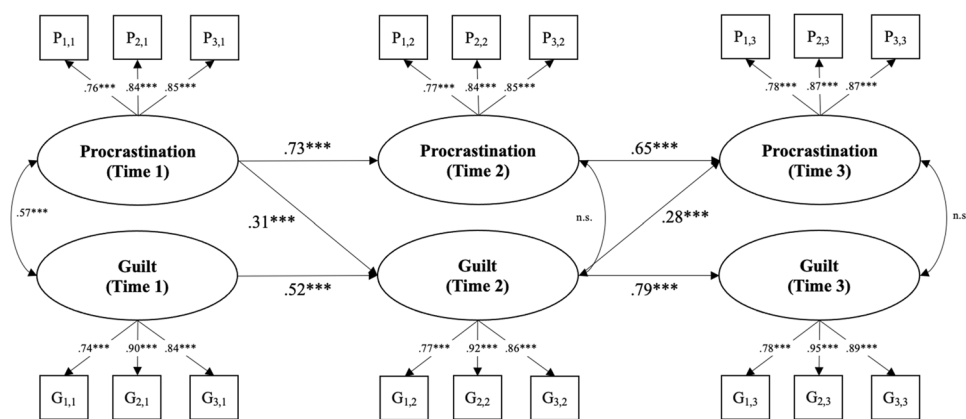
between their emotions and procrastination on academic tasks due to specific features of graduate training that qualitatively differ from undergraduate experiences. For example, graduate students are likely to have more invested in their studies, either financially (e.g., accumulated debt, family expenses; Longfield et al., 2006), task-wise (e.g., graduate theses more demanding than course exams), or career-wise (e.g., training for more advanced, challenging academic or industry careers) and therefore procrastination on academic tasks in graduate school may also represent a more emotional experience than for undergraduates. This assumption is consistent with existing research based on the Control-Value Theory showing greater perceptions of value to correspond with higher levels of both positive and negative learning-related emotions in students (Goetz et al., 2006), and with findings showing graduate students to exhibit strong emotional attachments to specific academic tasks (e.g., strong negative emotions when engaging in writing tasks that are perceived as reflecting academic identity; Aitchison et al., 2012). However, these assertions are beyond the scope of the present research and future research is needed on this topic.

Hypothesis 2 Directionality of Procrastination-Emotion Relations.

Hypothesis 2a Emotions predicting procrastination.

For both undergraduate and graduate students, Hypothesis 2a was supported with respect to hope, shame, and hopelessness. More specifically, there were directional relationships observed in the cross-lagged analyses in which hope, shame, and hopelessness negatively predicted subsequent academic procrastination. In addition, support for Hypothesis 2a was found for undergraduate students' anxiety which positively related to subsequent procrastination, and graduate students' pride that negatively related to subsequent academic procrastination.

With respect to *positive emotions*, hope negatively related to academic procrastination for both undergraduate and

graduate students, such that students who had an optimistic perspective towards learning and felt confident when studying were less likely to engage in procrastination on their academic assignments (e.g., AEQ items such as: "I have an optimistic view towards studying" and "I feel confident towards studying"). Our results mirror earlier cross-sectional findings in showing students who were hopeful to efficiently begin and complete their work and thus also less likely to engage in subsequent procrastination on assignments (e.g., Alexander & Onwuegbuzie, 2007; Sirois & Giguère, 2018; Zhou & Kam, 2016). In addressing a lack of prior research on the role of pride in procrastination, the present findings showed feelings of pride to negatively relate to subsequent academic procrastination, albeit only for graduate students. Graduate students who felt greater pride in their learning-related capabilities and accomplishments (e.g., AEQ items such as: "I'm proud of my capacity" and "I think I can be proud of my accomplishments at studying") were less likely to exhibit academic procrastination. These findings suggest that positive emotions may serve to motivate students towards task completion and avoid procrastination, especially students in graduate degree programs. This assumption is consistent with the Control-Value Theory in which activating positive emotions such as hope are assumed to enhance motivation to learn and facilitate optimal self-regulated learning. Moreover, this finding could also signify that positive emotions may play a larger role in the prevention of procrastination behaviours for graduate students.

