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From Dawdle to Done: Reinforcement Processes in Procrastination

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy in
Psychological & Brain Sciences

by

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June 2026

The dissertation of Anusha Garg is approved.

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To mom, dad, and bhaiya.

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STATEMENT OF CONTRIBUTION

Study 1 has been published in *BMC Psychology* (Garg, Shelat, & Schooler, 2025). Study 2 is currently under review in *Motivation Science* (Garg & Schooler, 2026). This thesis consists of material all of which Garg authored or co-authored.

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PRESS & MEDIA

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Diario AS (Spain): Adiós a procrastinar: los dos pasos para dejar de postergar las tareas para siempre - *Almudena García Felipe* (2025) <https://as.com/actualidad/sociedad/adios-a-procrastinar-los-dos-pasos-para-dejar-de-postergar-las-tareas-para-siempre-f202512-n/>

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Infobae (Latin America): Cómo dejar de procrastinar en solo 2 minutos: la técnica científica que aumenta la productividad (2025)

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Der Standard (Austria): Neue Methode schlägt der Prokrastination im entscheidenden Moment ein Schnippchen (2025)

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Diabetes UK: Simple reflection exercises tackle procrastination

<https://www.diabetes.co.uk/news/2025/nov/simple-reflection-exercises-tackle-procrastination.html>

MedicalXpress: A two-minute fix for procrastination - *Debra Herrick* (2025)

<https://medicalxpress.com/news/2025-11-minute-procrastination.html>

UCSB: Featured post about procrastination research and the Dawdle AI app (2025)

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University of California: A two-minute fix for procrastination - *Debra Herrick* (2025)

<https://www.universityofcalifornia.edu/news/two-minute-fix-procrastination>

NewlyInternetFounders: Procrastination researcher built an app that gets you from doomscrolling to working in 30 seconds (2025)

https://youtube.com/shorts/cd6tVoWXWBI?si=guTTYu_IXbsNHRqK

Futurity: A two-minute fix for procrastination - *Debra Herrick (2025)*

<https://www.futurity.org/procrastination-dawdle-ai-3305622-2/>

KCBS Radio (San Francisco): Interviewed on procrastination research and Dawdle, a science-backed productivity app - *Catherine Whitman (2025)*

https://www.audacy.com/stations/kcbsradio/shows/show-schedule?action=AUTOPLAY_FULL&actionContentId=101-365

UCSB TV: Interviewed about Dawdle and featured to UCSB student population - *Arly Lara (2025)* <https://www.instagram.com/reel/DRLVGPrAR9j/?igsh=NTc4MTIwNjQ2YQ==>

The Current: A two-minute fix for procrastination - *Debra Herrick (2025)*

<https://news.ucsb.edu/2025/022229/two-minute-fix-procrastination>

ScienMag: Brief, scalable fix for overcoming state procrastination (2025)

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A science-backed productivity app with 4,000+ users

Product & Software Development

Designed and built full app architecture using SwiftUI, Firebase, Figma, and OpenAI API

Led 100+ iterative design cycles with student designers (UI/UX, dark mode, branding)

Developed AI procrastination coach trained on 100+ research papers

Set up analytics, notifications, crash handling, and event logging in Firebase

Led engineering workflow (sprints, debugging, GitHub merges, code reviews)

UX Research

Conducted data analysis using BigQuery

Identified power and super users and contacted them for interviews

Conducted 25+ interviews for market validation

Conducted 15+ user interviews for feedback per app version

Identified user funnels such as decreased user sign on due to the length of the onboarding tutorial → Led iterative changes to improve tutorial performance

Research Translation

Integrated empirical procrastination research directly into app features (copy, UI, interventions)

AI behavior prompt-engineered to deliver science-backed micro-interventions

Leadership & Team Management

Recruited & managed engineers, designers, and a 12-person marketing team

Built 3-team marketing structure: Strategy/Writing → Creators → Engagement

Ran weekly huddles on analytics, growth, and content performance

Managed Notion, Slack, GitHub workflows and OKRs

Recruited 15 campus ambassadors; organized campus launch and tabling

Marketing & Growth

Ran growth experiments, user funnels, A/B tests

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Product: UX research, analytics (Firebase), rapid prototyping

Other: Marketing analytics, leadership, scientific writing

ABSTRACT

From Dawdle to Done: Reinforcement Processes in Procrastination

by

Anusha Garg

Procrastination is a pervasive self-regulation failure characterized by the voluntary delay of intended action despite anticipated negative consequences. Although prior research has identified multiple contributing factors—including emotion regulation, temporal discounting, and individual differences—less is known about the mechanisms that operate at the moment of task initiation and early engagement, as well as how repeated experiences during task engagement contribute to more enduring patterns of procrastination. The present dissertation addresses this gap by examining how task structure and reinforcement processes influence state procrastination and by testing whether repeated reinforcement of effort can increase engagement with effortful tasks over time.

Across three studies, this dissertation investigates interventions targeting distinct phases of procrastination. Study 1 tested a brief micro-intervention based on the Temporal Decision Model (Zhang & Feng, 2020), designed to alter task appraisals by reducing task aversiveness and increasing outcome desirability. Participants identified a real, current procrastinated task and completed a short reflective intervention. Participants in the control

conditions completed neutral, length matched questions regarding the procrastinated task. Results indicated that this intervention increased intentions to begin working on the task.

Study 2 extended this work by examining behavior during task engagement and isolating the effects of subtask structuring and reinforcement. Participants worked on a procrastinated task for a fixed period and were randomly assigned to a control condition, a Subtask Only condition, or a Subtask + Reward condition. Structuring tasks into subtasks increased initiation to start the procrastinated task, whereas pairing effort with reinforcement increased participants' willingness and persistence to continue working on the task. These findings demonstrate that different components of an intervention may differentially influence initiation versus persistence.

Study 3 further examined whether repeated exposure to subtasking and reinforcement could influence engagement with course readings over time in a naturalistic academic context. Using a longitudinal design, participants completed recurring course-related readings under conditions that varied in the presence of subtasking and reinforcement cues. Results showed that repeated pairing of effort with reinforcement was associated with increased engagement with readings across time, consistent with principles of learned industriousness. These findings suggest that reinforcement processes not only shape momentary behavior but also contribute to more stable patterns of task engagement.

Taken together, the findings of this dissertation provide a mechanistic account of procrastination that integrates momentary decision processes with reinforcement learning principles. The results suggest that procrastination is not solely a function of stable traits, but is also shaped by how effort is experienced and reinforced during task engagement. By demonstrating that brief interventions can influence both task initiation and persistence, and

that repeated reinforcement of effort can increase engagement over time, this work offers both theoretical and practical contributions. Theoretically, it advances an account of procrastination grounded in learned industriousness (Eisenberger, 1992) and reinforcement processes. Practically, it provides a framework for designing interventions that target specific phases of the procrastination cycle and that can be implemented in real-world contexts, including digital platforms.

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From Delay to Effort: A Reinforcement-Based Account of Procrastination

Procrastination is often understood as a failure of time management or self-control. Yet individuals frequently delay tasks even when they recognize the negative consequences of doing so and genuinely intend to begin. This paradox suggests that procrastination cannot be explained solely by lack of knowledge or motivation, but instead reflects how effort, emotion, and decision-making interact in the moment of task engagement. Existing theories have made substantial progress in identifying the emotional and motivational processes that give rise to procrastination, particularly the tendency to prioritize short-term relief over long-term goals. However, less attention has been devoted to the implications of these processes for intervention. If procrastination unfolds at the level of momentary decisions, then targeting the experience of effort at the point of engagement—rather than focusing on broad habits or traits—may offer more proximal and tractable routes to change.

The present dissertation pursues this possibility by drawing on the theory of learned industriousness (Eisenberger, 1992), which proposes that when effortful behavior is consistently paired with reward, effort itself can acquire positive motivational value. The studies in this dissertation examine whether applying this principle to moments of potential delay can promote task engagement. Specifically, the research investigates whether reinforcing small instances of effortful behavior can increase willingness to initiate and persist in tasks that might otherwise be postponed.

Defining Procrastination

Procrastination is a common experience that many individuals encounter in daily life—postponing sending a difficult email in favor of watching TV, delaying studying until the night before an exam, or opting to nap instead of putting away laundry. This form of maladaptive delay is known as procrastination, which originates from the Latin *pro* meaning forward and *crastinus* meaning of tomorrow (Klein, 1971; Mish, 1994). Procrastination is most often defined as the voluntary delay of an intended course of action despite expecting negative consequences for the delay (Steel, 2007). Consistent with this definition, prior work has emphasized the discrepancy between intention and behavior, such that the greater the gap between what one intends to do and what one actually does, the greater the procrastination (Lay, 1994; Schraw et al., 2007). Procrastination is also typically accompanied by subjective discomfort and self-criticism, distinguishing it from neutral or strategic delay (Ferrari, 1992b; Klassen et al., 2008). Klingsieck (2013) further specifies key features of procrastination, noting that the delayed activity is necessary or personally important, the delay is voluntary and unnecessary, and it is often experienced as irrational and accompanied by negative consequences and/or negative affect. More recently, Mahy et al. (2024) have characterized this as a ‘multicomponent definition’ of procrastination, which requires that a delay be voluntary, unnecessary, intentional, and accompanied by expected negative consequences—criteria that, while widely adopted, may be overly restrictive given that subjective intentionality is difficult to assess in real time. Together, these definitions underscore that procrastination is not simply delay but a dysfunctional pattern of postponement characterized by self-regulatory conflict.

Importantly, procrastination is not a rare or isolated behavior. It is highly prevalent across populations and contexts. Cross-national estimates suggest that approximately 20% of

adults exhibit chronic patterns of procrastination, underscoring its global nature (Argiropoulou & Ferrari, 2015; Ferrari et al., 2007; Ferrari & Tibbett, 2020; Harriott & Ferrari, 1996; Lee, 2015; Levin & Ferrari, 2015; Marini & Ferrari, 2012; McCown et al., 1989; Nomura et al., 2015). With respect to demographic differences, men appear marginally more likely to report chronic procrastination than women (van Eerde, 2003), and white-collar and professional employees have been reported to procrastinate more than blue-collar and unskilled employees (Nguyen et al., 2013). Situational procrastination is even more common in academic settings. Academic procrastination refers to the tendency to delay school-related activities (e.g., studying, completing assignments, registering for classes). Among university students, at least 50% report severe difficulties with academic procrastination, with estimates reaching up to 75% (Day et al., 2000; Ferrari & Tibbett, 2020; Miyake & Kane, 2022; Schraw et al., 2007).

Beyond its frequency, procrastination is associated with detrimental outcomes across multiple domains. Psychologically, higher levels of procrastination are consistently associated with greater depression, anxiety, stress, as well as reduced life satisfaction (Beutel et al., 2016; van Eerde, 2003; Steel, 2007). Procrastination is also linked to perfectionistic concerns and repetitive negative thinking such as rumination (Flett et al., 2016; Sirois et al., 2017), and has been associated with broader anxiety-related difficulties (Stöber & Joormann, 2001). Socially, procrastinators are often judged negatively and may avoid situations involving self-reflection or evaluation (Ferrari, 1991b, 1992b), which can contribute to interpersonal distancing and stigmatization in peer and work environments (Ferrari & Patel, 2004; Ferrari & Pychyl, 2012). These findings suggest that procrastination affects both internal well-being and interpersonal functioning.

