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The development and validation of a one-off scale to measure procrastination and precrastination traits in young adults

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Abstract

Background Procrastination is the voluntary delay of urgent tasks. Precrastination, on the other hand, is the tendency to complete tasks as soon as possible. The extreme of both these conditions is considered harmful to mental health. There was a significant gap in the measurement of these conditions, and no single tool was discovered to measure both these conditions simultaneously. The current study was the first-ever in this regard, intended to assess a person's inclination toward procrastination or precrastination at the same time.

Objective The present study aimed to develop and validate a comprehensive scale to measure both procrastination and precrastination traits single-handedly.

Methods The development of the Procrastination and Precrastination Traits Scale (PPTS) involved generating potential items through literature review, expert feedback, pilot testing, exploratory factor analysis (EFA), and confirmatory factor analysis (CFA). Moreover, the convergent and divergent validity were also evaluated. Data were collected using crowd-sourcing from 5000 participants (women = 60%; aged 18 to 38 years with a mean age of 28 years, SD = 5) from Africa, Asia, Australia, Europe, North America, and South America.

Results The EFA identified two distinct factors representing procrastination and precrastination, leading to an 18-item scale. The CFA confirmed a good model fit for the two-factor structure of the 18 items. The reliability of both procrastination ($\omega = 0.86$, $\alpha = 0.87$) and precrastination ($\omega = 0.79$, $\alpha = 0.77$) was highly satisfying. The fit indices of the CFA reflected strong validity (CFI = 0.94, TLI = 0.93, NNFI = 0.93, and RMSEA = 0.05). The convergent validity of the PPTS was established through the significant positive correlation of its procrastination scale with the Pure Procrastination Scale ($r = 0.80$; $p < 0.001$). The divergent validity of the PPTS was established through the significant inverse correlation of its procrastination scale with the Satisfaction with Life Scale ($r = -0.47$; $p < 0.001$).

Conclusions The PPTS is a reliable and valid tool for measuring procrastination and precrastination. The process of developing and validating the PPTS involved data collection from six diverse continents, enabling the PPTS's potential universality and significance.

Keywords Procrastination, Precrastination, Scale Development, Factor Analysis, Reliability, Validity, Cross-Cultural Analysis

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Introduction

Procrastination, defined as the voluntary delay of urgent tasks, is a prevalent phenomenon with various risk factors and consequences [1, 2]. It is the intentional and irrational act of delaying decisions and choices, even when aware that this delay would result in negative consequences [3, 4]. Procrastination is often understood by researchers as a situation where there is a difference between a person's desire to do something and their actual performance of that activity [5]. Researchers have identified three types of chronic procrastination: avoidant procrastination, which involves avoiding tasks that challenge one's abilities and undermine one's confidence; decisional procrastination, which refers to delaying the process of making decisions; and arousal procrastination, where individuals tend to rush through tasks when faced with a deadline [6]. Academic, decisional, neurotic, and compulsive procrastination depend on cognitive, emotional, and behavioral factors. Decisional procrastination delays decisions, while behavioral procrastination delays actions. Context also distinguishes procrastination [7]. Factors such as personality traits like self-control and conscientiousness, cultural differences, gender disparities, and educational levels have been identified as predictors of procrastination [1, 2].

Procrastination is associated with negative outcomes such as stress, health issues, academic under-achievement, and lower levels of well-being [8, 9]. Moreover, procrastination has been linked to poor sleep habits, including greater social jetlag, shorter sleep duration, insomnia symptoms, and excessive daytime sleepiness, particularly in adolescents and young adults [8, 10].

Psychological factors like evaluation anxiety, task aversiveness, low self-efficacy, fear of failure, and perfectionism are closely associated with procrastination tendencies, leading to lower levels of health, wealth, and well-being [11–13]. Moreover, factors such as lack of motivation, overconfidence, self-esteem issues, and social problems have been identified as contributors to academic procrastination among university students, impacting their learning outcomes and mental well-being [14]. Research has consistently shown that male students tend to procrastinate more than their female counterparts when examining the relationship between gender and procrastination [15–17]. Unmarried individuals procrastinate more than married ones [9, 18, 19]. Studies have also shown positive connections between procrastination, joblessness, unemployment, and poor socioeconomic conditions [16, 20].

Academic procrastination is the last-minute postponing of school responsibilities such as term papers and other academic obligations. Academic postponements are "maladaptive and adaptive forms of delay,

and adaptive forms of delay may be more consistent with certain facets of self-regulating learning"[21]. In the context of e-learning, procrastination negatively impacts academic achievement, leading to disengaged learning, increased dropout rates, and poor performance, emphasizing the importance of addressing procrastination in educational settings [22]. Task-related factors such as discomfort, unfamiliarity with tasks, perceived risk (monetary, psychological, social, and physical), and fear of failure can significantly influence procrastination behaviors among students [23].

Procrastination has resulted in significant losses across several domains, including financial, social, and psychological [24]. It has been linked to various negative outcomes, including poor academic and job performance, increased stress and anxiety, and lower well-being [24, 25]. On the other hand, procrastination is a relatively new construct, and its implications for individual and organizational functioning are still being explored [26–28].