With respect to directional effects of *negative emotions* on procrastination, shame and hopelessness were positively related to subsequent academic procrastination earlier in the academic year for undergraduate students, with the same pattern of results found for graduate students later in the year. Students' shame (e.g., AEQ items such as: "I feel ashamed that I can't absorb the simplest of details" and "My memory gaps embarrass me") and hopelessness regarding their academic pursuits (e.g., AEQ items such as: "I worry because my abilities are not sufficient for my program of studies") influenced students' academic procrastination

later in the year. These results expand upon previous cross-sectional research in which procrastination was found to negatively relate to shame-proneness (Fee & Tangney, 2000; Martinčeková & Enright, 2018). In addition, for undergraduate students, anxiety consistently related to academic procrastination throughout the year, showing greater worrying about learning activities (e.g., AEQ items such as: "When I look at the books I still have to read, I get anxious") to lead to academic procrastination. Taken together, both samples of students may have procrastinated on academic tasks to remedy feelings of embarrassment and shame due to perceptions of low ability (e.g., memory gaps) so as to preserve their self-image by avoiding their tasks and the associated insecurities. Also, these findings suggest that students who feel hopeless about their studies may also experience exhaustion that undermines their energy and motivation for goal pursuit (for theoretical assertions on the role of hopelessness in academic persistence, see Pekrun & Linnenbrink-Garcia, 2012). Following directly from the misregulation hypothesis (Balkis & Duru, 2016), it is possible that feelings of nervousness, fear, and worry regarding one's capabilities to understand academic materials when learning, particularly as an undergraduate, could lead to academic procrastination to remedy these unpleasant affective states. However, despite the plausible nature of these assertions, they were not testable in the present data sets and represent valuable topics for future research on mediational paths between academic procrastination and negative emotions (e.g., utilizing larger, multi-item measures of self-efficacy, physical and/or emotional exhaustion, avoidance motivation).

Thus, these results imply that perceptions of competence may also serve a critical role in mitigating procrastination in undergraduate and graduate students. Just as students who experienced negative emotions (e.g., anxiety, shame, and hopelessness) tended to focus more on their lack of ability, students who experienced hope and pride were instead more focused on their goals and self-assured in their abilities. Whereas students who perceived their capabilities as limited and accordingly feel anxious, shameful, and hopeless were more likely to subsequently procrastinate on academic tasks, students who believed in themselves and felt more capable tended to experience feelings of hope and pride that, in turn, lead to lower procrastination. These findings are in line with the misregulation hypothesis in showing students' negative self-perceptions with respect to learning activities to coincide with negative emotional experiences that consequently lead to maladaptive procrastination behaviours.

Hypothesis 2b Procrastination predicting emotions.

Hypothesis 2b was supported for undergraduate students' guilt and graduate students' anger and boredom. Cross-lagged findings demonstrated that academic procrastination

positively influenced undergraduate students' guilt throughout the term. This finding is consistent with previous research showing students who engage in procrastination experience guilt about their task avoidance when they enjoy an alternative activity instead of doing their academic work (Lavoie & Pychyl, 2001; Pychyl et al., 2000). The present findings thus demonstrate that undergraduates who procrastinate end up consistently feeling guilty for their actions, likely due to a persistent awareness of these behaviours showcasing their lack of engagement (e.g., APSI questionnaire items such as: "Gave up studying early in order to do more pleasant things"). For graduate students, academic procrastination negatively predicted subsequent anger, consistent with previous research showing anger to be negatively linked with academic procrastination among undergraduate students (Ferrari & Olivette, 1994). Thus, students who engaged in procrastination were found to subsequently experience greater anger due to their inability to stay on track with their goals (e.g., APSI questionnaire items such as: "I allowed myself to get distracted from [my] work"). Lastly, the present research showed procrastination to positively relate to boredom earlier in the year for graduate students, consistent with research conducted by Blunt & Pychyl (1998) who proposed that students engage in procrastination when they are not able to work on boring academic tasks (e.g., AEQ item: "Because I'm bored I have no desire to learn" or APSI questionnaire item: "I drifted off into day dreams while studying"). Since boredom is often considered a deactivating negative emotion that typically leads to inaction due to the inability to generate intrinsic interest and motivation (Pekrun, 2014; Vodanovich & Rupp, 1999), the finding that procrastination predicted boredom, as opposed to vice versa, may seem counterintuitive. However, consistent with Pekrun et al. (2014) showing boredom to potentially serve as both an activity-related emotion (predicting achievement-striving) and an outcome-related emotion (predicted by achievement striving), these findings suggest that students who already procrastinated on academic assignments may further disengage from these assignments, perhaps due to these tasks being monotonous or no longer holding personal value.

