


Self-regulation and procrastination in college students: A tale of motivation, strategy, and perseverance

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Abstract

Procrastination is a delay in an intended course of action and, thus, a self-regulation failure hindering growth and well-being. Contrarily, self-regulation is a set of cognitive and metacognitive skills and strategies supporting goal-directed behavior. There is ongoing discussion regarding the extent to which (and the ways in which) promoting self-regulation may counteract procrastination. On the one hand, it is argued that procrastination is linked with stable personal dispositions; on the other hand, it is said that this problematic behavior is associated with contextual influences. To deepen the understanding of these relationships, we used structural equation modeling (SEM) to test a theory-driven model integrating four self-regulation factors (goal setting, decision making, persevering, and learning from mistakes) and two measures of procrastination (irrational and academic). We hypothesized that goal setting, decision making, and perseverance would sequentially mediate between learning from mistakes and procrastination outcomes, thus, suggesting that cognitive-motivational (learning from mistakes, goal setting), strategic (decision making), and volitional (perseverance) factors may all be necessary for successful self-regulation, which could

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potentially be promoted by contextual influences. Participants of the present study were 433 Chilean university students (304 women, 129 men, $M = 20.74$ years, $SD = 2.86$) who completed measures for procrastination and self-regulation. Findings support the important roles of goal setting and perseverance for successful self-regulation and suggest that goal setting may mediate the effects of learning from mistakes on perseverance and decision making; whereas perseverance may mediate the effects of goal setting and decision making on procrastination variations. These results suggest that the negative effects of motivational and strategic factors of self-regulation on procrastination may depend at least partly on the abilities to improve goals and persevere. Taking into account these critical roles in dealing with procrastination, it seems appropriate to support college students' self-regulation skills and strategies, raising awareness about the indispensability of adequate goal setting and persistence in following through with intended courses of action.

KEYWORDS

perseverance, procrastination, self-regulation, structural equation modeling (SEM), university students

Practitioner Points

- Student procrastination reflects failed behavioral self-regulation.
- Motivation, strategy, and implementation are required to avoid procrastination.
- Teachers must provide ongoing support for goals, decisions, and perseverance.

1 | INTRODUCTION

The aim of the present study is to extend existing knowledge about the relationships between self-regulation and procrastination, by way of analyzing the direct and indirect roles of specific self-regulation factors in the prediction of procrastination variations. Recent factor-analytical work (Garzón-Umerenkova et al., 2017) has seen four factors emerge in the study of self-regulation, which correspond to a great extent with previous conceptualizations of self-regulation as a stepwise and cyclical construct, including a cognitive-motivational dimension (learning from mistakes and goal setting), a strategic one (decision making), and a volitional one (persevering). We use these factors to propose a theory-based structural model to explore some specific roles that each of these factors could play in the prediction of procrastination variations. In line with previous literature, cognitive-motivational factors are hypothesized to have positive effects on strategic and volitional ones, the latter in turn negatively predicting

procrastination variations. A disposition-based explanation of procrastination precludes the possibility of contextual change. Contrarily, the viability of the theory-based structural model we propose suggests the possibility of influencing the highly important volitional dimension via contextual influences on previous cognitions, motivation, and strategy. These factors may thus prove helpful for teachers and others searching for psycho-social interventions to optimize students' chances of keeping focus and persevering throughout their learning processes.

1.1 | Procrastination: A self-regulation failure, a pressing problem among students

Procrastination—behaviorally—is the delay in an intended course of action that becomes problematic (Steel, 2010); and—formally—it is defined as a self-regulation failure (Pychyl & Flett, 2012; Steel, 2007) or as a subpar conscious self-control over one's own actions (Steel & Ferrari, 2013). Approximately eight in 10 students procrastinate despite its undesirable yet foreseeable consequences on various areas of life (Steel & Ferrari, 2013), including poor academic performance (Balkis et al., 2013; Beswick et al., 1988; Fritzsche et al., 2003; Zhang et al., 2018), poor time management (Knaus, 2000), increased risk of worsening physical and mental health (Fernie et al., 2016; Flett et al., 2016; Khalid et al., 2019; Rice et al., 2012; Saddler & Sacks, 1993; Sirois & Tosti, 2012; Sirois et al., 2003; Stead et al., 2010), and worsening financial situation (Klingsieck et al., 2013).