The study of procrastination has a rich history, with researchers examining its cognitive, affective, and behavioral underpinnings [29–31]. Procrastination has become a pressing problem in finance and healthcare, as people delay paying their bills and visiting their primary care doctors [32]. It has been extensively studied in psychology and recognized as a pervasive human behavior with significant consequences for well-being and productivity [9, 24, 32]. However, recent research has identified a phenomenon called "precrastination," which refers to the tendency to complete tasks as soon as possible, even at the expense of extra effort [26–28, 33, 34]. While procrastination and precrastination may seem like opposing tendencies, emerging evidence suggests that they can coexist within the same individual, leading to a complex interplay of motivations and behaviors [26–28, 33, 34]. While procrastination has been extensively studied, the development and manifestation of precrastination tendencies have received less attention. Existing research suggests that precrastination may stem from a desire for closure, a preference for autonomy, or a desire to minimize cognitive load [26–28, 33, 34]. However, the developmental trajectories and potential interactions between procrastination and precrastination remain largely unexplored.

Previous psychometric research has predominantly focused on developing scales to measure procrastination tendencies. Previous studies have yielded the development of self-report questionnaires such as the Pure Procrastination Scale (PPS) [24], the Irrational Procrastination Scale (IPS) [35], the General Procrastination Scale (GPS) [36], the Adult Inventory of Procrastination (AIP) [37], the Tuckman Procrastination Scale (TPS) [38], and the Decisional Procrastination Scale (DPS) [39]. These

tools focus on assessing the irrational delay of intended behavior, a core aspect of procrastination.

A growing body of evidence suggests that procrastination and precrastination can coexist within the same individual [26, 27, 30]. This coexistence raises intriguing questions about the underlying mechanisms that govern the expression of these seemingly contradictory tendencies and their potential impacts on individual functioning. Understanding the development and interplay of procrastination and precrastination is crucial for several reasons. First, it can shed light on the cognitive and motivational processes that shape task engagement and time management behaviors, which have significant implications for productivity, well-being, and goal attainment. Second, it can inform the development of targeted interventions and strategies to effectively manage these tendencies, potentially enhancing individual and organizational performance. Third, it can contribute to a more nuanced understanding of individual differences in task engagement and decision-making, which has implications for personnel selection, job design, and training.

While procrastination (delaying tasks) and precrastination (completing tasks prematurely) may appear as opposing tendencies, emerging evidence suggests they represent complementary temporal regulation strategies that can coexist within individuals across different contexts [27]. This dual-process perspective motivated our development of a unified scale, as fragmented measurement risks overlooking critical behavioral patterns—such as how precrastination on routine tasks may enable procrastination on complex ones [40, 41]. By capturing both constructs simultaneously, the PPTS offers researchers a more nuanced tool to examine how these strategies interact dynamically in real-world settings, rather than treating them as mutually exclusive behaviors.

Given the importance of this topic, there is a pressing need for research that examines the development of procrastination and precrastination within the same individuals over time. By studying these tendencies together, researchers can gain insights into their potential interactions, underlying mechanisms, and impacts on various life domains.

The purpose of this study was to develop and validate a psychometric tool designed to measure both procrastination and precrastination traits simultaneously in young adults, thereby addressing a significant gap in existing research, which has typically assessed these behaviors in isolation. Although procrastination (task delay) and precrastination (premature task completion) are increasingly recognized as distinct yet interrelated constructs, a unified scale to evaluate their co-occurrence and differential impacts has not been established. The specific objectives of this study were: Firstly, to create a comprehensive scale

that integrates validated indicators of procrastination with emerging markers of precrastination; and secondly, to establish the psychometric properties of this newly developed scale.

The development of a unified scale measuring both procrastination and precrastination stems from critical theoretical and methodological considerations. Existing research has typically examined these behavioral tendencies as discrete constructs, using separate measurement tools that fragment our understanding of individual differences in task completion behaviors. By creating a single integrated scale, we aim to capture the nuanced interplay between procrastination and precrastination within the same individual, recognizing that these are not mutually exclusive but potentially complementary behavioral strategies. This approach allows for a more holistic assessment of an individual's temporal self-regulation, moving beyond binary categorizations to understand the complex cognitive and motivational processes underlying task management. A unified instrument provides researchers and practitioners with a more comprehensive and parsimonious tool for assessing individual differences in task completion behaviors, potentially revealing subtle interactions and trade-offs between premature and delayed task engagement that may be obscured when using separate measurement approaches.

The focus on young adults in this study is both intentional and significant. Young adulthood is a critical developmental stage marked by substantial transitions, heightened personal autonomy, and the emergence of self-regulatory behaviors [42]. This life phase is particularly conducive to examining procrastination and precrastination, as individuals concurrently develop academic, professional, and personal time management strategies [43]. During this time, young adults encounter complex task environments in educational settings, early career stages, and personal life domains, making them an ideal population for investigating the emergence and interaction of these contrasting behavioral tendencies [42]. Young adults are uniquely positioned to offer insights into the cognitive and motivational processes that underpin task completion behaviors, as they navigate increasingly sophisticated personal and professional challenges that require refined self-regulation skills.

Methods

The development of the scale

To develop the procrastination and precrastination traits scale, we began by generating an extensive list of potential items through a comprehensive review of the literature on procrastination and precrastination. We examined existing scales, such as the pure procrastination scale, the general procrastination scale, the Tuckman

procrastination scale, and empirical studies on procrastination. This review helped us identify common behaviors and themes associated with both constructs. From this, we drafted items that encapsulated key aspects of delaying and hastening behaviors, ensuring that each item was clear, concise, and measured a single construct. Once we had a preliminary list of items, we conducted several rounds of refinement. Initial drafts were reviewed for face validity and clarity by a panel of experts in psychology and behavioral research. Feedback from this panel led to the rewording of some items to enhance clarity and reduce ambiguity. We also ensured all items fit a shared response format, asking participants to rate the frequency of each behavior on a 5-point Likert scale ranging from 1 (Never) to 5 (Always) for ease of administration. The preliminary item pool, consisting of 20 items (10 for procrastination and 10 for precrastination), was pilot tested with a small, diverse sample ($N=20$). Participants provided feedback on the clarity and relevance of each item. We used this feedback to further refine the items, ensuring that they were understandable and accurately captured the intended behaviors.