Procrastination is also linked to physical health risk. Individuals who procrastinate more are more likely to delay health-promoting behaviors such as scheduling medical checkups, exercising, or maintaining a healthy diet (Sirois et al., 2003; Sirois, 2007). Chronic procrastination has been associated with poorer self-care during illness and greater reports of physical symptoms (Sirois, 2003, 2014), and appears to exacerbate stress and maladaptive coping in clinical populations managing chronic conditions (Sirois, 2015). These patterns suggest that procrastination can function as a long-term vulnerability factor by increasing avoidance of preventive and effortful health behaviors.

Academically and financially, procrastination also takes a measurable toll. Students who procrastinate more tend to earn lower grades and report higher stress around performance and deadlines (Rice et al., 2012; Steel, 2007). Although delay does not invariably lead to poor outcomes (Chun Chu & Choi, 2005), it often increases unnecessary pressure and undermines efficiency. In occupational settings, procrastination is widely viewed as counterproductive, with potential downstream costs for performance and organizational functioning (Metin et al., 2016). Financially, procrastination contributes to avoidant planning behaviors such as delaying retirement preparation, which can have long-term economic consequences (Nguyen et al., 2013). Taken together, these findings suggest that procrastination is not merely a problem of time management, but reflects resistance to effortful engagement that can undermine well-being across psychological, physical, academic, and economic domains.

It is important to note that much of this evidence is correlational. Consequently, the direction of causality remains difficult to determine. Procrastination may contribute to these outcomes, but it is also possible that psychological distress increases the likelihood of

procrastination. Experimental paradigms that manipulate task engagement, such as those developed in the present research, provide an opportunity to examine these relationships more directly by testing how changes in procrastinatory behavior influence downstream outcomes.

Despite its prevalence and negative consequences, procrastination does not manifest uniformly across individuals or situations. Some individuals display persistent patterns of delay across many contexts, whereas others procrastinate primarily under specific task conditions—for example when tasks are perceived as overwhelming, emotionally aversive, or effortful. This variability suggests that procrastination cannot be understood solely as a stable behavioral tendency. Instead, it reflects dynamic interactions between individuals and the immediate demands of the task environment. Understanding this variability raises an important theoretical question: *how should procrastination be conceptualized in relation to stable individual differences and momentary decision processes?*

The following section addresses this question by distinguishing between trait and state forms of procrastination.

Trait vs. State Procrastination

To understand how procrastination operates, it is useful to distinguish between its trait and state forms. While some individuals exhibit stable, chronic patterns of delay, others procrastinate primarily in particular situations. This distinction has important implications for how procrastination is conceptualized, measured, and addressed through intervention. It also raises a broader question relevant to the present research: how momentary episodes of procrastination relate to more stable patterns of behavior across time.

Traits are typically defined by their stability across time and situations (Steyer et al., 1999). Although early models acknowledged procrastination as both a state and a trait (van Eerde, 2000; Lay & Silverman, 1996), much contemporary research has emphasized a trait-based perspective. Although procrastination is theorized as a momentary process, it has predominantly been measured and targeted as a trait—a mismatch that limits the translational value of existing frameworks for intervention. Chronic procrastination has been linked to relatively stable personality characteristics such as low conscientiousness and high impulsivity (Steel, 2007). Trait procrastination measures demonstrate moderate to high test–retest reliability, with some studies showing stability over periods as long as ten years (Steel, 2007), as well as consistency across domains such as academic and everyday task procrastination (Milgram et al., 1998). Trait procrastination has also been associated with broader dispositional characteristics including low self-efficacy, low self-esteem, boredom proneness, and achievement motivation (van Eerde, 2003; Kim & Seo, 2015; Steel, 2007).

Although these findings suggest that procrastination has stable individual differences, this does not imply that procrastination is purely dispositional or invariant across situations. Evidence indicates that procrastination is partly heritable, with twin studies estimating that genetic factors account for approximately half of the variance (Gustavson et al., 2014). Subsequent behavioral genetic work further indicates that the shared variance between procrastination and executive function abilities is largely attributable to genetic influences (Gustavson et al., 2015), suggesting that goal-management capacities relevant to procrastination have a substantial dispositional basis. At the same time, environmental influences also play an important role. For example, Ferrari and Olivette (1994) found that late adolescent females who perceived their parents as more authoritarian reported higher

levels of chronic indecision and avoidant procrastination. Such findings suggest that procrastination may be shaped by both dispositional and experiential factors.

These observations highlight an important conceptual distinction between trait–state variation and dispositional–contextual explanations. The trait–state distinction refers to the temporal stability of behavior—whether procrastination persists across time or fluctuates across moments. In contrast, dispositional versus contextual explanations concern the sources of variation in behavior. Individuals may differ dispositionally in their overall tendency to procrastinate, yet still exhibit substantial variability in procrastination across situations. Thus, a person may have a higher baseline propensity to procrastinate while procrastination itself continues to arise as a state that fluctuates in response to task demands and situational factors.

State procrastination reflects the dynamic interaction between individuals and their immediate context (Steyer et al., 1999). A growing body of research shows that procrastination varies with situational factors such as task difficulty, size, perceived importance, and self-efficacy (Fritzsche et al., 2003; Prohaska et al., 2000; Solomon & Rothblum, 1984), as well as environmental conditions (Koppenborg & Klingsieck, 2022), affective states and fatigue (Sirois & Pychyl, 2013), fear of failure and evaluation anxiety (Ferrari et al., 1992; Ferrari & Tice, 2000; Lay, 1992), and momentary motivation (Steel & König, 2006). Even individuals with similar trait levels may therefore procrastinate more or less depending on the immediate demands of a task and their momentary capacity to tolerate effort and discomfort.

This situational sensitivity is further supported by studies demonstrating substantial intra-individual variation in procrastinatory behavior across time and tasks (Baulke et al.,

2021; Beck & Jackson, 2022; Gadosey et al., 2021; Wieland et al., 2018). Beck and Jackson (2022), using an idiographic experience-sampling approach, found that future procrastination behavior was predicted by both stable person-level traits and transient situational factors, and that the relative weight of these influences varied substantially across individuals. Empirical work has also found only weak to moderate correlations between trait measures and observed procrastination behavior (e.g., Ferrari, 1992a; Krause & Freund, 2014; Lay, 1986; Tice & Baumeister, 1997). These findings suggest that trait assessments capture only a portion of the variance in actual procrastination behavior. Recent work further indicates that commonly used trait measures, such as the General Procrastination Scale (GPS), may contain meaningful state-driven variance (Koppenborg et al., 2024). Together, this evidence reinforces the view that procrastination reflects both relatively stable individual differences and context-dependent fluctuations. Table 1 provides a side-by-side comparison of these two constructs.

Table 1

Comparison of trait and state procrastination

Dimension	Trait Procrastination	State Procrastination
Definition	A stable individual difference reflecting a general tendency to delay tasks across situations	A momentary tendency to delay a specific task in a specific context
Time scale	Persistent across time and situations	Fluctuates moment to moment and across tasks
Stability	Relatively stable; moderate heritability (~46%)	Situationally sensitive; varies with task features and context
Measurement	Self-report scales (e.g., GPS, PPS) administered at one point in time	Experience sampling, behavioral observation, task-specific ratings
Intervention target	Long-term habits, self-regulation skills, stable tendencies	Momentary decision processes at the point of task initiation

Why the Trait–State Distinction Matters for Theory and Intervention

In light of these empirical and measurement distinctions, differentiating trait and state procrastination matters for at least three reasons. First, it clarifies what is being measured. Trait procrastination scales typically ask respondents to summarize how they “generally” behave across time. While useful for predicting broad outcomes, this approach can obscure the situational contingencies that produce procrastination in specific moments. In contrast, state measures capture what individuals feel and do in relation to a particular task at a particular time, which is often the level at which interventions must operate. The distinction therefore exposes a key mismatch in the literature: procrastination is theorized as a momentary process but predominantly studied through instruments designed to measure stable traits, limiting the field’s ability to identify when and how intervention should operate.

Second, the distinction sharpens the intervention target. Many interventions aim to reduce procrastination by changing broad habits or traits through therapy, skills training, or long-term self-regulation practice. Although valuable, such approaches often require sustained effort and motivation—conditions that individuals who struggle with procrastination may find difficult to maintain. A state-level perspective instead focuses on what can shift the decision process at the moment of delay. Even modest changes in appraisal—making a task feel slightly more manageable, slightly more worthwhile, or the experience of effort slightly less aversive—may be sufficient to move an individual from avoidance to initiation.

Third, the distinction brings an interesting developmental question into view: how do repeated states accumulate into traits? Trait procrastination does not emerge in isolation.

Even when genetic and temperamental factors contribute to individual differences (Gustavson et al., 2014), traits are expressed through repeated behavioral patterns, and repeated patterns are shaped by learning. While fully resolving how state procrastination consolidates into trait-like tendencies is beyond the scope of the present dissertation, this question underscores the importance of intervening at the state level. If state procrastination is the moment at which avoidance is enacted, it is also the most proximal point at which intervention can operate. This pragmatic logic—rather than a claim that procrastination is necessarily learned—guides the dissertation’s focus on momentary intervention targets.

Consistent with this view, Mahy et al. (2024) propose that trait-like procrastination tendencies may partly reflect the accumulation of repeated state-level enactments over development, with reinforcement processes shaping how effort and avoidance are evaluated across time.

Yet most existing theoretical models do not explicitly address whether state procrastination provides useful intervention leverage. Emotion regulation theories emphasize procrastination as an avoidance response to negative affect (Sirois & Pychyl, 2013), whereas trait-oriented frameworks link procrastination to enduring self-regulatory deficits (Baumeister et al., 1994; Steel & König, 2006). Both perspectives explain important aspects of procrastination, but they offer less guidance on how momentary intervention—targeting the experience of effort at the point of engagement—might interrupt avoidance and support task initiation.

If each instance of delay produces immediate relief—such as a reduction in anxiety or discomfort—this relief may function as a reinforcer, gradually strengthening avoidance as a default behavioral response. Over time, procrastination may become increasingly

automatized and less dependent on deliberate cost–benefit evaluation, such that relatively minor task friction can trigger disengagement. This theoretical possibility—that a developmental progression from context-dependent delay to trait-like avoidance may be sustained by reinforcement—is explored further in Chapter 5. Importantly, the present dissertation does not directly test whether procrastination is learned in this sense. Rather, it takes a pragmatic intervention stance: if effort aversiveness is a proximal driver of delay at the state level, then reinforcing effortful engagement at that same moment may offer a tractable route to reducing procrastination, regardless of its developmental origins.