It is contested whether procrastination is best conceptualized as a general relatively stable personal tendency which pre-exists and accounts for an individual's procrastination behavior in general and in specific contexts (such as the academic one); or if, alternatively, it is best understood as a context-dependent construct, insofar it results from the interplay between cognitions, motivation, behavior, and the specific characteristics of a given context. On the one hand, some conceptualizations of procrastination and their corresponding measures, such as irrational procrastination (Steel, 2010), have focused on the nuclear aspect of procrastination, implemental delay, arguing that procrastination is irrational in nature and closely linked with stable personal dispositions, making some people high procrastinators. On the other hand, given the higher prevalence of this problem among students, it has been researched in the academic setting and it has been argued that, specifically, academic procrastination (AP) may be associated with context-based evaluations of academic tasks such as writing papers, studying for exams, and reading materials. In line with this argument, AP has been conceptualized and measured as individuals' affective, cognitive, and behavioral reactions to specific characteristics of tasks and contexts that interact to predict procrastination variations (Solomon & Rothblum, 1984). Similarly, procrastination among students has been found to be associated with indecision and irrational beliefs about the self (Beswick et al., 1988).

As such, AP (implemental delay in academic tasks and resulting psychological distress) is sensitive to contextual conditions and thus is studied as a separate construct in the setting of academic learning. In this regard, it is relevant to explore if irrational procrastination and AP are strongly associated with each other and if their variations can be explained by self-regulation factors to similar degrees and via similar effects, or if alternatively self-regulation factors yield differential effects on the variations of these two types of procrastination. All in all, it is contested whether AP is a specific reflection (specifically in the academic domain) of a pre-existing individual irrational procrastination tendency, or if, alternatively, irrational procrastination is a specific step within a sequence of self-regulation failures, including inadequate goals and evaluations, and delayed decision and volition, resulting in a slip into irrationality, implemental delay, and psychological distress.

1.2 | General self-regulation and self-regulation in academic learning

For its part, the concept of self-regulation stems from the ideas of Kanfer (1970) about self-monitoring, which is considered an indispensable component of behavioral control. In this context, self-regulation has been defined as an ability to decide, enact, and flexibly maintain planned behavior aimed at attaining one's own goals (Brown, 1998). Self-regulation was first conceptualized to help promote behavior change and was said to comprise seven steps

(Miller & Brown, 1991): information reception and evaluation, change initiation, option search, planning, implementation, and assessment. Nonetheless, self-regulation is argued to be a more general disposition which can operate in diverse areas such as academic learning.

1.2.1 | Cyclical phases or steps of self-regulation

Research into self-regulation in academic learning has distinguished three cyclically concatenated phases: forethought, performance, and self-reflection (Zimmerman & Campillo, 2003) and has also identified four cyclically concatenated steps: goal setting and strategic planning; strategy implementation and monitoring; strategic outcome monitoring; and self-evaluation and monitoring (Zimmerman et al., 1996). General self-regulation theories and theories about self-regulation in academic learning coincide in highlighting the cyclical nature of this construct. For instance, considering phases, a self-reflection phase (occurring after the performance phase), reinforces a subsequent forethought phase (with implications for a future performance phase). Also, a self-evaluation and monitoring step reinforces or feeds back into an improved future goal setting and strategic planning step.

1.2.2 | Critical dimensions of self-regulation

Apart from the sequential conceptualizations based on phases or steps, self-regulation has been argued to be based on three distinct pillars or dimensions whose processes may overlap in time (Kuhl, 1987; Ryan & Deci, 2017): first, a cognitive-motivational dimension (typically involved in forethought and self-reflection phases, in which goals are—respectively—set and monitored); second, a strategic dimension (typically expressed in decision making); and third, a volitional dimension (typically reflected in the tenacity to maintain a planned course of action in spite of obstacles during performance). On a cognitive-motivational dimension, goals are set, but this does not guarantee moving from intention to action (Dewitte & Lens, 2000; Kadzikowska-Wrzosek, 2018; Steel et al., 2018; Zimmerman, 2008). On a strategic dimension, decision making and monitoring are enacted (Zimmerman, 1998) to maintain goal-oriented behavior, for instance, monitoring the attainment of strategic outcomes and steering goal pursuit. On a volitional dimension, specific intentions are generated about how to pursue the goals (Lay, 1986). A four-factor structure (goal setting, decision making, perseverance, and learning from mistakes) has been postulated (Garzón-Umerenkova et al., 2017) which corresponds to a great extent (see Figure 1) with the abovementioned three phases (Zimmerman