Participants

The total sample size included in the final analyses was 5000 participants split into two studies. Study 1 included 259 individuals with no missing values for sex or age. The ages ranged from 18 to 38 years old, with a mean of 28 and a median of 29. The standard deviation of age is 5 years. More of the sample (154, 59%) is female, while fewer (105, 41%) are male. Study 2 included 4,741 individuals with complete information on sex and age. The age range is from 18 to 38 years old, with a mean of 28 and a median of 28. The standard deviation for age is 6 years. The sample is split between females (2,846, 60%) and males (1,859 or 40%). For cross-cultural comparison purposes, participants were reclassified according to their country of origin (not residence) into continental groupings based on the United Nations geoscheme classification system (e.g., participants originally from Tunisia is classified in Africa and Pakistan is classified in Asia).

Design and procedure

This study employed a cross-sectional survey design to develop and validate the Procrastination and Precrastination Traits Scale. The design consisted of two primary phases: scale development and scale validation. In the first phase, initial items were generated based on theoretical frameworks and existing literature on procrastination and precrastination. Expert reviews and cognitive interviews were conducted to refine the items. In the second phase, the psychometric properties of the scale

were evaluated using exploratory and confirmatory factor analyses, along with assessments of reliability and validity. Data was collected online using social media crowdsourcing platforms.

Measures

The procrastination and precrastination traits scale (PPTS)

The PPTS a psychometric tool that assesses individuals' tendencies towards procrastination and precrastination using 18 items. Originally consisting of 20 items, the scale was refined by removing two items to achieve its final form. Respondents are instructed to rate each statement on a 5-point Likert scale ranging from 1 (Never) to 5 (Always). The scale is divided into two sections. The first section comprises 10 items that evaluate procrastination behaviors, such as delaying important tasks, putting off unpleasant chores, and waiting until the last minute to prepare for deadlines. Sample statements include "I delay getting started on important tasks, even when I know I shouldn't" and "I wait until the last minute to prepare for tests or deadlines." The remaining 8 items measure precrastination tendencies, which involve a prompt and proactive approach to tasks. Examples of these behaviors include completing chores immediately and maintaining organized spaces. Illustrative statements in this section include "I complete tasks as soon as possible to get them out of the way" and "I keep my work and living spaces consistently neat and organized."

The pure procrastination scale (PPS)

The Pure Procrastination Scale (PPS) [44] measures procrastination behaviors in various domains of life [44]. The scale consists of 12 items that are rated on a 5-point Likert scale ranging from "1" (very rarely or does not represent me) to "5" (very often or always represents me). The items cover a range of procrastination behaviors such as delay in starting or completing tasks, postponing decisions, and the inability to meet deadlines. The PPS has demonstrated strong psychometric properties in various further studies Cronbach $\alpha > 0.75$ [19, 44–47].

The satisfaction with life scale (SWLS)

The SWL [48] was employed to determine the convergent validity of the PPTS. The SWLS is a well-known and widely used measure for assessing overall cognitive evaluations of life satisfaction. It employs a 7-item Likert scale for responses, with options ranging from 1 (indicating "strongly disagree") to 7 (indicating "strongly agree"). Higher scores indicate higher levels of life satisfaction [48]. The scale's reliability and validity have been demonstrated in numerous studies conducted worldwide [48–51].

Ethical issues

Ethical approval was granted by the departmental review committee at COMSATS University with the code CUI-ISB/HUM/ERC-CPA/2024–011. All the procedures performed in this study were in accordance with the 1964 Helsinki Declaration and its subsequent amendments.

Data analysis plan

Before conducting the analyses, the data were visualized to check for normality and identify potential outliers. Appropriate data screening and cleaning procedures were followed to ensure that the assumptions of the statistical tests were met. Several strategies were employed to ensure data integrity. Initially, missing values and outliers were identified through visual inspection of distributions and descriptive statistics, including extreme *z*-scores (± 3.29). To detect potential automated or careless responses, repetitive sequences, such as consecutive identical answers across items, were flagged algorithmically. Additionally, monotonous response patterns, exemplified by straight-lining "1" or "5" across all items, were analyzed using variance thresholds. Response time stamps were also reviewed to identify implausibly rapid completions, defined < 2 s per item). Suspect cases were cross-verified manually, and participants exhibiting these patterns (only $n = 11$) were excluded to minimize noise. Normality assumptions were confirmed via skewness (-0.8 to 0.7) and kurtosis (-1.1 to 1.3) indices, and multicollinearity was assessed using variance inflation factors ($VIF < 5$). Descriptive statistics were used for categorical and continuous data.

The data analysis followed several steps. First, an exploratory factor analysis was conducted on the initial 20-item procrastination and precrastination traits scale to examine the underlying factor structure. The number of factors retained in the EFA was determined using a combination of statistical and theoretical criteria. First, the Kaiser-Guttman criterion (eigenvalues > 1) was applied. Second, a scree plot was visually inspected. Items with primary factor loadings < 0.40 or cross-loadings $>$ below 0.40 or cross-loadings above 0.30 were identified for removal to enhance clarity. The maximum likelihood extraction method and no rotation were employed. Factor loadings, uniqueness values, and model fit indices were evaluated to identify and remove problematic items. After scale refinement based on the exploratory analysis, a confirmatory factor analysis was performed on the final 18-item scale using the maximum likelihood estimation method. Multiple fit indices (e.g., CFI, TLI, RMSEA, SRMR) were examined to assess the goodness-of-fit of the model. Factor loadings, residual variances, average variance extracted, and the heterotrait-monotrait ratio were calculated and reported.