In sum, trait and state procrastination are related but distinguishable constructs with different implications for theory and intervention. Trait procrastination reflects cumulative individual differences shaped by temperament and repeated experience, whereas state procrastination captures the moment-to-moment decision to engage or delay in a specific task. Both levels of analysis are needed to understand the full scope of procrastinatory behavior. Importantly, state procrastination offers a tractable intervention target: by addressing the immediate cost–benefit appraisals that precede delay, it may be possible to shift behavior before avoidance becomes habitual.

The present dissertation therefore emphasizes intervening at the state level, when individuals are actively deciding whether to engage or delay. In the following section, dominant theoretical accounts of procrastination are reviewed to clarify what is known about the proximal drivers of state procrastination and to identify where a reinforcement-based intervention perspective may offer additional explanatory and practical leverage.

Theories of Procrastination

Building on the distinction between state and trait procrastination outlined above, several theories have been proposed to explain why individuals delay tasks despite intending to complete them. Broadly, these accounts emphasize emotional, cognitive, and motivational processes that influence behavior in the moment. Together, they provide important insight into the proximal drivers of procrastination—why avoidance becomes appealing at a particular point in time.

However, while each of these models accurately describes the state-level decision processes through which procrastination unfolds, none specifies how to intervene at the moment of delay—that is, what to do differently when an individual is deciding whether to engage or avoid. In this section, I review the most influential theories of procrastination, highlighting both their contributions and this shared limitation in guiding state-level intervention.

Short-Term Mood Regulation Theory

Sirois and Pychyl (2013) argue that when individuals perceive a task as aversive—whether boring, frustrating, difficult, or anxiety-inducing—they experience negative affect, which increases the likelihood of task avoidance. In these situations, individuals prioritize short-term mood repair over long-term goal pursuit, reflecting a breakdown in self-regulation and a diminished capacity to tolerate effortful discomfort. This tendency to “give in to feeling good” is driven by the desire to escape or downregulate unpleasant emotional states (Tice & Bratslavsky, 2000). Supporting this view, experimental studies have shown that individuals induced into negative moods are significantly more likely to procrastinate than those in neutral affective states (Tice et al., 2001). Procrastination in this model functions as a form of emotion-focused coping, temporarily relieving stress, anxiety, or boredom by

shifting attention to more pleasant activities. This account is consistent with the transactional model of stress (Lazarus & Folkman, 1984), in which avoidance serves as a short-term—though ultimately maladaptive—strategy when task demands are appraised as exceeding coping resources.

This framework is particularly effective at explaining when procrastination is likely to occur, but it is less explicit about what that means for intervention. Notably, the temporary emotional relief that follows avoidance may itself become reinforcing over time, strengthening the association between discomfort and disengagement—a theoretical possibility explored further in Chapter 5. For the purposes of the present research, however, what is most relevant is that this framework does not directly address how to intervene at the moment of delay to promote task engagement. From an intervention perspective, this leaves open the question of whether altering the motivational value of effort itself—rather than solely reducing task aversiveness—could support initiation.

Temporal Motivation Theory (TMT)

Temporal Motivation Theory (TMT) provides an integrative framework for understanding procrastination by incorporating key motivational variables within a broader cost–benefit model (Steel & König, 2006). According to TMT, motivation to engage in a task is determined by expectancy (E), value (V), sensitivity to delay (γ), and delay (D), such that motivation is conceptualized as $Utility = (E \times V) / (\gamma \times D)$. Tasks with high expectancy of success and high subjective value generate stronger motivation, particularly when rewards are immediate. As the delay to reward increases, however, task utility diminishes—especially for individuals who are more sensitive to delay. This framework helps explain why individuals often procrastinate on important tasks: distant outcomes are discounted relative to

immediately rewarding alternatives. TMT also captures the dynamic nature of motivation over time, with task utility often increasing as deadlines approach, prompting last-minute engagement.

In this sense, TMT provides a strong account of procrastination as a momentary motivational calculation, explaining fluctuations in engagement as task utility changes. However, the model implicitly assumes that each episode of procrastination reflects a new evaluation of costs and benefits. It does not address how repeated procrastination might become automatic or habitual—a theoretical possibility explored further in Chapter 5. More relevant for the present research, TMT does not directly address how to intervene at the moment of delay; knowing that task utility is low does not itself suggest how to raise it at the moment of decision.

Temporal Decision Model (TDM)

The Temporal Decision Model (TDM; Zhang & Feng, 2020) builds on both mood regulation and TMT by framing procrastination as a present-focused decision in which the immediate aversiveness of a task outweighs its perceived outcome utility. Individuals often anticipate that this balance will shift in the future, believing their future selves will be more willing or better able to complete the task. This self-deferral logic helps explain why procrastinators intend to act “later” even when aware of potential negative consequences.

Like TMT, however, TDM primarily explains the internal logic of procrastinatory thinking at a single decision point. The model clarifies why delaying appears rational in the moment but does not address how repeated acts of delay may become reinforced through repetition. In other words, while TDM explains why procrastination makes sense from the individual's perspective at the time, it offers limited guidance on how to intervene at that

same decision point to make engagement feel more viable than delay. Although TDM and TMT both describe procrastination as a form of temporally weighted valuation, they differ in emphasis. TMT focuses on how motivation fluctuates as a function of expectancy, value, delay, and impulsiveness, whereas TDM places greater emphasis on the decision to postpone action by comparing the present self's aversive experience with the anticipated willingness or ability of a future self to complete the task. Thus, TDM is less about momentary motivational strength and more about the self-deferral process that makes delay seem reasonable in the present.

Motivational and Self-Regulation Theories

Additional perspectives have linked procrastination to broader motivational and self-regulatory processes. These approaches primarily explain individual differences in susceptibility to procrastination rather than the mechanisms through which procrastination unfolds in specific moments. Motivation-based accounts emphasize the role of low intrinsic or extrinsic motivation (Amabile, 1993; Deci et al., 1981), particularly when tasks lack personal meaning (Brownlow & Reasinger, 2000). Attribution theory suggests that procrastinators may externalize blame for delays to preserve self-esteem, attributing failure to external factors such as luck or task difficulty rather than ability (Ferrari, 1991a; Weiner, 1985), which can promote self-handicapping strategies that further reinforce avoidance.

Self-regulated learning frameworks (Wolters, 2003) highlight the importance of goal orientation, self-efficacy, and cognitive strategies in predicting procrastination. Students with mastery goals and strong self-regulatory skills are more likely to plan, monitor, and persist through challenging tasks, whereas those with avoidance goals are more likely to disengage

or delay. Expectancy–Value Theory (Wigfield & Eccles, 2000) similarly emphasizes task utility and success expectancy as predictors of task initiation (Wu & Fan, 2017).

While these perspectives help identify motivational beliefs and dispositional tendencies associated with procrastination, they typically treat these tendencies as relatively stable characteristics and provide less explanation for how such patterns emerge, persist, or change through experience. Few explicitly address how to intervene at the moment of delay, or how reinforcing effortful engagement in the moment might shift the motivational calculus in favor of initiation.

Limitations and Summary of the Existing Theories of Procrastination

Across the theoretical frameworks reviewed, several common themes emerge. Most accounts emphasize task aversiveness—whether through negative emotional responses, reduced motivation, or perceived self-regulatory difficulty—as a central driver of procrastination. Others highlight deficits in emotion regulation or motivational control, positioning procrastination as a failure to manage competing internal demands. Collectively, these theories have substantially advanced our understanding of why procrastination occurs in the moment, often conceptualizing each episode as the outcome of a situational evaluation that favors short-term relief over long-term goals.

However, these models tend to treat procrastination primarily as a momentary appraisal-based and deliberative process, and less often address how that understanding translates into actionable intervention. In particular, while these theories are informative about the triggers of procrastination, they provide limited guidance on how to intervene directly at the moment of delay—when individuals are deciding whether to engage or avoid. This gap is significant, because if procrastination is enacted at the state level, then effective

intervention may need to operate at the same level. Accordingly, considerably less attention has been paid to interventions that target the proximal experience of effort at the moment of task initiation.

In sum, existing theoretical accounts offer complementary but partial explanations of procrastination. Mood regulation accounts clarify the affective triggers of avoidance; TMT and TDM specify the motivational arithmetic underlying task appraisals; and self-regulation frameworks identify the dispositional factors that shape susceptibility. Together, these perspectives establish that procrastination is a multidetermined behavior rooted in the immediate experience of task aversiveness and effort. What remains underspecified, however, is how intervention at the moment of decision can be designed—and how repeated experiences of effortful engagement might reduce the tendency to avoid in the future. Table 2 provides an overview of these theoretical perspectives.

A framework capable of addressing this gap must therefore engage with the proximal experience of effort during task initiation—not merely explain why avoidance occurs, but provide principles for how effortful engagement can be made more likely. The present research draws on the theory of learned industriousness (Eisenberger, 1992), which proposes that when effortful behavior is consistently paired with reward, individuals begin to associate effort itself with positive outcomes. Importantly, this framework does not require that procrastination itself be learned or that its absence was the cause of the problem in the first place. Rather, learned industriousness is applied here as an intervention framework: because effort aversiveness is a proximal driver of delay across multiple theoretical accounts, reinforcing effortful engagement at the moment of initiation may reduce procrastination regardless of how it originally developed. Learned industriousness therefore suggests that

reinforcing effort can promote persistence and task engagement. The current studies examine whether this principle can be applied to interrupt procrastination at the state level, potentially weakening avoidance-based reinforcement and reducing the likelihood of habitual delay.

Table 2

Summary of major theories of procrastination

Theory	Core Mechanism	Key Prediction
Short-term Mood Regulation (Sirois & Pychyl, 2013)	Task aversiveness triggers negative affect; avoidance provides immediate mood repair	Procrastination is more likely when tasks feel emotionally threatening
Temporal Motivation Theory (Steel & König, 2006)	$\text{Motivation} = \text{Expectancy} \times \text{Value} / (\text{Sensitivity} \times \text{Delay})$; procrastination occurs when utility is low or delay is long	Tasks that are uncertain, low-value, or temporally distant are more likely to be delayed
Temporal Decision Model (Zhang & Feng, 2020)	Procrastination occurs when immediate task aversiveness outweighs perceived outcome utility at a decision point	Reducing aversiveness or increasing utility at the moment of decision should reduce delay
Motivational/Self-Regulation Theories (Wolters, 2003)	Stable motivational beliefs (self-efficacy, goal orientation) shape self-regulatory success	Higher self-efficacy and mastery orientation predict less procrastination

A Shift in Perspective: From Explaining Delay to Cultivating Effort

To fully integrate the theory of learned industriousness as an intervention framework for procrastination, it is useful to consider what procrastination fundamentally interferes with: effortful engagement and persistence toward an intended goal. Effort, defined as “the physical or mental application that is devoted to achieving a result” (Hayakawa, 1968, p. 183), lies at the heart of goal-directed behavior. When individuals procrastinate—regardless of the specific trigger—they are not necessarily avoiding effort altogether, but rather avoiding the exertion of effort toward a particular intended task. In this way, procrastination

reflects not only a delay in action but a difficulty initiating effortful engagement with a goal that is perceived as demanding or unpleasant.