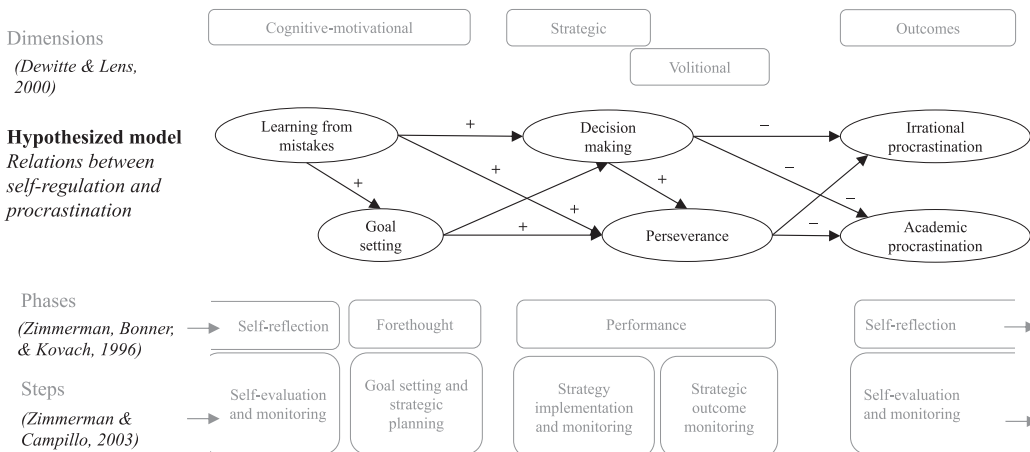


FIGURE 1 Synthesis of self-regulation conceptualizations and hypothesized model.

& Campillo, 2003), four steps (Zimmerman et al., 1996), and three critical dimensions (Dewitte & Lens, 2000; Kadzikowska-Wrzošek, 2018; Kuhl, 1987; Lay, 1986; Ryan & Deci, 2017; Steel et al., 2018; Zimmerman, 1998, 2008). Nonetheless, decision making, as a strategic aspect, and perseverance, as a volitional aspect, extend beyond the performance phase (Zimmerman et al., 1996) whenever strategy or monitoring are relevant.

1.3 | Antecedents in the relationship between student procrastination and self-regulation

Literature shows a negative association between students' self-regulation and procrastination, suggesting that low self-regulation may account for procrastination (Garzón-Umerenkova et al., 2018). The more self-regulated a student, the less probable they procrastinate (Wolters et al., 2005), as students with better self-regulation strategies, show lesser procrastinating behaviors, better academic performance (Grunschel et al., 2016), more adaptive use of cognitive and metacognitive strategies (Wolters, 2003), and more effort and persistence (Wolters et al., 2005; Zhang et al., 2018; Zimmerman, 1998). In fact, people with better self-regulation skills also perceive more well-being (Kadzikowska-Wrzošek, 2018), which suggests that self-regulation may help in avoiding procrastination thus preventing the discomfort resulting from a negative effect on autonomy (Zimmerman, 1998). Furthermore, interventions designed to prevent procrastination via support of self-regulatory processes in learning (Grunschel et al., 2018; Zimmerman, 1998) have recommended considering cognitive, metacognitive, behavioral and volitional aspects simultaneously (Grunschel & Schopenhauer, 2015; Pintrich & De Groot, 1990; Sæle et al., 2017) to counteract procrastination tendencies.

1.4 | The present study

There is an ongoing discussion about how the strategic and volitional aspects of self-regulation—occurring mainly during the performance phase—may mediate between the cognitive-motivational factors—occurring during the forethought phase—and academic outcomes like procrastination. On the one hand, with a focus on the volitional dimension of self-regulation, perseverance has consistently shown to predict adaptive responses to counteract procrastination (Lam & Zhou, 2019; Rebetz et al., 2018; Wolters & Hussain, 2015; Wypych et al., 2018), such as the ability to complete projects (Dewitte & Schouwenburg, 2002), thus, potentially preventing proclivity to irrational procrastination (Burka & Yuen, 1983; Silver & Sabini, 1981). On the other hand, with a focus on the strategic dimension, decision making is important for self-regulation, as providing students with autonomous decision over their learning processes promotes self-regulated learning (Pintrich & De Groot, 1990; Wolters & Hussain, 2015; Zimmerman, 2008). Furthermore, decision making may partially mediate the predictive effects of the cognitive motivational factors of learning from mistakes and goal setting on procrastination variations (Valenzuela et al., 2020).

There are few studies that use these four self-regulation factors (Garzón-Umerenkova et al., 2017) to conjointly analyze their predictive effects on procrastination variations, via cognitive-motivational, strategic, and volitional factors of self-regulation. The goal of the present study was to assess the effects of these factors on irrational and AP variations via structural equation modeling, in this way testing theory-derived focal interests. This extends—to these four factors—evidence of self-regulation being cyclical and sequential (Zimmerman, 2008). In this regard, we assessed whether learning from mistakes (self-reflection phase) positively predicts variations in goal setting, decision making, and perseverance (forethought and performance phases). With this same interest, we explored the potential mediating role of goal setting between learning from mistakes and performance phase factors of decision making and perseverance. Furthermore, with an interest in the sequential nature of self-regulation, we analyzed the

potential sequential mediating roles of decision making and perseverance (strategic and volitional factors, in the performance phase) between goal setting (cognitive-motivational factor, in forethought phase) and procrastination variations.

The hypothesized model contributes to the understanding of the relationships between procrastination and self-regulation factors, exploring their specific roles and correspondences with phases, steps, and dimensions of self-regulation. We contribute specificity and theorization to the analyses supporting the reflections for intervention and policy-making among teachers and officials responsible for the prevention of student procrastination. Based on the above, we derived the following hypotheses:

Hypothesis 1. learning from mistakes positively and directly predicts variations in goal setting (H1a), decision making (H1b), and perseverance (H1c).