To comprehensively evaluate the factor structure of the PPTS, we CFA on both a hypothesized two-factor model and a single-factor model. This approach allowed us to systematically compare the model fit and determine the most appropriate factor structure for the scale.

To evaluate the reliability of the scale, coefficient ω and coefficient α were computed for each factor (procrastination and precrastination). Convergent and divergent validity were assessed by correlating the two factors with established measures of pure procrastination and life satisfaction. Potential differences in procrastination and precrastination scores across geographical regions were investigated using a one-way ANOVA. The assumption of homogeneity of variances was tested using Levene's test. Since the assumption was met and the ANOVA was not significant, post-hoc tests were not conducted. The *p*-value was set at < 0.05 for all analyses. Commonly accepted thresholds for model fit indices include CFI and TLI ≥ 0.90 (acceptable) and ≥ 0.95 (excellent), RMSEA ≤ 0.08 (acceptable) and ≤ 0.05 (excellent), and SRMR < 0.08 (good fit). Sampling adequacy is guided by KMO ≥ 0.60 (adequate) and ≥ 0.80 (meritorious), with Bartlett's test ($p < 0.05$) confirming factorability. For validity, AVE ≥ 0.50 supports convergent validity, while HTMT ratios < 0.85 – 0.90 indicate discriminant validity. Reliability standards suggest ω and $\alpha \geq 0.70$ (acceptable) and ≥ 0.80 (good). All analyses were performed using STATA SE 17 software.

Results

An exploratory factor analysis was conducted on the initial 20-item Procrastination and Precrastination Traits Scale using maximum likelihood extraction and no rotation ($N = 259$). The analysis revealed two distinct factors (based on eigenvalues > 1 , and scree plot inflection), as shown in Table 1. Factor 1 appeared to represent the procrastination construct, with items Proc1 through Proc10 loading highly on this factor (factor loadings ranging from 0.45 to 0.75). These items captured various procrastination tendencies, including delaying important tasks (Proc1), postponing unpleasant obligations (Proc2, Proc3), last-minute preparation (Proc4), self-handicapping beliefs (Proc5), prioritizing distractions over important tasks (Proc6), procrastinating on health habits (Proc7), delaying decision-making (Proc8), leaving communications unanswered (Proc9), and allowing disorganization due to postponement (Proc10). Factor 2 seemed to reflect the precrastination construct, with items Prec1 through Prec3 and Prec5 through Prec9 loading highly (factor loadings ranging from 0.50 to 0.90). These items captured behaviors indicative of precrastination, such as completing tasks immediately (Prec1, Prec2), tackling unpleasant tasks without delay (Prec3), getting ahead of

Table 1 Exploratory factor analysis of the initial version of the procrastination and precrastination traits scale (20-items) $N = 259$ participants

Item	Factor Loadings		
	Factor 1	Factor 2	Uniqueness
Proc1	0.70		0.50
Proc2	0.50		0.71
Proc3	0.50		0.64
Proc4	0.45		0.72
Proc5	0.74		0.46
Proc6	0.66		0.59
Proc7	0.63		0.56
Proc8	0.75		0.46
Proc9	0.58		0.68
Proc10	0.47		0.73
Prec1		0.67	0.55
Prec2		0.67	0.59
Prec3		0.50	0.70
Prec4	-0.54		0.75
Prec5		0.50	0.65
Prec6			0.90
Prec7		0.53	0.65
Prec8		0.62	0.61
Prec9		0.62	0.64
Prec10	-0.54		0.75

Maximum likelihood extraction method was used in combination with no rotation

Factor 1 = Procrastination and Factor 2 = Precrastination

Abbreviations 'Proc' = Procrastination and 'Prec' = Precrastination

Based on exploratory factor analysis items Prec4 and Prec10 were suggested for deletion

Proc1 = I delay getting started on important tasks, even when I know I shouldn't

Proc2 = I keep putting off unpleasant chores or obligations

Proc3 = I find myself aimlessly browsing instead of working

Proc4 = I wait until the last minute to prepare for tests or deadlines

Proc5 = I tell myself I'll get more done "tomorrow" rather than following through today

Proc6 = I waste time on unimportant distractions instead of priorities

Proc7 = I procrastinate on health habits like exercise, diet, or appointments

Proc8 = I unnecessarily delay making even small decisions

Proc9 = I leave emails, messages or calls unanswered for too long

Proc10 = My spaces become cluttered and disorganized from postponing cleaning/organizing

Prec1 = I complete tasks as soon as possible to get them out of the way

Prec2 = I take care of chores or obligations immediately rather than delaying

Prec3 = I tackle unpleasant tasks right away without postponing

Prec4 = I start working on assignments or projects immediately rather than waiting

Prec5 = I try to get things done ahead of schedule when possible

Prec6 = I don't postpone making decisions, even on small matters

Prec7 = I reply to messages, emails, or calls promptly without delay

Prec8 = I keep my work and living spaces consistently neat and organized

Prec9 = I don't wait for deadlines to start on important tasks or goals

Prec10 = At work/school, I complete things well before they are due

schedule (Prec5), avoiding postponement of decisions (Prec6), prompt communication responses (Prec7), consistent organization (Prec8), and not waiting until deadlines (Prec9). However, two items exhibited problematic factor loadings. Prec4 ("I start working on assignments or projects immediately rather than waiting") had a negative cross-loading of -0.54 on Factor 1, while Prec10 ("At work/school, I complete things well before they are due") also cross-loaded negatively at -0.54 on Factor 1. The uniqueness values for these two items were high (0.75 for both), suggesting they may not be reliable indicators of the intended precrastination construct. Based on these results, Prec4 and Prec10 were identified as potential candidates for removal from the scale. See Table 1.