While procrastination is commonly described in terms of delay or avoidance, a growing body of research suggests that it is closely tied to how effort is experienced in the moment. Across motivational and emotion regulation frameworks, procrastination frequently occurs when tasks are perceived as cognitively, emotionally, or physically demanding. In such situations, effort is experienced as aversive, depleting, or unpleasant, and avoidance serves as a means of reducing that perceived burden (Sirois & Pychyl, 2013). Importantly, individuals may still exert effort during procrastination by engaging in alternative activities that feel more manageable or immediately rewarding (i.e., ‘productive procrastination’, Westgate et al., 2017). Thus, procrastination is better understood as a shift away from effortful engagement with a specific task rather than a general avoidance of effort itself.

Empirical research supports the importance of effort-related appraisals in procrastination. Blunt and Pychyl (2000) found that students were significantly more likely to procrastinate on tasks perceived as both aversive and effortful. Similarly, Steel’s (2007) meta-analysis demonstrated strong associations between procrastination and low conscientiousness—a trait linked to persistence and effortful control—as well as high impulsivity, reflecting difficulty sustaining cognitive effort. The Short-Term Mood Regulation theory (Sirois & Pychyl, 2013) likewise characterizes procrastination as an emotion-focused avoidance strategy, particularly in response to tasks that demand emotional or cognitive exertion. Chronic procrastinators also tend to overestimate task difficulty and underestimate their ability to cope, further increasing the perceived cost of engagement (Milgram et al., 1992).

As Steel (2007, p. 52) concluded in his review, “The review here strongly indicates that task aversiveness, that is decreasing the value of a task, increases procrastination,” underscoring the central role of perceived effort and task cost in the procrastination process. If procrastination is partly driven by the experienced cost of effort in the moment, then an alternative intervention approach is not only to reduce task aversiveness but also to increase the subjective value of effortful engagement itself. The theory of learned industriousness provides a framework for how effort may acquire positive value through reinforcement, thereby supporting persistence even when tasks remain demanding.

Theory of Learned Industriousness

The theory of learned industriousness (Eisenberger, 1992) proposes that individuals can acquire a generalized tendency to persist in effortful behavior when effort is consistently paired with positive reinforcement. Over time, effort itself—often experienced as costly—can become secondarily rewarding. This framework helps explain why individuals with similar abilities may differ markedly in their willingness to persist: such differences may reflect not only stable personality traits, but also individual histories in which effort has been differentially reinforced.

Learned industriousness directly challenges Hull’s (1943) law of least effort, which posits that organisms naturally gravitate toward minimizing effort expenditure. While this principle holds in many situations, Eisenberger and colleagues (e.g., Eisenberger et al., 1979; Eisenberger & Adornetto, 1986) demonstrated that under certain reinforcement contingencies, individuals will exert greater effort because effort itself becomes associated with rewarding outcomes (details reviewed in the following sections). In this way, effort is not inherently aversive; its motivational value can be shaped through experience.

This account is grounded in principles of both operant and classical conditioning, whereby repeated pairing of effort with reward can alter its affective and motivational value. The following sections outline these learning mechanisms and describe how they provide a theoretical basis for applying learned industriousness to the problem of procrastination.

Operant Conditioning. Operant conditioning, first formalized by Skinner (revised and consolidated version, 2019), refers to the process by which behavior is shaped through its consequences. Behaviors followed by positive outcomes (reinforcers) are more likely to recur, whereas those followed by negative outcomes (punishers) are less likely to be repeated. Reinforcement may involve the addition of a pleasant stimulus (positive reinforcement) or the removal of an aversive one (negative reinforcement), but in both cases its function is to increase the likelihood of the behavior.

Within the framework of learned industriousness, positive reinforcement plays a central role. When individuals are rewarded for exerting effort on challenging tasks—through praise, recognition, tangible incentives, or feelings of mastery—their effortful behavior becomes more likely to recur. Importantly, what is reinforced is not only successful outcomes but the process of sustained effort itself. Over time, consistent reinforcement of effort can increase persistence even on unrelated or novel tasks (Eisenberger, 1992).

Classical Conditioning. While operant conditioning strengthens effortful behavior through consequences, classical conditioning helps explain how effort itself can acquire positive emotional value. Classical conditioning occurs when a stimulus is repeatedly paired with an outcome that naturally elicits an emotional response. Over time, the stimulus itself begins to evoke that response.

In the context of learned industriousness, the subjective experience of effort—often initially uncomfortable or unpleasant—is repeatedly followed by rewarding outcomes such as accomplishment, praise, or success. These rewards evoke positive emotional responses, and through repeated pairing, effort itself may come to elicit similar positive affective responses even in the absence of immediate reward. In this way, effort can transition from something primarily avoided to something that is more tolerable or even intrinsically satisfying, supporting sustained engagement. This process is consistent with the concept of a secondary reinforcer: a stimulus that acquires motivational value not through any inherent property, but through its repeated association with primary rewards. This is a central mechanism through which learned industriousness operates, and it provides the theoretical basis for expecting that reinforcing effortful engagement can, over time, reduce the perceived cost of effort and support greater task persistence.

Together, operant and classical conditioning provide a framework for understanding how effort can become valued over time. Through repeated reinforcement, individuals may not only persist longer in effortful behavior but also come to experience effort itself as less aversive. The following section reviews empirical evidence supporting the concept of learned industriousness.

Evidence for Learned Industriousness. Behavioral evidence from both animal and human studies supports the theory of learned industriousness (Haynos et al., 2023). For example, when rats are required to exert high effort for reward, they subsequently exert greater effort in unrelated transfer tasks compared with rats not exposed to high-effort contingencies (e.g., Eisenberger et al., 1979; Eisenberger et al., 1989; McCuller et al., 1976; Wenrich et al., 1967), even when those tasks involve aversive outcomes.

Similar findings have been observed in human participants. Early experiments demonstrated that rewarding high effort in initial tasks—such as solving complex math problems or anagrams—increased persistence on later unrelated challenges (Eisenberger & Leonard, 1980; Eisenberger & Masterson, 1983). More recent work has shown that when rewards are contingent on cognitive effort, participants later show stronger preferences for more demanding tasks even in the absence of reward, suggesting that mental effort can acquire intrinsic value (Inzlicht et al., 2018). In applied contexts, persistence has also predicted meaningful behavioral outcomes; for example, smokers demonstrating greater task persistence prior to quitting were more likely to maintain abstinence over a 12-month follow-up period (Brandon et al., 2003).

Neuroscientific evidence further supports this account. Brain regions involved in reward and motivation, including the ventral striatum and ventromedial prefrontal cortex, show increased activity both in response to rewards earned through effort and in anticipation of effortful engagement (Schouppe et al., 2014; Vassena et al., 2014). Individuals also tend to value rewards obtained through greater effort more highly than identical rewards obtained with minimal effort (Alessandri et al., 2008), and individual differences in dopamine signaling are associated with willingness to pursue effortful goals (Westbrook & Braver, 2016). Together, these findings indicate that effort can acquire motivational value when consistently paired with reward.

Implications for Procrastination. The relevance of learned industriousness to procrastination becomes apparent when considering that many episodes of procrastination involve disengagement from tasks anticipated to feel effortful, unpleasant, or taxing. Even when the long-term importance of a task is clear, the immediate experience of effort can

dominate the decision to begin. From this perspective, interventions that increase the rewarding value of effortful engagement—particularly at the moment of action—may make task initiation more likely.

Learned industriousness therefore provides a framework for examining whether reinforcing effort can support persistence and task engagement in the context of procrastination. By increasing the positive value associated with effortful engagement, individuals may become more willing to initiate and persist in tasks that would otherwise be delayed.

Thus, procrastination and industriousness can be understood as reflecting different experiential relationships with effort: one in which effort is primarily experienced as costly, and another in which effort becomes associated with reward and persistence. The present research examines whether reinforcing small instances of effortful engagement can shift this experience at the state level, thereby increasing task engagement without requiring that task aversiveness be eliminated entirely.

From Theory to Intervention: Applying Learned Industriousness to State Procrastination

The preceding sections established that procrastination often emerges at specific moments of task engagement, when individuals evaluate whether to initiate or delay effortful action. Across theoretical accounts, these moments are characterized by an imbalance between the immediate costs of effort and the perceived value of task engagement. Tasks that are experienced as cognitively demanding, emotionally uncomfortable, or low in immediate reward are more likely to be postponed, even when individuals intend to complete them. As a

result, procrastination frequently reflects a short-term preference for avoiding effort-related discomfort rather than a lack of long-term goals or intentions.

Existing theories help explain why avoidance becomes attractive in these moments. Short-term mood regulation accounts emphasize the role of negative affect, suggesting that individuals delay tasks to alleviate discomfort or restore a more positive emotional state (Sirois & Pychyl, 2013; Tice & Bratslavsky, 2000). Temporal Motivation Theory and the Temporal Decision Model similarly describe procrastination as arising from momentary evaluations in which effortful tasks carry lower immediate utility relative to more rewarding alternatives (Steel & König, 2006; Zhang & Feng, 2020). Although these frameworks differ in emphasis, they converge on a common observation: at the moment of decision, effort is often experienced as costly, and avoidance provides immediate psychological relief.

This convergence has important implications for intervention design. If procrastination is enacted at moments where effort feels disproportionately costly, interventions that operate solely at the level of long-term traits or habits may fail to address the proximal processes that give rise to delay. Instead, interventions that target the experience of effort during task initiation may be particularly effective. From the perspective of learned industriousness, this suggests that changing how effort is experienced—not only how tasks are evaluated—may be a critical mechanism for promoting engagement. When effortful engagement is associated with positive outcomes or manageable progress, the perceived cost of effort may decrease, increasing willingness to initiate and persist in future tasks.

Existing Interventions for Procrastination

A substantial body of research has examined interventions aimed at reducing procrastination by targeting the emotional and cognitive factors associated with task

avoidance. Cognitive Behavioral Therapy (CBT; Rozental et al., 2018b; Toker & Avci, 2015), Acceptance and Commitment Therapy (ACT; Dionne, 2016), and emotion regulation interventions (Grunschel et al., 2018; Schuenemann et al., 2022) have demonstrated efficacy in reducing procrastination by helping individuals identify maladaptive thoughts, regulate negative affect, and reframe task-related appraisals. Similarly, time-management and self-regulation approaches seek to translate adaptive intentions into action through planning, monitoring, and goal-setting strategies (Rozental et al., 2015; Wolters & Brady, 2021).

Interventions that increase perceived task utility or expectancy have also shown promise. Breaking complex tasks into smaller subgoals, for example, increases perceived achievability and enhances motivation by making progress more immediately visible (Bandura & Schunk, 1981; Heath et al., 1999). Such approaches can reduce perceived task difficulty and increase engagement by shifting attention from distant outcomes to proximal progress.