Hypothesis 2. goal setting mediates between learning from mistakes and performance phase factors of decision making and perseverance. (Hypothesis 2a: goal setting mediates between learning from mistakes and decision making. Hypothesis 2b: goal setting mediates between learning from mistakes and perseverance.)

Hypothesis 3. decision making and perseverance mediate between goal setting and procrastination. (Hypothesis 3a: decision making mediates between goal setting and irrational procrastination variations. Hypothesis 3b: perseverance mediates between goal setting and irrational procrastination variations. Hypothesis 3c: decision making and perseverance sequentially mediate between goal setting and irrational procrastination variations. Hypothesis 3d: decision making mediates between goal setting and academic procrastination variations. Hypothesis 3e: perseverance mediates between goal setting and academic procrastination variations. Hypothesis 3f: decision making and perseverance sequentially mediate between goal setting and academic procrastination variations.)

Hypothesis 4. learning from mistakes, negatively and indirectly predicts variations in procrastination via goal setting, decision making, and perseverance. (Hypothesis 4a: learning from mistakes, negatively and indirectly predicts variations in irrational procrastination via goal setting, decision making, and perseverance. Hypothesis 4b: learning from mistakes, negatively and indirectly predicts variations in academic procrastination via goal setting, decision making, and perseverance.)

2 | METHODS

A total of 433 Chilean university students participated in the study (70.2% women and 29.8% men) with an average age of 20.74 years ($SD = 2.86$). They answered a 15-min questionnaire via Qualtrics software (Qualtrics, Provo, UT; January 2020). One researcher attended the students' in-person classes during academic hours. Students were informed about the goal of the study and data use and provided informed consent. The Bioethics Commission at the authors' university granted approval (Institutional Review Board IRB00003099).

2.1 | Instruments

Self-regulation was assessed with the Spanish Short Self-Regulation Questionnaire (SSSRQ), derived from Brown et al. (1999), validated in Spanish by Pichardo et al. (2014) and—via Rasch analysis—by Garzón-Umerenkova et al. (2017), with a Cronbach's α of .87 in the global score, and ranging from .71 to .81 in the factors (Pichardo et al., 2014). Alpha in the present study was .88, globally, and ranged from .69 to .85 in the factors (Table 1). The

TABLE 1 Descriptive statistics and Cronbach's α s ($N = 433$).

	M	SD	Min	Max	Skew	Kurtosis	α
Overall self-regulation	3.30	0.60	1.33	4.75	-0.254	-0.183	.88
Learning from mistakes	3.55	0.89	1	5	-0.279	-0.492	.77
Goal setting	3.40	0.69	1	5	-0.273	-0.111	.84
Decision making	3.01	0.78	1	5	-0.226	-0.244	.77
Perseverance	3.22	0.80	1	5	-0.154	-0.230	.68
Irrational procrastination	3.07	0.63	1	5	0.078	0.031	.82
Academic procrastination	5.73	1.40	2	10	-0.023	0.111	.83

17-item instrument is divided into four scales each reflecting one factor: learning from mistakes (e.g., "I don't seem to learn from my mistakes"); goal setting (e.g., "I set goals and monitor my progress"); decision making (e.g., "I delay making any decision"); and perseverance (e.g., "I have a lot of willpower"). Responses capture the individual's agreement with each item on a Likert scale ranging from 1 = *Not at all* to 5 = *Very much*. Factor scores were computed as the average of the corresponding items and overall self-regulation as the average of the factors' scores.

Irrational procrastination was measured with the Irrational Procrastination Scale (IPS; Steel, 2010), designed to measure general procrastination uni-dimensionally, and validated in Spanish by Guilera et al. (2018) via factor analysis (Cronbach's $\alpha = .90$). The instrument includes nine items measured on a 5-point Likert-type scale, ranging from 1 "Does not describe me at all" to 5 "Describes me completely". A sample item is "I delay tasks beyond what is reasonable." Factor score was computed by averaging the corresponding items, and Cronbach's α in the present study was .83 (Table 1).