A confirmatory factor analysis was conducted on the final 18-item Procrastination and Precrastination Traits Scale with a large sample ($N = 4741$). The analysis revealed a two-factor structure, aligning with the proposed constructs of procrastination (Factor 1) and precrastination (Factor 2). All items loaded significantly on their respective factors, with factor loadings ranging from 0.55 to 0.72 for procrastination items and 0.24 to 0.68 for precrastination items. However, item Prec6 ("I don't postpone making decisions, even on small matters") had a relatively low factor loading of 0.24 on the precrastination factor. The model demonstrated good fit based on multiple indices, including the CFI (0.94), TLI (0.93), NNFI (0.93), and RMSEA (0.05). The SRMR value of 0.04 also indicated good fit. Preliminary analyses supported the use of factor analysis, with a KMO of 0.93 and a significant Bartlett's test. The average variance extracted was 0.39 for the procrastination factor and 0.32 for the precrastination factor. The heterotrait-monotrait ratio of 0.67 suggested some overlap between the two factors. Reliability analyses showed good internal consistency for the procrastination factor ($\omega = 0.86$, $\alpha = 0.87$) and acceptable reliability for the precrastination factor ($\omega = 0.79$, $\alpha = 0.77$). See Table 2.

When comparing the two-factor and one-factor models, the two-factor model demonstrated substantially better fit indices. The one-factor model exhibited notably lower fit indices, with the CFI at 0.789, TLI at 0.762, and RMSEA at 0.087, which are considerably less optimal compared to the two-factor model's CFI of 0.94 and RMSEA of 0.05. These results suggest that the two-factor structure more accurately represents the underlying construct of procrastination and precrastination traits.

To assess convergent and divergent validity, the final 18-item PPTS was correlated with the established PPS and the SWLS in a large sample ($N = 4741$). The procrastination factor (Factor 1) exhibited a strong positive correlation with the PPS ($r = 0.80$, $p < 0.001$), providing evidence of convergent validity. As expected, the

Table 2 Confirmatory factor analysis and reliability analysis of the final version of the procrastination and precrastination traits scale (18-items) N = 4741 participants

Factor loadings						Residual variances			
Factor	Indicator	Value	SE	z-value	p-value	Value	SE	z-value	p-value
Factor 1	Proc1	0.63	0.02	45.38	<0.001	0.61	0.02	44.02	<0.001
	Proc2	0.55	0.02	38.71	<0.001	0.7	0.03	45.69	<0.001
	Proc3	0.62	0.02	44.39	<0.001	0.62	0.03	44.14	<0.001
	Proc4	0.57	0.02	40.32	<0.001	0.67	0.03	45.21	<0.001
	Proc5	0.65	0.02	47.57	<0.001	0.58	0.02	43.59	<0.001
	Proc6	0.69	0.02	50.98	<0.001	0.53	0.02	42.24	<0.001
	Proc7	0.6	0.02	43.25	<0.001	0.64	0.03	44.7	<0.001
	Proc8	0.72	0.02	54.22	<0.001	0.48	0.02	41.08	<0.001
	Proc9	0.67	0.02	49.09	<0.001	0.56	0.02	43.1	<0.001
	Proc10	0.58	0.02	40.82	<0.001	0.67	0.03	45.27	<0.001
Factor 2	Prec1	0.67	0.02	47.71	<0.001	0.55	0.03	39.84	<0.001
	Prec2	0.63	0.02	43.64	<0.001	0.61	0.03	41.72	<0.001
	Prec3	0.68	0.02	48.47	<0.001	0.54	0.02	39.45	<0.001
	Prec5	0.52	0.02	35.35	<0.001	0.72	0.03	44.64	<0.001
	Prec6	0.24	0.02	15.36	<0.001	0.94	0.04	48	<0.001
	Prec7	0.52	0.02	34.88	<0.001	0.73	0.03	44.79	<0.001
	Prec8	0.61	0.02	41.95	<0.001	0.63	0.03	42.49	<0.001
	Prec9	0.57	0.02	39.35	<0.001	0.67	0.03	43.43	<0.001

Maximum likelihood extraction method was used in combination with no rotation
 Factor 1 = Procrastination and Factor 2 = Precrastination
 Abbreviations 'Proc' = Procrastination and 'Prec' = Precrastination
 Based on exploratory factor analysis items Prec4 and Prec10 were deleted
 Proc1 = I delay getting started on important tasks, even when I know I shouldn't
 Proc2 = I keep putting off unpleasant chores or obligations
 Proc3 = I find myself aimlessly browsing instead of working
 Proc4 = I wait until the last minute to prepare for tests or deadlines
 Proc5 = I tell myself I'll get more done "tomorrow" rather than following through today
 Proc6 = I waste time on unimportant distractions instead of priorities
 Proc7 = I procrastinate on health habits like exercise, diet, or appointments
 Proc8 = I unnecessarily delay making even small decisions
 Proc9 = I leave emails, messages or calls unanswered for too long
 Proc10 = My spaces become cluttered and disorganized from postponing cleaning/organizing
 Prec1 = I complete tasks as soon as possible to get them out of the way
 Prec2 = I take care of chores or obligations immediately rather than delaying
 Prec3 = I tackle unpleasant tasks right away without postponing
 * Prec4 = I start working on assignments or projects immediately rather than waiting
 Prec5 = I try to get things done ahead of schedule when possible
 Prec6 = I don't postpone making decisions, even on small matters
 Prec7 = I reply to messages, emails, or calls promptly without delay
 Prec8 = I keep my work and living spaces consistently neat and organized
 Prec9 = I don't wait for deadlines to start on important tasks or goals
 * Prec10 = At work/school, I complete things well before they are due
 * Removed from original 20 items version
 Model fit
 Baseline model = χ^2 25,141.91, df (153), $p < 0.001$
 Factor model = χ^2 1677.4, df (153), $p < 0.001$
 Fit indices
 Comparative Fit Index (CFI) = 0.94