Despite their effectiveness, many existing interventions require extended delivery across sessions, sustained motivation, or facilitator involvement—conditions that make them difficult to deploy at the precise moments when procrastination occurs. The limitation is not that these approaches target the wrong processes, but that they cannot be delivered at the point of decision. Consequently, they may be less suited to address state procrastination as it unfolds in everyday contexts, where the relevant moment passes long before a therapy session or training exercise can be accessed. Miyake and Kane (2022) similarly argue that therapy-based interventions, despite their effectiveness, cannot be readily implemented at scale, and propose instructor-based ‘small-teaching’ interventions as a complementary

approach—brief, easily implementable techniques that target proximal drivers of procrastination within classroom contexts.

More recent work has begun to explore shorter, context-sensitive approaches that operate closer to the moment of task engagement, including implementation intentions and real-time self-regulation strategies (Gollwitzer, 1999; Svartdal et al., 2020). These approaches reflect a growing recognition that procrastination fluctuates across situations and may be responsive to brief interventions targeting momentary appraisals and behavioral initiation (Krause & Freund, 2014; Sirois et al., 2019).

Toward State-Level Intervention through Effort Engagement

Building on this emerging direction, the present research adopts a state-level perspective informed by the principles of learned industriousness. Rather than attempting to directly modify stable traits or long-term habits, this approach focuses on the immediate experience of effort during task initiation. If effort can acquire positive motivational value through reinforcement, then interventions that facilitate successful engagement with effort—even briefly—may increase willingness to begin and continue tasks that would otherwise be avoided.

Importantly, this perspective does not assume that procrastination reflects a global unwillingness to exert effort. Individuals often exert effort in alternative activities while delaying a target task. Instead, the focus is on how effort is evaluated in relation to a specific task at a specific moment. By making initial engagement feel more manageable or rewarding, interventions may shift this evaluation in favor of action.

Accordingly, the present dissertation examines whether interventions that operate at the moment of decision—by reducing perceived task aversion, enhancing perceived value,

and reinforcing early effort—can promote task initiation and persistence. In doing so, it seeks to translate principles derived from learned industriousness into brief, scalable intervention strategies aimed at reducing state procrastination.

Overview of the Present Research

This dissertation examines whether principles derived from learned industriousness can be applied to reduce state procrastination through brief, scalable interventions targeting moments of task engagement. Across three studies, the research progresses from examining changes in task-related intention, to observable task engagement, and finally to sustained engagement across repeated task encounters. Together, these studies investigate whether reinforcing effort at the point of initiation can increase willingness to begin and continue tasks that are otherwise delayed.

Chapter 2 (Study 1) introduces a brief intervention designed for individuals actively procrastinating a task. The intervention combines affect labeling, subgoal generation, and reward selection to alter how the task is experienced at the moment of decision. Study 1 examines whether these changes in task appraisal increase individuals' intention to begin working on a currently procrastinated task. By focusing on initiation intention, this study provides an initial test of whether modifying in-the-moment perceptions of effort and task value can influence readiness to act.

Chapter 3 (Study 2) extends this work by examining real task engagement rather than intention alone. In addition to assessing whether participants initiate and continue working on their procrastinated task, Study 2 evaluates the mechanisms underlying the effects observed in Study 1. Specifically, the study compares subgoal generation alone with a combined subgoal and reinforcement condition to determine whether reinforcement contributes

uniquely to engagement beyond reducing task complexity. This allows for a clearer understanding of how effort-related reinforcement influences behavioral persistence during ongoing task performance.

Chapter 4 (Study 3) examines whether repeated reinforcement of effort can support consistent engagement over time within a naturalistic academic context. Using a mobile application that provides reinforcement following completion of small units of effort, this longitudinal study evaluates whether students in the intervention condition demonstrate greater consistency in completing assigned readings compared to a control condition. By examining behavior across repeated opportunities for engagement, this study assesses whether reinforcing effort at the state level can support sustained task engagement without assuming changes in underlying traits.

Finally, Chapter 5 integrates the findings across studies and discusses their theoretical, empirical, methodological, and practical implications for procrastination research. The dissertation's primary contribution is to demonstrate how insights about state procrastination and learned industriousness can be leveraged to design and evaluate new forms of brief, scalable intervention targeting the moment of task initiation. Building on these empirical findings, Chapter 5 also introduces a reinforcement-based account of procrastination as a theoretical extension—not a claim tested in the present studies, but a speculative framework outlining directions for future research.

Study 1: Now I Feel Like I’m Going to Get to It Soon: A Brief, Scalable Intervention for State Procrastination

This chapter is based on a previously published article: Garg, A., Shelat, S., & Schooler, J. W. (2025). Now I feel like I’m going to get to it soon: A brief, scalable intervention for state procrastination. *BMC psychology*, 13(1), 1158. The text has been adapted for inclusion in this dissertation.

As explained in Chapter 1, procrastination cannot be understood solely as a stable dispositional tendency, but instead reflects momentary decision processes that unfold during task engagement. Although individual differences influence susceptibility to procrastination, the decision to initiate or delay action occurs at the level of immediate task appraisal. This state-level perspective implies that interventions need not exclusively target long-term behavioral change; rather, they may operate by shifting the evaluations that occur at the moment individuals decide whether to engage with an intended task. Yet as Chapter 1 argued, knowing that task appraisals drive delay does not itself tell us how to shift them—The present chapter provides an initial empirical test of whether brief, targeted appraisal change is sufficient to increase individuals’ intentions to act.

As outlined in Chapter 1, the Temporal Decision Model (TDM; Zhang & Feng, 2020) conceptualizes procrastination as a cost–benefit evaluation in which individuals weigh task aversion against outcome utility. When the immediate aversiveness of a task outweighs its perceived benefits, delay becomes the preferred option, even when individuals intend to act later. This framework suggests that procrastination may be reduced by altering the balance between these competing appraisals. The present study adopts this logic as a starting point,

examining whether a brief intervention designed to simultaneously reduce task aversion and enhance outcome utility can influence individuals' willingness to engage with a currently procrastinated task.

The goal of the present study is therefore not to evaluate a comprehensive treatment for chronic procrastination, but to test whether momentary task appraisals associated with delay are responsive to brief intervention. Building on the foundation established in Chapter 1, the present study focuses specifically on interventions that can be implemented at the moment of task avoidance, targeting the proximal decision processes that characterize state procrastination. If procrastination reflects a temporary imbalance between perceived costs and benefits, then even modest shifts in these appraisals may be sufficient to increase the likelihood of task initiation.

Consistent with this state-level framing, recent experience-sampling work has shown that the onset of academic procrastination behavior is predicted by within-person fluctuations in momentary task appraisals rather than by stable individual differences alone (Wieland et al., 2021).

To test this possibility, the intervention targeted two components of the decision process identified by cost-benefit models of procrastination. The current study 1) employs Affect Labeling to reduce task aversion and 2) time management and subtask generation to increase task outcome utility. These three components are summarized in Table 3.

Affect Labeling, or the articulation of emotions into words, has been shown to reduce emotional reactivity to distressing stimuli (Constantinou et al., 2014; Fan et al., 2019; Lieberman et al., 2011; Torre & Liberman, 2018). The most common method to employ Affect Labeling involves having participants choose, speak, or write a word that describes

their feelings about the task at hand. In the present study, participants were prompted to contemplate and articulate the reasons behind their procrastination, leveraging this implicit emotion regulation strategy to alleviate distress. We anticipated that participants would write about emotions such as distress, frustration, anger, hopelessness, or boredom related to the task, thereby employing the Affect Labeling technique to reduce distress. We expected that this technique would result in participants reporting lower levels of feeling averse to doing the task, experiencing a more pleasant mood, and feeling less stressed compared to participants in the control groups.

Our second aim was to increase outcome utility by guiding participants through time estimation and subtask generation. Participants were instructed to select an easy subtask and estimate the time required to complete it. We conjectured that the easy subtasks would take less time to complete than the overall task, making the subtask's outcome utility more immediate and attainable compared to that of the main task. Essentially, this process creates a pseudo-deadline that is closer and more manageable than the original deadline. Participants were also asked to identify a small reward they would receive upon completing the subtask. This introduces an extrinsic motivator and shifts the perceived value of goal completion closer to the present. Since the subtask requires less time to complete than the main task, this strategy effectively enhances the outcome utility of the task. We hypothesized that participants in the experiment group would thereby report greater outcome utility, and a higher motivation to complete the task than participants in the control groups.

Table 3

Intervention components and their implementation

TDM Component	Strategy	Implementation
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Task aversion	Affect Labeling	Participants articulated why they were avoiding the task
Outcome utility	Subtask generation	Participants selected an easy subtask and estimated the time needed to complete it
	Reward selection	Participants identified a small reward for completing the subtask

We also hypothesized that, by combining Affect Labeling to reduce task aversion with subgoal generation and reward selection to enhance outcome utility, participants would exhibit an increased gap between outcome utility and task aversion. Accordingly, this outweighing of outcome utility compared to task aversion should mediate the relationship between group assignment and the self-reported likelihood of completing the procrastinated task, consistent with cost–benefit decision-making models of procrastination.

We also sought to examine the impact of social desirability bias—“the tendency to give answers that make the respondent look good” (Paulhus, 1991, p. 17)—as a potential source of bias in self-report measures of procrastination. Procrastination as a field largely relies on self-report data that is susceptible to self-reporting biases. Social desirability bias is more likely to occur in situations where behaviors, norms, and attitudes align with widely accepted standards or involve sensitive issues (Grimm, 2010). When responding to procrastination-related questions, participants may obscure true perceptions of their tasks, motivations, and intentions in order to present themselves favorably to the experimenter; this would substantially bias responses in self-report surveys. In the context of our study, this may result in participants overstating their likelihood of task completion, along with similar trends across other dependent variables. To explore the social desirability bias as a main

predictor and/or moderator of effects on our dependent measures, we included a short form version of the Marlowe-Crowne Social Desirability Scale (Vésteinsdóttir et al., 2017). Specifically, social desirability scores were included as a covariate in follow-up ANCOVAs, and the interaction between group assignment and social desirability was examined to assess whether social desirability moderated the effect of the intervention on each dependent variable.

In summary, this study takes an important first step in designing a brief, scalable intervention aimed at reducing state procrastination. The intervention integrates three evidence-based strategies—Affect Labeling, subgoal generation, and reward selection—to maximize its potential impact on self-reported task completion likelihood. By increasing perceived task utility and reducing task aversion, we hypothesized that participants in the experimental condition would report a greater intention to complete their procrastinated task compared to those in the control conditions.

Method

Participants and Design

A total of 1,035 participants were recruited through Prolific. The sample size was determined by budget constraints, with each participant receiving \$1 for completing the study. All participants completed a seriousness check, which asked them to indicate whether they had responded attentively or simply clicked through the survey. The prompt reassured participants that they would be compensated regardless of their answer to encourage honesty. Participants who reported not engaging seriously ($n = 1$) were excluded from the analysis (Aust et al., 2013). The mean participant age was 38.99 years ($SD = 13.63$), and 63.3% identified as female. The racial composition of the sample was Asian = 7.5%, Black =

10.9%, White = 73.1%, Mixed = 4.9%, and Other = 3.6%, with all participants residing either in the United States of America or United Kingdom. Additionally, 14% of the sample consisted of students. This makes the study generalizable to broader adult populations, and the intervention scalable not just for academic but also general procrastination. On average, participants took 6.47 minutes ($SD = 4$ minutes) to complete the study.