AP was measured with the Procrastination Assessment Scale–Student (PASS; Solomon & Rothblum, 1984), translated into Spanish and validated via Rasch analysis with a reliability index of .99 for the 44 items, and of .91 for the participants (Garzón-Umerenkova & Gil-Flores, 2017). The PASS has two sections: procrastination prevalence and motives. We used the first section in which prevalence is assessed in six academic areas: writing a paper on time, studying for exams, keeping up with readings/assignments/activities, performing administrative academic tasks, meeting with tutors or professors, and academic activities in general. For each area, participants responded to the questions "to what extent do you procrastinate on this task?" (implemental delay) and "to what extent is procrastination on this task a problem for you?" (psychological distress) on a 5-point Likert-type scale ranging from 1 = *Never* to 5 = *Always*. Following authors' instructions, "Because definitions of procrastination stress both behavioral delay and psychological distress, the degree of procrastination and the degree to which it presents a problem are summed for each academic task (for a score ranging from 2 to 10)" (Solomon & Rothblum, 1984, p. 504). Consequently, six AP scores were computed, one per academic area, by adding up the corresponding scores in implemental delay and psychological distress in said area. Confirmatory factor analysis (CFA, see Supporting Information: Appendix) showed that a factor model of AP fit the data best when including only the first three academic areas and the sixth one (to the exclusion of the fourth and fifth). Such a modification was deemed reasonable following authors' assertions (Solomon & Rothblum, 1984, p. 506) that reports of procrastination are more frequent and relevant in the first "three academic areas, writing term papers, studying for exams, and doing weekly readings," and that "attending classes or meetings, filling out forms, and registering for courses are less important to students; consequently, students view procrastination as less of a problem with those tasks." Consequently, a global AP score was computed by averaging out the four aforementioned AP scores, and Cronbach's α in the present study was .84 (Table 1).

2.2 | Data analysis

Descriptive statistics and bivariate correlations were assessed with IBM Statistical Package for the Social Sciences (SPSS) version 19. A theory-based structural equation model (SEM) was hypothesized to assess the proposed relationships using IBM SPSS AMOS version 26. Complementarily, simple and multiple mediation analyses were performed using macro PROCESS for SPSS version 3.3 to explore the specific roles of self-regulation factors in the prediction of procrastination variations via the analysis of their indirect effects.

3 | RESULTS

3.1 | Descriptive statistics

Table 1 shows that means for learning from mistakes and goal setting (cognitive-motivational dimension of self-regulation) were higher than the center point (3) of the scale; means for decision making (strategic dimension) were around the center point; and means for perseverance (volitional dimension) slightly above. The mean for irrational procrastination was around the center point of the scale, whereas the mean for the prevalence of AP was slightly below 6 points on a possible range of 2 through 10.

Bivariate correlations between self-regulation factors revealed robust internal consistency (Table 2), but were below .85, providing evidence of discriminant validity. Furthermore, as expected, self-regulation factors correlated negatively with irrational and AP measures, which in turn were positively correlated to each other, but distinct. Overall self-regulation was more robustly associated with irrational procrastination than with AP.

3.2 | Structural equation model of self-regulation factors predicting procrastination variations

Figure 2 depicts the results of the full SEM analysis of the theory-based hypothesized model integrating the relationships between self-regulation factors and procrastination measures (item-level omitted for clarity). The model showed subpar fit to the data: Minimum discrepancy function divided by degrees of freedom (CMIN/DF = 2.713), tucker-lewis index (TLI = 0.849), comparative fit index (CFI = 0.862), standardized root mean square residual (SRMR = 0.0632), root mean square error of approximation (RMSEA = 0.063), 90% confidence interval (CI): [0.059–0.067], *P* value of close fit (PCLOSE = 0.000). However, following the authors (Garzón-Umerenkova

TABLE 2 Bivariate correlations between study variables (*N* = 433).

	1	2	3	4	5	6
1. Overall self-regulation						
2. Learning from mistakes	.74					
3. Goal setting	.77	.40				
4. Decision making	.70	.31	.39			
5. Perseverance	.82	.45	.61	.45		
6. Irrational procrastination	-.73	-.42	-.66	-.51	-.64	
7. Academic procrastination	-.54	-.31	-.46	-.42	-.46	.58

Note: All correlations are significant at the $p < .001$ level.

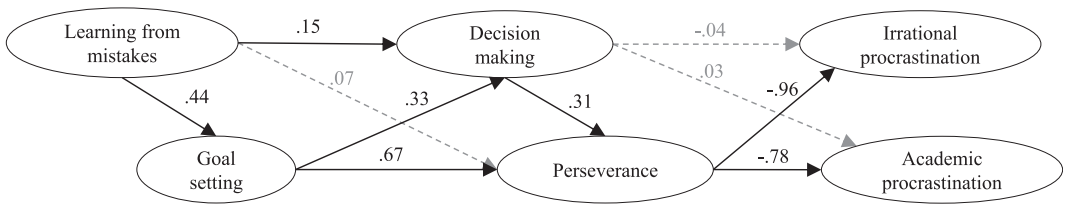


FIGURE 2 Structural equation modeling model of self-regulation factors predicting procrastination variations. All significant paths (** $p < .01$) depicted with continuous arrows.

et al., 2017), a smaller number of items adequately reflecting their factors is an improvement in self-regulation measurement, which led to retaining the best-performing items in the structural model (see Supporting Information: Appendix 1). After these modifications, the model fit the data well (Browne & Cudeck, 1993; Hu & Bentler, 1999): CMIN/DF = 1.830, TLI = 0.956, CFI = 0.964, SRMR = 0.0460, RMSEA = 0.044 [90% CI: 0.035– 0.052], PCLOSE = 0.885.