Table 2 (continued)

Tucker-Lewis Index (TLI) = 0.93
 Bentler-Bonett Non-normed Fit Index (NNFI) = 0.93
 Bentler-Bonett Normed Fit Index (NFI) = 0.93
 Parsimony Normed Fit Index (PNFI) = 0.82
 Bollen's Relative Fit Index (RFI) = 0.92
 Bollen's Incremental Fit Index (IFI) = 0.94
 Relative Noncentrality Index (RNI) = 0.94
 Information criteria
 Log-likelihood = -135,407.43
 Number of free parameters = 55
 Akaike (AIC) = 270,924.85
 Bayesian (BIC) = 271,280.37
 Sample-size adjusted Bayesian (SSABIC) = 271,105.6
 Other fit measures
 Root mean square error of approximation (RMSEA) = 0.05
 RMSEA 90% CI lower bound = 0.05
 RMSEA 90% CI upper bound = 0.05
 RMSEA p-value = 0.71
 Standardized root mean square residual (SRMR) = 0.04
 Hoelter's critical N ($\alpha=0.05$) = 458.92
 Hoelter's critical N ($\alpha=0.01$) = 495.61
 Goodness of fit index (GFI) = 0.99
 McDonald fit index (MFI) = 0.85
 Expected cross validation index (ECVI) = 0.38
 Kaiser-Meyer-Olkin (KMO) test = 0.93
 Bartlett's test of sphericity = χ^2 25,100.37, df (153), $p < 0.001$
 Average variance extracted
 Factor 1 = 0.39
 Factor 2 = 0.32
 Heterotrait-Monotrait Ratio
 Factor 1 to Factor 2 = 0.67
 Reliability
 For Factor 1, the coefficient ω is 0.86, and the coefficient α is 0.87
 For Factor 2, the coefficient ω is 0.79, and the coefficient α is 0.77

procrastination factor also demonstrated a moderate negative correlation with the SWLS ($r = -0.47$, $p < 0.001$), suggesting that higher procrastination is associated with lower life satisfaction. In contrast, the precrastination factor (Factor 2) had a moderate negative correlation with the PPS ($r = -0.44$, $p < 0.001$) and a weaker positive correlation with the SWLS ($r = 0.27$, $p < 0.001$). These findings align with the conceptualization of precrastination as the opposite of procrastination, with precrastination being negatively related to pure procrastination and positively associated with life satisfaction. The procrastination and precrastination factors also showed a moderate negative correlation with each other ($r = -0.54$, $p < 0.001$), further supporting their divergent nature as contrasting constructs. The results are presented in Table 3.

The PPTS was computed for a large sample of 5000 participants from six different continents: Africa ($N = 825$),

Asia ($N = 1217$), Australia ($N = 833$), Europe ($N = 885$), North America ($N = 402$), and South America ($N = 838$). A one-way ANOVA was conducted to examine differences in procrastination and precrastination scores across the continents.

For procrastination scores, the ANOVA results showed no significant difference between the six continent groups, $F(5, 4994) = 1.48$, $p = 0.218$. The mean procrastination scores were relatively similar, ranging from 25.77 (North America) to 26.70 (Australia), with small standard deviations between 7.24 (Asia) and 7.90 (North America). Levene's test for homogeneity of variances was not significant ($p = 0.052$), suggesting that the assumption of equal variances was met.

Similarly, for precrastination scores, the one-way ANOVA revealed no significant differences across the six continents, $F(5, 4994) = 0.974$, $p = 0.432$. The mean

Table 3 Convergent and divergent validity of the final version of the procrastination and precrastination traits scale (18-items) with the 12-item pure procrastination scale (PPS) and the satisfaction with life scale (SWLS) N = 4741 participants

Variables	Factor 1	Factor 2	PPS	SWLS
Factor 1	-			
Factor 2	-0.54*	-		
PPS	0.80*	-0.44*	-	
SWLS	-0.47*	0.27*	-0.39*	-

Factor 1 = Procrastination and Factor 2 = Precrastination of the procrastination and precrastination traits scale (18-items)

PPS = the 12-item Pure Procrastination Scale

SWLS = the satisfaction with life scale

* p-value < 0.001

Table 4 Differences, homogeneity, and variance between the procrastination and precrastination traits scale (18-items) scored between continents N = 5000 participants

Continent	N	Procrastination	Precrastination
Africa	825	26.52 ± 7.46	25.59 ± 6.95
Asia	1217	26.61 ± 7.24	25.45 ± 6.67
Australia	833	26.70 ± 7.29	25.39 ± 7.04
Europe	885	26.46 ± 7.38	25.91 ± 6.97
North America	402	25.77 ± 7.90	25.88 ± 6.46
South America	838	26.05 ± 7.44	25.87 ± 6.89

One-Way ANOVA (Fisher's)

The F-statistic for procrastination is 1.48 with degrees of freedom 5 and 4994. The p-value is 0.218. The F-statistic for precrastination is 0.974 with degrees of freedom 5 and 4994. The p-value is 0.432

Homogeneity of Variances Test (Levene's)

The F-statistic for the homogeneity of variances test for procrastination is 2.2 with degrees of freedom 5 and 4994. The p-value is 0.052. The F-statistic for the homogeneity of variances test for precrastination is 2.17 with degrees of freedom 5 and 4994. The p-value is 0.06

precrastination scores ranged from 25.39 (Australia) to 25.91 (Europe), with standard deviations between 6.46 (North America) and 7.04 (Australia). Levene's test for homogeneity of variances was also not significant ($p = 0.06$), indicating homogeneous variances. See Table 4.