The study employed a single-factor between-subjects design with participants randomly assigned to one of three groups: the experimental group ($N = 348$), control group 1 ($N = 336$), or control group 2 ($N = 351$).

Procedure

Participants on Prolific (www.prolific.com) first acknowledged a warning that the study would consist of multiple open-ended questions, and that they would not terminate their participation due to this (Zhou & Fishbach, 2016). Then, participants were randomly assigned to one of the three groups.

Participants in the experiment group responded to 7 questions related to task specifics. The questions were all open-ended, requiring either one word or very brief responses. Participants were asked to name and describe one task they had been actively procrastinating. They were then asked to reflect on the qualities of the task, particularly their aversion to the task. Afterwards, they responded to a question asking about the perceived benefits of completing the task. Upon answering 4 questions related to the aforementioned, participants then named a subtask they could complete, followed by addressing the amount of time it would take them and indicating how they would reward themselves for completing the subtask.

Participants in control group 1 answered seven neutral, task-related questions that were structurally similar to those in the experimental condition (e.g., task location, who assigned the task), but lacked any affective or motivational content. These items were designed to control for the effects of time on task and engagement with the topic, without targeting task aversion or outcome utility. Participants in control group 2 were simply asked to name the task they are procrastinating (Table 4 lists the questions each condition was shown).

Table 4

Intervention and control conditions items.

Experimental condition	Control condition (merged)	
	Control 1	Control 2
What task are you currently procrastinating on?	What task are you currently procrastinating on?	What task are you currently procrastinating on?
Provide a brief description of the task.	Provide a brief description of the task.	
Why are you avoiding doing this task?	What items do you need to complete the task?	
What are the benefits of completing this task?	What is the due date for this task?	
Tasks can be broken down into subtasks. Name an easy subtask you can complete for this task.	When were you assigned this task?	
How long will it take you to complete this subtask (in minutes)?	Who assigned this task to you?	
Name a small reward for completing the subtask.	What location does this task have to be completed in?	

Immediately after all conditions, participants rated the impact of the intervention on 6 dependent variables. Two questions were adapted from Zhang et al. (2021), where participants rated the outcome value, “How desirable are the benefits of completing this task?” ($0 = \text{Extremely Undesirable}$ to $9 = \text{Extremely Desirable}$) and task aversiveness, “How averse are you going to feel if you have to start or complete this task in the next 24 hours?” ($0 = \text{Extremely Averse}$ to $9 = \text{Extremely Unaverse}$) of the task. Two questions were related to their emotions upon having done the interventions, specifically inquiring about mood ($0 = \text{Extremely Unpleasant}$ to $9 = \text{Extremely Pleasant}$) and stress levels ($0 = \text{Extremely Stressed}$ to $9 = \text{Extremely Calm}$). Finally, participants rated their motivation to ($0 = \text{Extremely Unmotivated}$ to $9 = \text{Extremely Motivated}$) and likelihood of completing the task ($0 = \text{Extremely Unlikely}$, $9 = \text{Extremely Likely}$). For the complete list of items, please refer to Table 5.

Table 5

Dependent variables list, with the preceding instructions stating: “The following items ask about the task you’ve been procrastinating on. Please respond to these questions.”

Variable name	Question	Likert range (9 point)
Task completion likelihood	In the next 24 hours, how likely would you be to do this task?	Extremely unlikely - extremely likely
Outcome utility	How desirable are the benefits of completing this task?	Extremely undesirable - extremely desirable
Task aversion	How averse are you going to feel if you have to start or complete this task in the next 24 hours?	Extremely averse - extremely unaverse
Mood	How would you rate your mood regarding this task?	Extremely unpleasant - extremely pleasant

Stress	How stressed do you feel regarding this task?	Extremely stressed - extremely calm
Motivation	How motivated do you feel to complete this task?	Extremely unmotivated - extremely motivated

Finally, all participants responded to the Brief Marlowe-Crowne Social Desirability Scale. This 10-item scale measures social desirability bias, or the tendency to present oneself in a socially desirable manner (Vésteinsdóttir et al., 2017). All items are measured using True/False statements, with an example item being “I have never intensely disliked anyone”. A high score suggests a tendency to appear more socially desirable.

Participants were then directed to answer the seriousness check question. This question enquires about how seriously the participant answered the questions in the study, with participants indicating less than ideal data being dropped from the analysis. All participants were given monetary compensation upon completion of the entire study.

Results

Analysis Strategy

The study included two control groups, control group 1 and control group 2. Control group 1 was matched to the experimental group on the total number of items and asked neutral task-related questions, while control group 2 was simply asked to answer with a task they were procrastinating. This design of control groups enabled us to check if the presence of basic task-related questions would result in any difference from a condition where the participant only lists the task. If there was no difference, we could treat both control groups as an equivalent baseline condition. One-way ANOVAs across all groups were conducted,

revealing no significant differences between the control groups in pairwise comparisons on any of the dependent variables.

To further reinforce a lack of significant differences between the control groups on all metrics, we also assessed the strength of evidence for the null hypothesis relative to the alternative examining Bayes Factors (BF_{10}) using the package BayesFactor (Morey & Rouder, 2023). Unlike traditional frequentist testing, Bayes Factors compare model strength rather than relying solely on p-values (Dienes, 2014; Rouder et al., 2009). Results consistently indicated moderate to strong evidence favoring the null hypothesis: BF_{10} values between .01–.03 reflect "very strong" evidence, .03–.10 indicate "strong" evidence, and .10–.33 suggest "moderate" evidence against the alternative hypothesis (Jeffreys, 1961; Rouder et al., 2009; Lee & Wagenmakers, 2014). See Table 6 for detailed ANOVA and Bayes Factor results. Based on this, we merged the two control groups into one before testing our main hypotheses.

Table 6

Pairwise comparisons contrasts between the control groups, and the associated Bayes Factor values.

Dependent variable	Mean difference (95% CI)	p-value	Bayes Factor	Evidence strength
Outcome utility	-.14 (-.45, .16)	.50	.15 ± .13%	Moderate
Task aversion	-.11 (-.46, .23)	.72	.11 ± .17%	Strong
Utility–aversion	-.03 (-.52, .46)	.99	.09 ± .22%	Strong
Mood	-.07 (-.37, .23)	.85	.10 ± .19%	Strong
Stress	.006 (-.33, .35)	.10	.09 ± .22%	Strong
Motivation	-.10 (-.46, .26)	.79	.11 ± .18%	Strong

Task completion likelihood	-.15 (-.59, .30)	.72	.11 ± .17%	Strong
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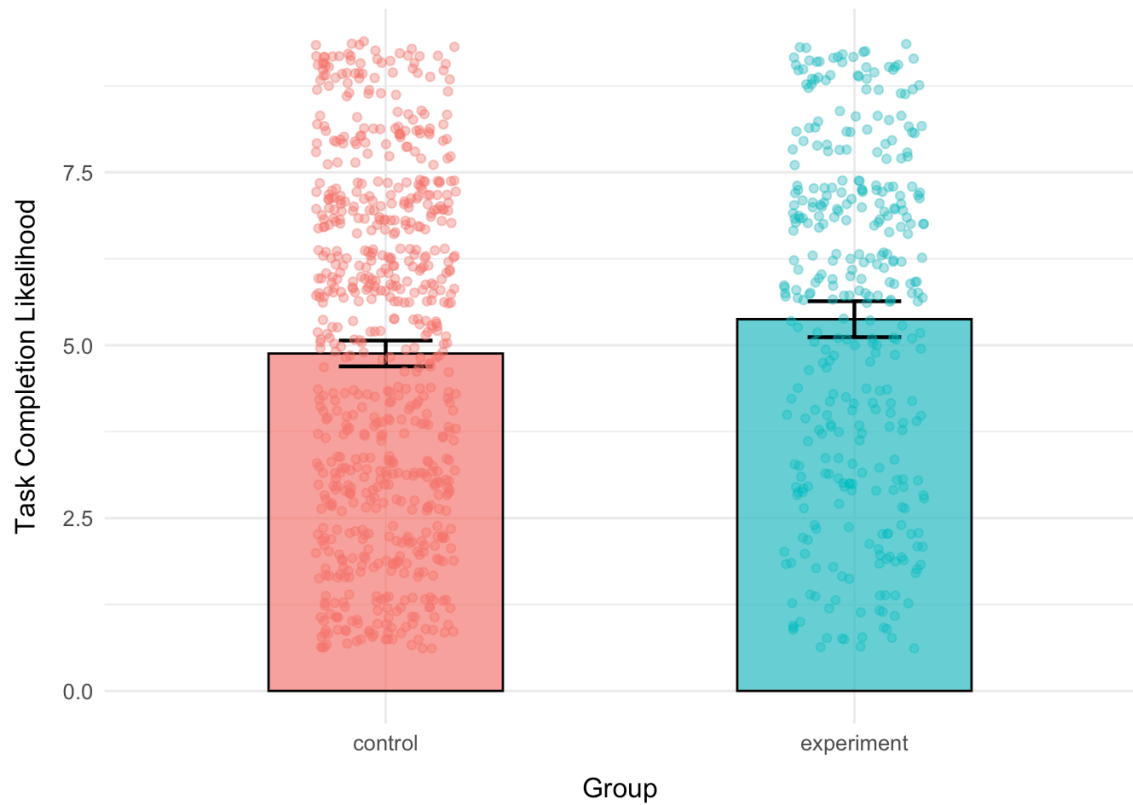
Group Differences

To assess whether the experimental group differed significantly from the control group, Welch's two-sample t-tests were conducted on seven self-reported measures related to participants' procrastinated tasks.

Task Completion Likelihood. The reported likelihood of completing the procrastinated task in the next 24 hours was significantly higher for the experimental group ($M = 5.38$, $SD = 2.47$) than for the control group ($M = 4.88$, $SD = 2.49$), $t(703.98) = -3.04$, $p = .002$, 95% CI [-.82, -.18], $d = -.2$ (Figure 1).