Hypothesized paths were all significant except for three: no direct effect was observed to predict perseverance variations based on variations in learning from mistakes, nor to predict procrastination variations (irrational nor academic) based on variations in decision making. In other words, variations in learning from mistakes did not predict perseverance variations without the mediating roles of decision making and goal setting; and decision making did not predict procrastination variations without the mediating role of perseverance.

3.3 | Simple and multiple local mediation analyses

SPSS macro PROCESS version 3.3 was used to perform simple and multiple mediation analyses locally (Table 3). Analyses were performed following simple mediation theory (Hayes & Scharkow, 2013; Hayes, 2017), using Bootstrapping with 10,000 samples, considering a mediation significant when the 95% confidence interval for the indirect effect did not include zero.

Multiple mediation analyses were performed to explore if procrastination variations (Y: alternatively irrational and academic), were predicted by a theory-consistent sequence of self-regulation factors, considering learning from mistakes as predictor (X), and goal setting (M_1), decision making (M_2), and perseverance (M_3) as sequential mediators. Alternatively, goal setting was tested as predictor (models 15 and 16).

3.4 | Contrasts of hypotheses

As can be derived from the structural model solution (Figure 2), learning from mistakes positively and directly predicted variations in goal setting (H1a) and decision making (H1b) but no direct effect on perseverance was observed (H1c). As Table 3 shows, positive predictive effects of learning from mistakes on decision-making variations were partially mediated by goal setting (H2a), goal setting also showed a robust mediating role in the positive effect of learning from mistakes on perseverance variations (H2b). Also, decision making partially mediated the positive effect of goal setting on irrational procrastination variations (H3a) and, alternatively, on AP (H3d). Furthermore, perseverance partially mediated the predictive effects of goal setting on irrational procrastination variations (H3b) and, alternatively, on AP variations (H3e). In turn, decision making and perseverance partially and sequentially mediated the predictive effects of goal setting on irrational procrastination variations (H3c) and alternatively on AP variations (H3f). Table 4 shows that learning from mistakes had an indirect negative predictive effect on variations in both types of procrastination, occurring via a sequence of mediating factors, including goal

TABLE 3 Simple mediation analyses.

Model: X → M → Y	a	b	c'	c	ab	SE _{ab}	95% CI
1. LM → GS → DM	0.32***	0.25***	0.16***	0.24***	0.08	0.021	0.04, 0.13
2. LM → GS → PE	0.33***	0.58***	0.21***	0.40***	0.19	0.028	0.14, 0.25
3. LM → DM → PE	0.24***	0.32***	0.32***	0.39***	0.08	0.021	0.04, 0.12
4. GS → DM → PE	0.31***	0.25***	0.59***	0.67***	0.08	0.021	0.04, 0.12
5. GS → DM → IP	0.31***	-0.25***	-0.48***	-0.56***	-0.08	0.019	-0.12, -0.04
6. GS → DM → AP	0.31***	-0.38***	-0.79***	-0.91***	-0.12	0.034	-0.19, -0.06
7. GS → PE → IP	0.67***	-0.34***	-0.33***	-0.56***	-0.23	0.028	-0.29, -0.18
8. GS → PE → AP	0.67***	-0.53***	-0.55***	-0.91***	-0.36	0.066	-0.49, -0.23
9. DM → PE → IP	0.41***	-0.45***	-0.19***	-0.37***	-0.18	0.027	-0.32, -0.19
10. DM → PE → AP	0.41***	-0.72***	-0.29***	-0.59***	-0.29	0.048	-0.39, -0.21

Note: *** represents effects significant at the $p < .001$ level.

Abbreviations: AP, academic procrastination; a, direct effect of X on M; ab, indirect effect; b, direct effect of M on Y; c, total effect; c', direct effect; CI, confidence interval; DM, decision making; GS, goal setting; IP, irrational procrastination; LM, learning from mistakes; M, mediator variable; PE, perseverance; X, predictor variable; Y, outcome variable.

setting, decision making, and perseverance (H4a and H4b); in the case of the outcome of AP, the mediating effect was total, given that the direct effect of learning from mistakes on AP was not significant.