Hypothesis 2c Simultaneous prediction.

Simultaneous directional relationships were found for anxiety among undergraduate students, providing some evidence for Hypothesis 2c. However, this finding was only present between Time 1 and Time 2, thus Hypothesis 2c was partially supported for anxiety and will be discussed below when discussing Hypothesis 2d. As for the remaining cross-lagged models, study findings did not show significant simultaneous directional paths between procrastination and emotions, with the results overall thus showing Hypothesis

2c to not be largely empirically supported by the present data.

Hypothesis 2d Sequential prediction.

Sequential predictive relationships between academic procrastination and emotions were found only for graduate students and specifically with respect to the emotions of enjoyment and guilt, and partially anxiety. Greater enjoyment at Time 1 predicted lower academic procrastination at Time 2 that, in turn, negatively impacted subsequent enjoyment at Time 3. Conversely, higher levels of academic procrastination at Time 1 predicted more guilt at Time 2 that, in turn, predicted greater academic procrastination at Time 3. In addition to the simultaneous prediction of anxiety and procrastination from Time 1 to Time 2, anxiety also predicted procrastination at Time 3.

The finding of sequential directional relations for enjoyment is directly consistent with the misregulation hypothesis in which students' emotions are proposed to impact subsequent procrastination, and further extends this hypothesis in showing this assertion to not only apply to negative emotions but also to positive emotions. This finding is also consistent with research showing academic procrastination to be positively associated with task aversiveness (e.g., Solomon & Rothblum, 1984) in suggesting that students procrastinate when they are not enjoying their tasks (e.g., not endorsing AEQ items such as: "I look forward to studying" and "Certain subjects are so enjoyable that I am motivated to do extra readings about them"). Moreover, our study showed that procrastination leads to lower enjoyment later on in the term, thus showing procrastination to not only increase negative emotions over time (as would be assumed given the preponderance of existing procrastination research focusing exclusively on negative emotions), but to also reduce positive emotions thus showing procrastination to be even more detrimental for students' overall affective well-being than previously assumed.

Among graduate students, procrastination was found to predict greater anxiety and guilt earlier on in the year. This finding is not consistent with Tice and Baumeister (1997) who found procrastination earlier in the academic year to be negatively related to stress in undergraduates. More specifically, whereas procrastinating on academic tasks should create more anxiety and guilt later on as deadlines are approaching due to the student feeling unprepared, it should predict less anxiety earlier on due to the task avoidance presumably occurring as a response aimed at reducing anxiety (i.e., misregulation). Nevertheless, guilt did more strongly predict greater subsequent academic procrastination later in the year, partially consistent with the misregulation hypothesis and Tice and Baumeister. One explanation may be that graduate students' anxiety and guilt for their procrastination

earlier in the year (i.e., before the first phase of the present study began) may have put them in unfavorable situations (e.g., not enough time to complete their tasks) that led to more procrastination so as to avoid these negative emotional states. In addition, as previously mentioned, this finding for graduate students may also reflect how graduate students may possess a clear sense of how important their success on academic tasks are with respect to their substantial existing investments, thus making procrastination a much more emotional experience as compared to undergraduates (Aitchison et al., 2012; Longfield et al., 2006).

Study limitations and future directions

With respect to assessment, the surveys used in the present study lacked domain specificity and students were not asked to think about a specific academic task or deadline (e.g., biology exam on September 21st). While the APSI did ask questions about procrastination that were directly related to learning and studying (e.g., "Prepared to study at some point of time but did not get any further"; Haghbin, 2015), the preambles of the APSI and the AEQ did not match. The APSI measure asked students to report behaviours/thoughts pertaining to academic procrastination experienced within the last week, while the AEQ asked students to recall typical studying occurrences that have occurred throughout their studies and did not specify a retrospective time frame. This divergence in these preambles may have confounded our results and is worth consideration upon interpretation of the results. Similarly, the timing of the assessments could have impacted the findings (e.g., right before a specific holiday or personal deadline). Recruiting participants from a single institution to complete course- or program-specific measures would remedy these issues by providing accounts of procrastination and emotions with respect to specific deadlines and tasks.