Figure 1

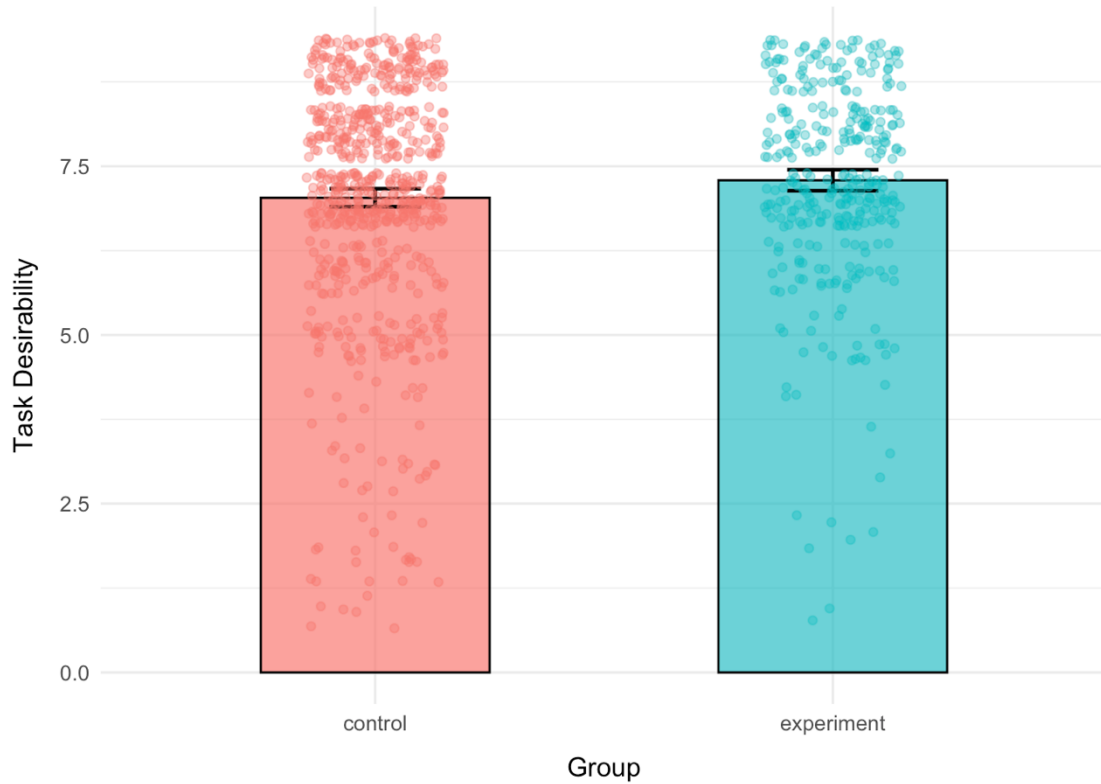
Mean of reported likelihood of task completion on a 9-point Likert scale for each group



Outcome Utility. The outcomes of the task were reported as more desirable by the participants in the experimental group ($M = 7.29$, $SD = 1.47$) than the control group ($M = 7.03$, $SD = 1.79$), $t(824.95) = -2.49$, $p = .013$, 95% CI $[-.46, -.05]$, $d = -.15$ (Figure 2).

Figure 2

Mean of outcome utility of task completion on a 9-point Likert scale for each group



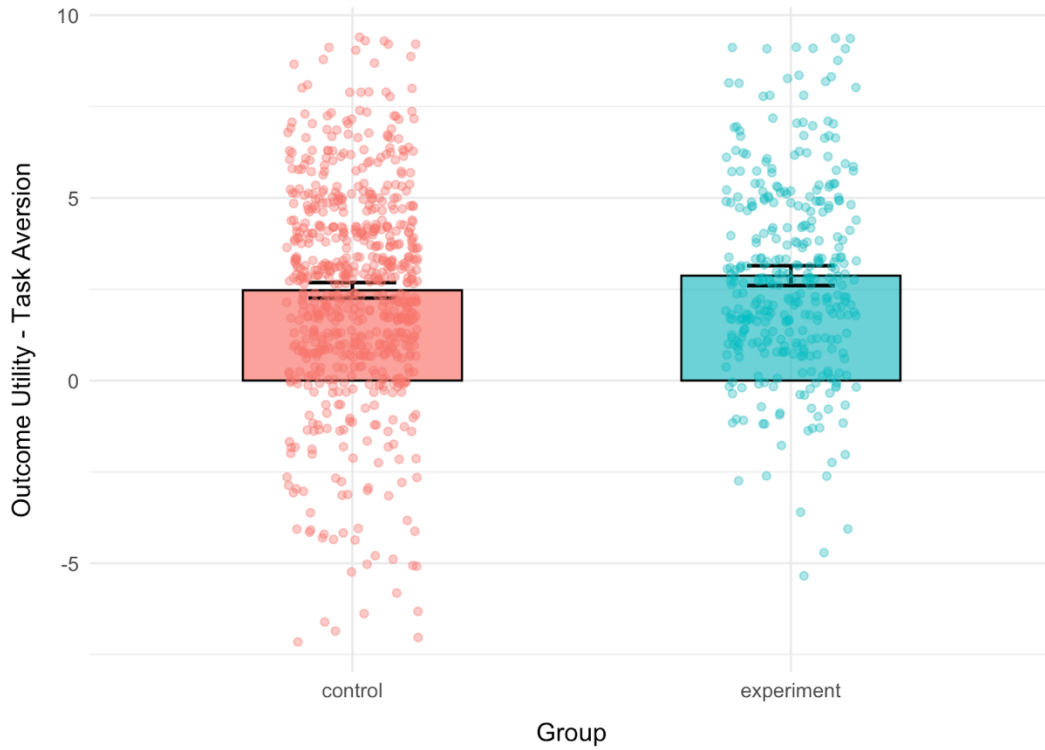
Task Aversion. The results indicated no significant difference between the experimental group ($M = 4.42$, $SD = 1.91$) and the control group ($M = 4.56$, $SD = 1.95$) on how aversive participants felt about completing the task in the near future, $t(710.29) = 1.11$, $p = .267$, 95% CI $[-.11, .39]$, $d = .07$, 95% CI $[-.06, .20]$.

Utility–Aversion. We computed the difference between outcome utility and task aversion to create a cost–benefit balance score, where a positive number indicates that outcome utility outweighs task aversion. The results suggested a significant difference between the groups, such that the participants in the experimental group ($M = 2.87$, $SD = 2.57$) reported a larger difference between outcome utility and task aversion than participants

in the control group ($M = 2.47$, $SD = 2.82$), $t(757.29) = -2.29$, $p = .022$, 95% CI $[-.74, -.06]$, $d = -.15$ (Figure 3).

Figure 3

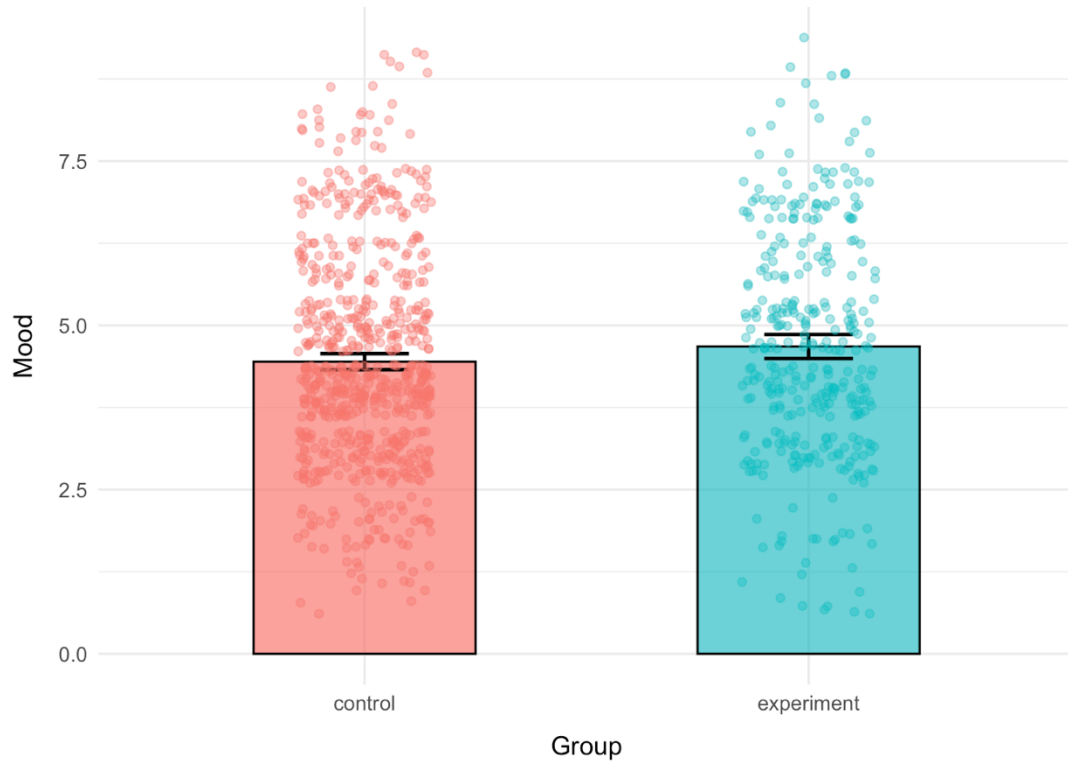
Mean of the gap between outcome utility and task aversion, calculated as the difference between the two, for each group



Mood. Participants in the experimental group ($M = 4.68$, $SD = 1.73$) reported having a significantly more pleasant mood regarding the task compared to participants in the control group ($M = 4.45$, $SD = 1.64$), $t(664.59) = -2.06$, $p = .039$, 95% CI $[-.45, -.01]$, $d = -.14$ (Figure 4).

Figure 4

Mean of reported mood on a 9-point Likert scale (higher values indicate a more pleasant mood) for each group



Stress. The results indicated no significant difference between the experimental group ($M = 4.52$, $SD = 1.94$) and the control group ($M = 4.73$, $SD = 1.88$) regarding the stress related to the task, $t(675.90) = 1.66$, $p = .098$, 95% CI $[-.04, .46]$, $d = .11$.

Motivation. The results indicated no significant difference in the motivation to complete the task between the experimental group ($M = 4.59$, $SD = 2.03$) and the control group ($M = 4.38$, $SD = 2.01$), $t(692.13) = -1.59$, $p = .112$, 95% CI $[-.47, .05]$, $d = -.11$. A full summary of results across all dependent variables is presented in Table 7.

Table 7

Means, standard deviations, effect sizes, and p-values for each dependent variable by group

Dependent variable	Experimental M (SD)	Control M (SD)	d	p
Task completion likelihood	5.38 (2.47)	4.88 (2.49)	-.20	.002
Outcome utility	7.29 (1.47)	7.03 (1.79)	-.15	.013
Task aversion	4.42 (1.91)	4.56 (1.95)	.07	.267
Utility–Aversion difference	2.87 (2.57)	2.47 (2.82)	-.15	.022
Mood	4.68 (1.73)	4.45 (1.64)	-.14	.039
Stress	4.52 (1.94)	4.73 (1.88)	.11	.098
Motivation	4.59 (2.03)	4.38 (2.01)	-.11	.112

Mediation Analysis

Given that both the outcome utility–task aversion difference and mood were found to be significant predictors of task completion likelihood, we conducted parallel mediation analysis using lavaan (Rosseel, 2012) to examine whether the effect of group assignment (experimental vs. control) on task completion likelihood was mediated by outcome utility–task aversion difference and mood. This model was saturated, and therefore fit the data perfectly by definition.

The direct effect of group assignment on task completion likelihood was significant, $b = .34$, $SE = .15$, $z = 2.20$, $p = .028$, 95% CI [.04, .63], reaffirming that participants in the experimental group reported a higher likelihood of completing their procrastinated task compared to the control group.