4 | DISCUSSION

This study extends previous knowledge about the relationships between student procrastination and specific self-regulation factors, thus, supporting reflection, intervention, and policy making in the prevention of student procrastination. It integrates theories of self-regulation with theories of procrastination into a viable model of prediction of procrastination variations based on self-regulation factors. We test specific theory-based roles of four self-regulation factors (learning from mistakes, goal setting, decision making, and perseverance) on irrational and AP variations via SEM and mediation analysis. In this way, we offer insights into how aspects of self-regulation may predict procrastination variations. Results are in line with previous research showing that self-regulation negatively predicts AP (Garzón-Umerenkova et al., 2018). Furthermore, the volitional dimension of self-regulation via its factor of perseverance is positively predicted by the cognitive, motivational, and strategic dimensions, via its factors of learning from mistakes, goal setting, and decision making. These findings suggest that perseverance can mediate between cognitions, motivations, strategies, and procrastination behaviors, thus, perseverance can at least partly be understood as a result of pedagogical contextual interventions.

Furthermore, findings contribute to the discussion of the roles of specific self-regulation factors in negatively predicting procrastination variations, as they are consistent with a theory-based model reflecting the cyclical nature of self-regulation, postulating that learning from mistakes positively predicts variations in cognitive-motivational (H1a: goal setting), strategic (H1b: decision making), and volitional (H1c: perseverance) dimensions of self-regulation (bearing in mind that effects of learning from mistakes on perseverance were indirect). These results suggest the cyclical nature of self-regulation in which learning from mistakes may predict subsequent perseverance variations indirectly via its associations with improved goal setting (H2b) and decision making.

TABLE 4 Multiple mediation analyses.

Model	c'	c	Ind	SE_{Ind}	95% CI
1. LM → GS → IP	-0.07*	-0.31***	-0.10	0.019	-0.14, -0.07
2. LM → DM → IP	-0.07*	-0.31***	-0.03	0.011	-0.05, -0.01
3. LM → PE → IP	-0.07*	-0.31***	-0.04	0.013	-0.07, -0.02
4. LM → GS → DM → IP	-0.07*	-0.31***	-0.01	0.005	-0.02, -0.01
5. LM → GS → PE → IP	-0.07*	-0.31***	-0.05	0.010	-0.07, -0.03
6. LM → DM → PE → IP	-0.07*	-0.31***	-0.01	0.004	-0.02, -0.003
7. LM → GS → DM → PE → IP	-0.07*	-0.31***	-0.01	0.002	-0.01, -0.002
8. LM → GS → AP	-0.09	-0.49***	-0.17	0.041	-0.26, -0.09
9. LM → DM → AP	-0.09	-0.49***	-0.04	0.021	-0.09, -0.01
10. LM → PE → AP	-0.09	-0.49***	-0.07	0.028	-0.13, -0.02
11. LM → GS → DM → AP	-0.09	-0.49***	-0.02	0.009	-0.04, -0.01
12. LM → GS → PE → AP	-0.09	-0.49***	-0.07	0.021	-0.12, -0.03
13. LM → DM → PE → AP	-0.09	-0.49***	-0.02	0.006	-0.03, -0.01
14. LM → GS → DM → PE → AP	-0.09	-0.49***	-0.01	0.003	-0.02, -0.002
15. GS → DM → PE → IP	-0.32***	-0.56***	-0.02	0.007	-0.04, -0.01
16. GS → DM → PE → AP	-0.53***	-0.91***	-0.03	0.012	-0.06, -0.02

Note: * and *** represent significant effects, respectively, at the $p < .05$ and $p < .001$ levels.

Abbreviations: AP, academic procrastination; CI, confidence interval; c , total effect of X on Y; c' , direct effect of X on Y; DM, decision making; GS, goal setting; Ind , indirect effect; IP, irrational procrastination; LM, learning from mistakes; M, mediator variable; PE, perseverance; X, predictor variable; Y, outcome variable.

The role of the strategic aspect of decision making in negatively predicting procrastination variations was found to be limited; first, no direct path was significant; and second, decision making partially mediated between goal setting and procrastination variations (Table 3), with a small indirect effect for irrational procrastination (H3a), and a somewhat bigger indirect effect for AP (H3e).

On the other hand, the role of perseverance was noteworthy as it negatively and directly predicted variations in irrational and AP, which is consistent with previous work asserting that perseverance is a consistent negative predictor of procrastination (Burka & Yuen, 1983; Silver & Sabini, 1981; Wolters & Hussain, 2015). Results are in line with the authors' signaling that lower perseverance in learning is linked with higher procrastination (Rebetz et al., 2018; Wypych et al., 2018). These results show that volitional processes that promote self-regulation are key elements in preventing the proclivity to procrastination, like perseverance as a facilitator of positive academic functioning (Jin et al., 2019), ensuring students' engagement until their goals are achieved (Zhang et al., 2018).

The role of the cognitive-motivational factor of goal setting was also relevant in the prediction of perseverance variations (Figure 2); suggesting that—as has been argued before (Grunschel et al., 2016)—students who set goals are less likely to procrastinate, and more likely to persist exerting effort throughout the learning process, avoiding maladaptive behaviors such as procrastination (Lam & Zhou, 2019). The point has been made that students who delay their intended tasks act less adaptively in the use of cognitive and metacognitive strategies (Wolters, 2003). In this regard, the cognitive-motivational and the volitional dimensions of self-regulation have been observed to be associated, as more perseverant students report to have stronger goal orientation (Wolters & Hussain, 2015; Wolters, 2003), and to be better at learning from mistakes and goal setting (Valenzuela et al., 2020).