Discussion

We initially developed a novel scale named the PPTS, which contains 20 items. Using a medium sample of 259 participants, the items of the initial version clustered into two distinct factors, aligning with the intended constructs of procrastination and precrastination. However, Prec4 and Prec10 did not load well on either factor, suggesting potential issues with those items. In a larger confirmatory sample, the 18-item scale showed an adequate two-factor structure representing procrastination and

precrastination, with most fit indices meeting criteria for good model fit. Reliability was good for the procrastination factor and acceptable for the precrastination factor. There was still some overlap between the two factors based on the heterotrait-monotrait ratio. The correlations observed in this large sample provide evidence for the convergent and divergent validity of the PPTS. The procrastination factor demonstrated strong convergence with an established procrastination measure and showed the expected negative relationship with life satisfaction. Conversely, the precrastination factor exhibited divergence from procrastination tendencies and a positive association with life satisfaction. Our results showed that procrastination and precrastination scores did not significantly differ across the six continents represented in the sample. The variances were relatively homogeneous for both procrastination and precrastination scores. These findings suggest that the PPTS may be measuring constructs that are consistent across diverse geographical regions and cultures.

The items of procrastination developed in our scale refer to the already established indicators of procrastination. Item 1 depicts the delay in initiating tasks (I delay getting started on important tasks, even when I know I shouldn't). Delaying tasks has been regarded as a core aspect of procrastination [52–54]. Item 2 projects the avoidance of unpleasant tasks (I keep putting off unpleasant chores or obligations). The tendency to avoid unpleasant chores or obligations has also been regarded as an integral part of procrastination in earlier studies [55, 56]. Item 3 reflects engagement in distracting activities (I find myself aimlessly browsing instead of working). Spending time on aimless or unimportant activities instead of focusing on work has been regarded as a significant indicator of procrastination [18, 24, 25]. Item 4 depicts last-minute preparation (I wait until the last minute to prepare for tests or deadlines). Studies reveal that preparation for tests or deadlines in procrastination is often delayed until the last minute [57–60]. Item 5 links our scale with rationalization in postponement (I tell myself I'll get more done tomorrow rather than following through today). Studies reveal that during procrastination, individuals tend to rationalize their delays and based on their own rationalization, they postpone tasks to the future [60, 61]. Item 6 depicts neglect of priorities (I waste time on unimportant distractions instead of priorities). In procrastination, time is wasted on distractions instead of addressing priorities [27, 62, 63]. Item 7 highlights procrastination on health-related tasks (I procrastinate on health habits like exercise, diet, or appointments). The habits of individuals related to health have also been studied extensively and it has been found that such people delay their health-related appointments

[64–66]. Item 8 reflects indecision (I unnecessarily delay making even small decisions). In procrastination, there is unnecessary delay in making even small decisions [13, 19, 29, 67]. Item 9 projects delayed communication (I leave emails, messages, or calls unanswered for too long). Responses to emails, messages, or calls are postponed for too long in procrastination [68]. Item 10 relates to disorganization (My spaces become cluttered and disorganized from postponing cleaning/organizing). Disorganization is regarded as an outcome of procrastination which reflects the disorganized environment such as a bedroom or office where delays in cleanliness can be easily observed [69, 70]. The ten items of our scale that relate to procrastination, therefore, cover both behavioral tendencies and cognitive processes behind behaviors.

The second part of our scale relates to precrastination. In precrastination, people tend to be proactive and desire to complete their tasks immediately. The CFA establishes that 8 out of 10 items of precrastination were statistically validated. Item 1 of our precrastination scale depicts the urgency in completing tasks (I complete tasks as soon as possible to get them out of the way). Previous studies highlight this focus on completing tasks as soon as possible during procrastination [27, 62, 71, 72]. Item 2 reflects the immediate attention to obligations (I take care of chores or obligations immediately rather than delaying). In precrastination, chores or obligations are addressed immediately rather than being delayed [40, 41, 73]. Item 3 highlights the prompt handling of unpleasant tasks (I tackle unpleasant tasks right away without postponing). The tendency to tackle unpleasant tasks right away is a prominent feature of procrastination [56, 74]. Item 5 focuses on the proactive approach to meeting deadlines (I try to get things done ahead of schedule when possible). In precrastination, there is always an effort to complete tasks ahead of schedule whenever possible [27, 33, 40, 41]. Item 6 depicts prompt decision making (I don't postpone making decisions, even on small matters). Literature suggests that people involved in precrastination make their decisions promptly without delay, even on small matters [12, 75, 76]. Item 7 projects timely communication (I reply to messages, emails, or calls promptly without delay). In precrastination, messages, emails, or calls are replied to without delay [21, 40]. Item 8 highlights consistent organization (I keep my work and living spaces consistently neat and organized). A significant tendency of people with precrastination is their ability to keep their work and living spaces neat and organized [24]. The last item of our precrastination scale reflects the proactive initiation of important tasks (I don't wait for deadlines to start on important tasks or goals). It is also prevalent among people with precrastination to start their important tasks or goals well before

deadlines [24, 59, 77, 78]. The eight items validated in our precrastination scale, therefore, cover all the known behaviors and attributes of people with precrastination.