Another limitation of the present research was that the distribution of gender was not equal. This imbalance is not uncommon in procrastination research and according to the preliminary analyses reported, did not confound results. Nevertheless, more research is needed to examine the associations between procrastination and gender, including other gender identities. Other unexamined variables could have mediated or moderated our results (e.g., self-efficacy, Cerino, 2014; Haycock, et al., 1998; Hensley, 2014; Klassen et al., 2008; perceptions of control, competence, or value, Pekrun, 2006; Pychyl et al., 2000) should be examined in future research. Also, further research to investigate what students do instead of their academic work when procrastinating is also encouraged (e.g., students procrastinate by completing another important task, i.e., productive procrastination, vs students procrastinate by watching television). Also, future studies could compare longitudinal trajectories

of procrastination and emotions between undergraduate and graduate students directly to statistically examine where differences lie. Other approaches are also encouraged to help extrapolate and support the findings (e.g., behavioural observations, experimental methods to infer causation, qualitative methods to triangulate findings, and experience sampling methods to capture real-time procrastination).

Implications of study findings

The results from the study outlined in this manuscript contribute to the existing literature on academic procrastination by providing a better understanding of the role that emotions play in self-regulation failure. By learning more regarding the associations between procrastination and emotions in students, researchers can now create more effective emotion regulation interventions (Eckert et al., 2016). For example, following from the results from the present study, emotion regulation interventions could be improved by focusing on helping students find adaptive ways of regulating high-arousal emotions (e.g., anxiety, guilt). In the absence of such information, at-risk students may otherwise find themselves in a loop whereby their anxiety initiates procrastination tendencies that, in turn, elicit more anxiety and ultimately impairs their academic achievement and well-being. Relatedly, cognitive-behavioural coaching could be used to help students learn techniques for increasing their focus on mastery and self-efficacy beliefs by teaching self-regulation strategies such as planning and organization (Häfner et al., 2014). Our results also support the use of interventions addressing enjoyment or intrinsic motivation in students. In support of this assertion, Scent and Boes (2014) showed acceptance-commitment therapy to reduce procrastination in university students through workshops enhancing awareness of procrastination habits and strengthening students' intrinsic values.

Conclusion

The present findings indicate that a moderate amount of the variance associated with academic procrastination to be reliably attributed to students' learning-related emotions, underscoring the importance of continued research on both positive and negative emotions as important affective correlates of academic procrastination. The present research specifically showed academic procrastination to be negatively related to positive emotions and positively related to negative emotions among both undergraduate and graduate students. Furthermore, cross-lagged models revealed

bidirectional configurations of effects between academic procrastination and learning-related emotions. Enjoyment, anxiety, hope, and guilt were observed to be the strongest predictors of academic procrastination, as demonstrated by the consistent and/or successive effects over time.

Appendix

Parceling is frequently used in multivariate analyses involving a latent-variable approach where several items (i.e., indicators) are added together to measure a theoretical construct (Little et al., 2002). By aggregating items together, parceling allows for fewer indicators (reducing the error), and has other benefits including more information in the resulting model (i.e., model efficiency), higher reliability, higher communality, more true-score variance, a higher ratio between the common-to-unique factor variance, as well as optimized sample size to parameter ratios, and better goodness of fit indices (Little, 2013; Matsunaga, 2008). Alongside the benefits associated with parceling, two main disadvantages are consistently cited (Marsh et al., 2013). As noted by Matsunaga (2008), study findings are mixed as to whether or not parceling increases estimation bias in simulation studies by way of decreasing effect size estimates. Well-conditioned data (e.g., normal data with no correlated errors) does not appear to benefit from the use of parceling due to a lack of space for improvements, whereas studies that do not include well-conditioned data have been found to benefit from the reduced error (Matsunaga, 2008). Critics further note that the dimensionality of a scale must be understood if one opts to use parcels, with authors suggesting that parceling may be acceptable when scale items are unidimensional in nature (Little et al., 2013) as the dimensionality of the factors may become distorted (leading to misrepresentations) when parcels are used with multidimensional scales due to potential masking multiple measurement issues (i.e., cross-loading factors, or correlated errors) that are present at the item level. Given that the present data was not perfectly normally distributed, effect size estimates may be marginally inflated from the use of parcels. Moreover, as the dimensionality of each scale was further assessed using EFAs showing all variables to be unidimensional in nature, the possibility of hidden measurement issues when creating parcels was considered minimal. Taken together, parceling was deemed an appropriate method for item reduction in the present study.