In what regards the potential mediating role of perseverance between goal setting and procrastination, SEM analyses (Figure 2) showed that perseverance mediated the predictive effects of goal setting on irrational (H3b) and AP variations (H3e). Both the path coefficients in the global model (Figure 2) as well as the local mediation analyses (Tables 3 and 4) signal that the predictive effects of goal setting (cognitive-motivational dimension) on procrastination variations via perseverance (volitional dimension) were significant, with noteworthy indirect effects accounting for variance in procrastination. This coincides with previous studies finding that students intend to accomplish tasks, but fail to accomplish it (Dewitte & Lens, 2000; Kadzikowska-Wrzosek, 2018; Zimmerman, 2008), reflecting a discrepancy between intention and action (Steel et al., 2018) resulting from low persistence.

Lastly, we were interested in exploring whether learning from mistakes, as self-reflective motivational state occurring after performance, could predict variations in procrastination via the theory-derived sequential effects of goal setting, decision making, and perseverance. Multiple mediation analysis served to assess the predictive effects of learning from mistakes (X) on procrastination variations (Y) via goal setting (M_1), decision making (M_2), and perseverance (M_3). Results (Table 4) show that part of the negative effects of goal setting on irrational procrastination (H3c), and on AP (H3f), occurs via the sequential mediating role of decision making and perseverance. Similarly, we assessed the indirect effects of learning from mistakes on irrational procrastination variations (H4a), and alternatively on AP variations (H4b), to explore whether these occurred via the theorized sequence of setting attainable goals, facilitating decision making and perseverance, thus, avoiding self-regulation failure. All four targeted sequential indirect effects (H3c, H3f, H4a, & H4b) were nonzero; and, specifically in the case of AP (H4b), the sequential mediation between learning from mistakes and procrastination was total, with a nonsignificant direct effect and a significant indirect one, suggesting that the sequence derived from the mentioned authors (Dewitte & Lens, 2000; Zimmerman & Campillo, 2003; Zimmerman et al., 1996), fits the observations collected.

4.1 | Practical implications

This work contributes to the knowledge about procrastination and self-regulation among college students. It offers insight into the potential specific roles of distinct self-regulation factors in counteracting procrastination. For instance, as opposed to studies defining perseverance as a personal disposition, this study opens avenues of interpretation to understand perseverance at least partly as a result of cognitive-motivational and strategic dimensions of self-regulation, including factors such as learning from mistakes, goal setting, and decision making. In line with these findings, psychosocial interventions into the cognitive and motivational dimensions of self-regulation may prove viable. For example, teachers may try to help students acknowledging previous specific shortcomings in accomplishing their intended learning activities in a nonjudgmental way (for instance, recognizing emotions originating avoidance and avoidance strategies used; or recognizing patterns of behavior accounting for goals slipping out of executive control). In this way, students would receive support promoting learning from mistakes and setting up goals to counteract these shortcomings. Also teachers should help students to generate and select meaningful attainable goals and to plan accordingly, generating planned action courses endorsed by their teachers and other fellow students aiding higher levels of commitment and focus. Teachers could also raise group-level awareness about the importance of perseverance in counteracting procrastination in the learning process, thus aiming at maintaining the conscious focus on goals via group dynamics such as students monitoring each other's decisions taken in the direction of the attainment of their own learning goals. Teachers, tutors, and similar figures can use these findings to better understand and explain procrastination and to be better equipped to potentially alleviate procrastination via distinct interventions with foci on distinct parts of the cycle of self-regulation (learning from mistakes, goal setting, decision making, and perseverance) that can be targeted via pedagogical activities as the aforementioned.

4.2 | Limitations of the present study and recommendations for future research

The data collection was based on a group of Chilean university students including around 70% women. In this regard, it is advisable to replicate this research in other contexts and with a more balanced proportion of men students contributing to generalizability. Furthermore, data were collected at a single time point, restricting the possibility of drawing strong causal inferences from the data. Even though fit indices inform about the plausibility of the theory-derived hypothesized model, longitudinal designs are needed to proceed to a confirmatory level in the discussion of causality including more robust approaches to mediational analyses. Also, the present results are based on self-report measures, and it would be necessary to collect other behavioral and associated objective measures of procrastination to complement self-reports. In the present research, the effects of decision making as self-regulation aspect were small; however, it is reasonable to include decision making along with procrastination measures linked to this strategy, such as decisional procrastination to explore designs including variables that are theoretically more proximal to decision-making and strategic aspects of procrastination.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

The Bioethics Commission at the university of the authors granted approval for the present study (IRB00003099).

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