The model comparison revealed important insights into the factor structure of procrastination and precrastination. While the one-factor model provided a less satisfactory fit, the two-factor model strongly supported the distinction between procrastination and precrastination as separate but related constructs. This finding aligns with theoretical perspectives suggesting that these traits, while interconnected, represent distinct psychological mechanisms. The lower fit indices of the one-factor model underscore the importance of maintaining the two-factor structure in future research and scale applications.

Implications

The development and validation of the PPTS have several practical implications for future research and practice. The most significant aspect of our scale is its combination of procrastination and precrastination under one platform. This will enable researchers and clinicians to easily identify if a person is inclined toward procrastination or precrastination. The identification of both of these conditions would further lead to adequate interventions. The PPTS can also be highly beneficial in an organizational context, whereby employers can assess the procrastination and precrastination tendencies of their human resources. Another prominent implication of the PPTS would be in education, whereby teachers and students can use this scale to improve academic achievements.

The development of the PPTS marks a significant advancement in measuring both procrastination and precrastination within a unified framework. However, we recognize several important considerations regarding the interpretation of our findings. First, although the scale exhibits strong psychometric properties, its cross-cultural consistency should be interpreted with caution due to the uneven distribution of our sample across geographic regions. Second, while the observed correlations between the PPTS factors and established measures ($r=0.80$ with the PPS) provide initial evidence for validity, these relationships primarily validate the procrastination component of our scale. The precrastination dimension necessitates further validation against behavioral measures, as no gold-standard comparison instrument currently exists. Third, the moderate negative correlation between procrastination and life satisfaction ($r=-0.47$), while theoretically significant, should not be overinterpreted, as these constructs likely influence each other through complex, bidirectional pathways. These considerations underscore that our findings, while promising, represent an initial rather than definitive step in understanding how

these temporal self-regulation strategies operate independently and in relation to one another.

Limitations and suggestions

Although we successfully collected online data from 5000 respondents from Africa, Asia, Australia, Europe, North America, and South America, we were unable to include the elderly population.

The primary limitation of this study is its narrow demographic focus, which exclusively sampled young adults. This restricted age range raises significant concerns regarding the generalizability of the PPT) across various life stages and developmental contexts. While our theoretical framework recognizes the complexity of task completion behaviors, the current sample does not adequately represent the potentially distinct manifestations of procrastination and precrastination among older adults, professionals, or individuals in diverse life circumstances.

Additionally, the methodological approach presents further limitations that warrant careful examination. The reliance on self-reported data introduces inherent biases that may undermine the scale's objectivity. Self-report measures are particularly vulnerable to social desirability bias, subjective interpretations by participants, and potential misrepresentations of their own behavioral tendencies. This limitation is especially pronounced when investigating complex psychological constructs such as procrastination and precrastination, where individuals may possess limited self-awareness or motivation to report their behaviors accurately.

Moreover, the cross-sectional design of our study constitutes a significant methodological constraint. Although we successfully established the psychometric properties of the PPTS, the research design precludes any meaningful insights into the developmental trajectories and dynamic interactions of procrastination and precrastination over time. The static nature of our approach fails to capture the potential contextual and temporal variations in task completion behaviors, leaving critical questions about the stability and malleability of these traits unresolved. Finally, we could measure the convergent validity of the Procrastination subscale only and did not assess the convergent validity of the Precrastination subscale, mainly due to the absence of any validated measure on procrastination.

Conclusion

The current study developed and validated the PPTS involving 500 respondents. The PPTS is unique in that it measures both procrastination and precrastination simultaneously, allowing for a valid differential assessment between these two interconnected mental conditions. We believe

that our study represents a significant advancement in the field of procrastination research. The newly developed scale will undoubtedly find applications in educational, organizational, and clinical settings, as well as in social surveys.

Abbreviations

AIC	Akaike Information Criterion
ANOVA	Analysis of Variance
CFI	Comparative Fit Index
CFA	Confirmatory Factor Analysis
EFA	Exploratory Factor Analysis
GFI	Goodness of Fit Index
KMO	Kaiser–Meyer–Olkin
MFI	McDonald Fit Index
NNFI	Bentler–Bonett Non-normed Fit Index
PPTS	Procrastination and Precrastination Traits Scale
PPS	Pure Procrastination Scale
RMSEA	Root Mean Square Error of Approximation
SE	Standard Error
SD	Standard Deviation
SRMR	Standardized Root Mean Square Residual
SWLS	Satisfaction with Life Scale
TLI	Tucker–Lewis Index

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s40359-025-03072-6>.

Supplementary Material 1.

Acknowledgements

None.

Authors' contributions

Author Contributions: Conceptualization: WH and HJ; Data Collection: WH, ZS, HJ; Data Analysis: WH and HJ; Writing and Reviewing the manuscript: WH, KT, AA, ZS, and HJ.

Funding

Open Access funding enabled and organized by Projekt DEAL. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data availability

Availability of data and materials: The corresponding author can provide the data upon request.

Declarations

Ethics approval and consent to participate

Ethical approval was granted by the departmental review committee at COMSATS University Code CUI-HSB/HUM/ERC-CPA/2024–011. Informed consent was obtained from the participants. All the procedures performed in this study were in accordance with the 1964 Helsinki Declaration and its later amendments.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Received: 2 February 2025 Accepted: 25 June 2025

Published online: 10 July 2025

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