Bandalos (2002) found that all-item-parceling (similar to a total score) and three-parcel models showed better goodness-of-fit when compared to six-parcel models.

The fewer the parcels, the lower the proportion of error represented, therefore the greater the true variance and model fit. Moreover, it is recommended to use averages of items instead of total scores to ensure that differences in the number of items used in each parcel does not affect the results, making the parcels more comparable (Little, 2013). Thus, the present study utilized parceling as a method of aggregating items within the unidimensional procrastination and emotion scales reducing the number of parameters required to be estimated in each cross-lagged model. The three-parcel method utilizing the random approach was adopted for all main analyses as it represents the most efficient and parsimonious parceling method (See Tables 6 and 7).

Table 6 Longitudinal measurement invariance (undergraduate students)

Model	χ^2 (df)	p	CFI	ΔCFI	TLI	ΔTLI	SRMR	ΔSRMR	RMSEA [90% CI]	ΔRMSEA
Enjoyment										
Configural	128.593 (102)	< .05	.987	–	.981	–	.067	–	.029 [.007−.043]	–
Metric (weak)	135.310 (110)	= .05	.988	.001	.983	.002	.074	.007	.027 [.000−.041]	.002
Scalar (Strong)	143.053 (118)	= .06	.988	.000	.985	.002	.075	.001	.026 [.000−.040]	.001
Hope										
Configural	150.023 (102)	< .01	.977	–	.965	–	.051	–	.038 [.024−.051]	–
Metric (weak)	158.360 (110)	< .01	.977	.000	.968	.003	.061	.01	.037 [.023−.049]	.001
Scalar (strong)	162.587 (118)	< .01	.979	.002	.972	.004	.063	.002	.034 [.020−.047]	.003
Pride										
Configural	144.798 (102)	< .01	.978	–	.966	–	.058	–	.036 [.021−.049]	–
Metric (weak)	155.134 (110)	< .01	.976	.002	.967	.001	.065	.007	.036 [.021−.048]	.000
Scalar (strong)	162.783 (118)	< .01	.977	.001	.970	.003	.067	.002	.034 [.020−.047]	.002
Anger										
Configural	171.585 (102)	< .01	.970	–	.956	–	.053	–	.046 [.034−.058]	–
Metric (weak)	181.153 (110)	< .01	.970	.000	.958	.002	.059	.006	.045 [.033−.057]	.001
Scalar (strong)	188.834 (118)	< .01	.970	.000	.961	.003	.060	.001	.043 [.031−.055]	.002
Anxiety										
Configural	143.883 (102)	< .01	.982	–	.973	–	.058	–	.036 [.021−.049]	–
Metric (weak)	152.006 (110)	< .01	.982	.000	.975	.002	.065	.007	.035 [.020−.047]	.001
Scalar (strong)	161.357 (118)	< .01	.982	.000	.976	.001	.067	.002	.034 [.019−.046]	.001
Shame										
Configural	121.884 (102)	= .09	.993	–	.989	–	.046	–	.025 [.000−.040]	–
Metric (weak)	126.727 (110)	= .13	.994	.001	.991	.002	.051	.005	.022 [.000−.037]	.003
Scalar (strong)	131.345 (118)	= .19	.995	.001	.994	.003	.051	.000	.019 [.000−.035]	.003
Hopelessness										
Configural	210.547 (102)	< .01	.963	–	.944	–	.060	–	.058 [.047−.069]	–
Metric (weak)	217.448 (110)	< .01	.963	.000	.948	.004	.066	.006	.055 [.044−.066]	.003
Scalar (strong)	229.875 (118)	< .01	.961	.002	.950	.002	.067	.001	.055 [.044−.065]	.000
Boredom										
Configural	159.184 (102)	< .01	.979	–	.969	–	.049	–	.042 [.029−.054]	–
Metric (weak)	164.488 (110)	< .01	.980	.001	.973	.004	.053	.004	.039 [.026−.051]	.003
Scalar (strong)	170.755 (118)	< .01	.981	.001	.975	.002	.053	.000	.037 [.024−.049]	.002
Guilt										
Configural	112.318 (102)	= .23	.995	–	.993	–	.039	–	.018 [.000−.035]	–
Metric (weak)	117.200 (110)	= .30	.997	.002	.996	.003	.046	.007	.014 [.000−.033]	.004
Scalar (strong)	121.299 (118)	= .40	.999	.002	.998	.002	.046	.000	.009 [.000−.030]	.005

Table 7 Longitudinal measurement invariance (graduate students)

Model	χ^2 (df)	p	CFI	ΔCFI	TLI	ΔTLI	SRMR	ΔSRMR	RMSEA [90% CI]	ΔRMSEA
Enjoyment										
Configural	162.386 (102)	< .01	.989	–	.984	–	.043	–	.028 [.019−.035]	–
Metric (weak)	165.555 (110)	< .01	.990	.001	.986	.002	.043	.000	.025 [.017−.033]	.003
Scalar (strong)	189.592 (118)	< .01	.987	.003	.983	.003	.044	.001	.028 [.020−.035]	.003
Hope										
Configural	155.271 (102)	< .01	.991	–	.986	–	.041	–	.026 [.017−.034]	–
Metric (weak)	157.480 (110)	< .01	.992	.001	.989	.003	.040	.001	.024 [.015−.031]	.002
Scalar (strong)	164.570 (118)	< .01	.992	.000	.990	.001	.041	.001	.023 [.014−.030]	.001
Pride										
Configural	173.953 (102)	< .01	.987	–	.980	–	.056	–	.030 [.022−.038]	–
Metric (weak)	180.283 (110)	< .01	.987	.000	.982	.002	.057	.001	.029 [.021−.036]	.001
Scalar (strong)	189.809 (118)	< .01	.987	.000	.983	.001	.057	.000	.028 [.020−.035]	.001
Anger										
Configural	207.453 (102)	< .01	.983	–	.975	–	.048	–	.036 [.029−.044]	–
Metric (weak)	213.510 (110)	< .01	.984	.001	.977	.002	.049	.001	.035 [.028−.042]	.001
Scalar (strong)	229.237 (118)	< .01	.983	.001	.977	.000	.049	.000	.035 [.028−.042]	.000
Anxiety										
Configural	162.711 (102)	< .01	.991	–	.986	–	.032	–	.028 [.019−.035]	–
Metric (weak)	172.605 (110)	< .01	.990	.001	.987	.001	.035	.003	.027 [.019−.035]	.001
Scalar (strong)	186.904 (118)	< .01	.989	.001	.986	.001	.036	.001	.027 [.020−.035]	.000
Shame										
Configural	148.967 (102)	< .01	.994	–	.991	–	.033	–	.024 [.015−.032]	–
Metric (weak)	154.652 (110)	< .01	.994	.000	.992	.001	.033	.000	.023 [.014−.031]	.001
Scalar (strong)	162.095 (118)	< .01	.994	.000	.992	.000	.034	.001	.022 [.013−.030]	.001
Hopelessness										
Configural	193.743 (102)	< .01	.988	–	.982	–	.042	–	.034 [.027−.041]	–
Metric (weak)	198.721 (110)	< .01	.988	.000	.984	.002	.042	.000	.032 [.025−.039]	.002
Scalar (strong)	218.217 (118)	< .01	.987	.001	.983	.001	.042	.000	.033 [.026−.040]	.001
Boredom										
Configural	206.629 (102)	< .01	.985	–	.977	–	.038	–	.036 [.029−.043]	–
Metric (weak)	218.854 (110)	< .01	.984	.001	.978	.001	.040	.002	.036 [.029−.043]	.000
Scalar (strong)	226.252 (118)	< .01	.984	.000	.979	.001	.040	.000	.034 [.028−.041]	.002
Guilt										
Configural	126.457 (102)	= .05	.996	–	.994	–	.029	–	.018 [.000−.027]	–
Metric (weak)	134.994 (110)	= .05	.996	.000	.994	.000	.031	.002	.017 [.000−.026]	.001
Scalar (strong)	144.273 (118)	= .05	.996	.000	.994	.000	.031	.000	.017 [.000−.026]	.000

Declarations

Conflict of interest We have no conflict of interest to disclose.

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