Regarding the mediators, group assignment significantly predicted both the utility–aversion difference ($b = .40$, $SE = .18$, $z = 2.26$, $p = .024$, 95% CI [.06, .75]) and mood ($b = .23$, $SE = .11$, $z = 2.07$, $p = .039$, 95% CI [.01, .45]). In turn, both the utility–aversion difference ($b = .21$, $SE = .03$, $z = 6.90$, $p < .001$, 95% CI [.15, .27]) and mood ($b = .33$, $SE =$

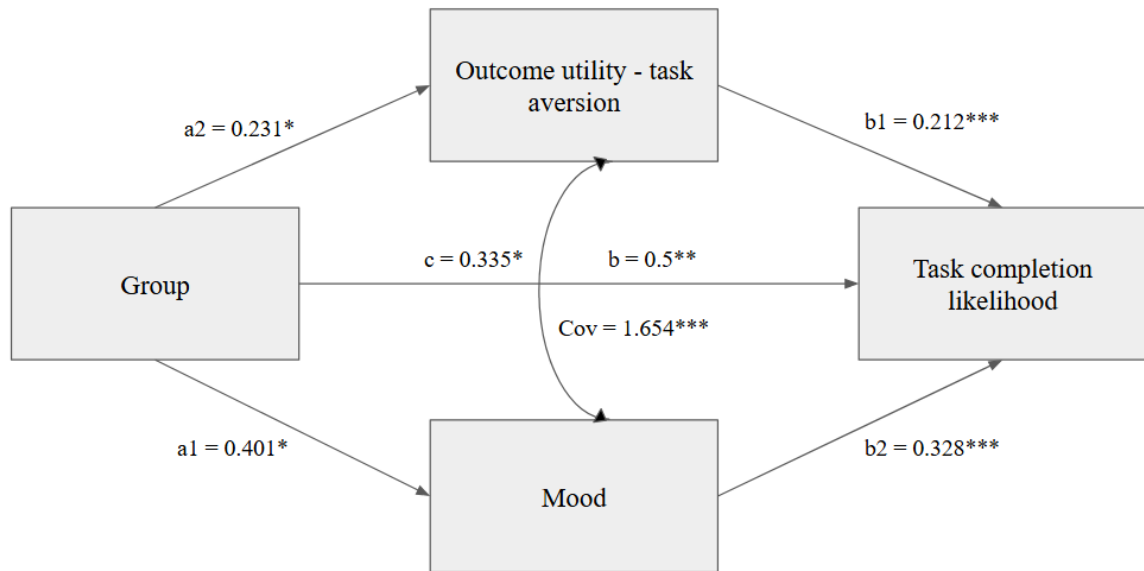
.05, $z = 7.00$, $p < .001$, 95% CI [.24, .42]) were significant predictors of task completion likelihood.

The indirect effect of group assignment on task completion likelihood through the utility–aversion difference was significant, $b = .09$, $SE = .04$, $z = 2.16$, $p = .031$, 95% CI [.01, .16]. The indirect effect through mood approached significance, $b = .08$, $SE = .04$, $z = 1.94$, $p = .053$, 95% CI [.00, .16]. The total indirect effect was significant, $b = .16$, $SE = .06$, $z = 2.61$, $p = .009$, 95% CI [.04, .28], indicating that the combined influence of both mediators accounted for a significant portion of the relationship between group assignment and task completion likelihood.

Finally, the total effect of group assignment on task completion likelihood was significant, $b = .50$, $SE = .16$, $z = 3.03$, $p = .002$, 95% CI [.17, .81], suggesting that both direct and indirect pathways contributed to the observed increase in task completion likelihood in the experimental group (Figure 5).

Figure 5

Mediation model of group differences being mediated by mood and utility–aversion on task completion likelihood.



Note. Indirect effects are shown as paths from group assignment through utility–aversion ($a1 \times b1$, b : .09) and mood ($a2 \times b2$, b : .08) to task completion likelihood, combining into a total indirect effect of .16. The direct effect ($c=.34$) and total effect ($b = c + \text{total indirect effect}=.50$) are also depicted. Please note that $*p < .05$, $**p < .01$, $***p < .001$.

Social Desirability Bias

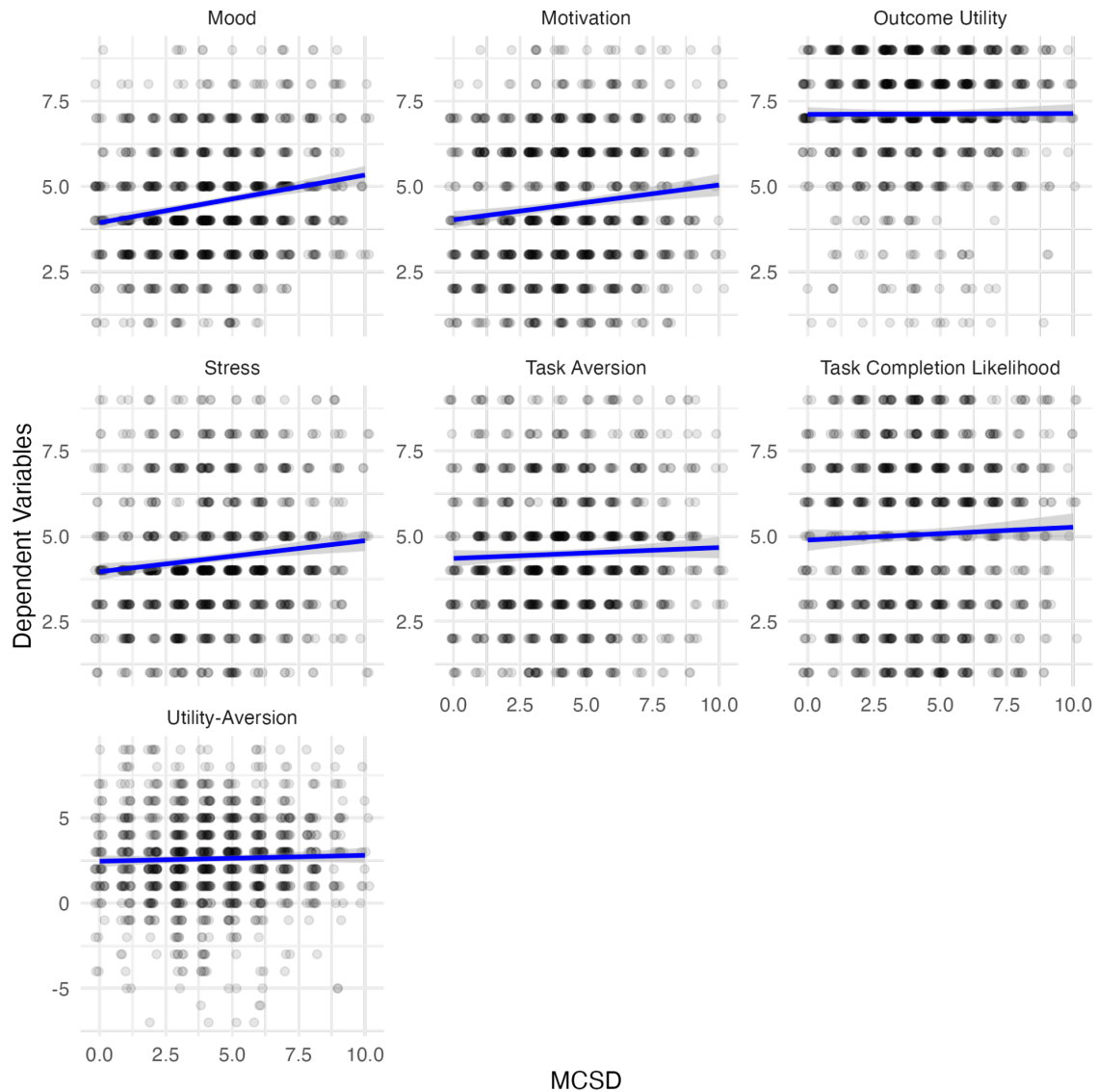
To assess whether the observed group differences on task-related outcomes were influenced by social desirability bias, a series of ANCOVAs was conducted with the Marlowe-Crowne Social Desirability Scale (MCSD) included as a covariate. The pattern of results remained consistent, with group assignment predicting task completion likelihood, outcome utility, and mood even after adjusting for social desirability. Full ANCOVA results are reported below.

The analysis revealed significant main effects of group assignment on likelihood of task completion, $F(1, 1031) = 9.20, p = .002$, outcome utility, $F(1, 1031) = 5.45, p = .020$, utility–aversion difference, $F(1, 1031) = 4.93, p = .027$, and mood, $F(1, 1031) = 4.59, p = .032$. These results suggest that the experimental group reported a higher likelihood of completing the task, greater outcome utility, a larger gap between outcome utility and task aversion, and a more pleasant mood compared to the control group, even after accounting for social desirability bias.

In contrast, no significant group differences emerged for task aversion, $F(1, 1031) = 1.22, p = .270$, stress, $F(1, 1031) = 2.84, p = .092$, or motivation, $F(1, 1031) = 2.58, p = .108$. Additionally, the main effect of MCSD and the interaction between group and MCSD were non-significant across all models ($ps > .22$), indicating that social desirability bias did not meaningfully influence the observed outcomes. Exploratory scatterplots depicting the bivariate relationships between MCSD and each outcome variable are presented in Figure 6.

Figure 6

Scatter plots of social desirability and the 7 dependent variables: mood, motivation, outcome utility, task aversion, utility–aversion, stress, and task completion likelihood



Discussion

The present study examined whether a brief, low-effort intervention could influence the decision processes underlying state procrastination. Grounded in the Temporal Decision Model (Zhang & Feng, 2020), the intervention was designed to shift momentary task

appraisals by increasing outcome utility and decreasing task aversion. Although the study did not assess actual task completion, participants reported a greater likelihood of engaging with a currently procrastinated task following the intervention. These findings provide initial evidence that brief strategies may influence goal-related decision making at the moment of delay.

Participants who completed the intervention—consisting of Affect Labeling, subgoal generation, and reward selection—reported greater perceived outcome utility, a larger gap favoring outcome utility over task aversion, more positive mood states, and a higher self-reported likelihood of task completion compared to controls. These results suggest that brief, targeted interventions can influence the cognitive and affective processes associated with state procrastination, particularly by enhancing perceived outcome utility relative to task aversion. In turn, these shifts appear sufficient to increase individuals' intentions to act on delayed tasks.

The findings of this study provide empirical support for the intervention's effectiveness. Participants who completed the intervention, which consisted of seven questions that guided respondents through Affect Labeling, subgoal generation, and reward selection techniques, reported significantly greater outcome utility, a larger gap favoring outcome utility over task aversion, more positive mood states, and a higher self-reported likelihood of task completion compared to the control group. These results suggest that brief, targeted interventions may help influence the processes that contribute to state procrastination—particularly by enhancing perceived outcome utility relative to task aversion—which may, in turn, increase individuals' intentions to follow through on delayed tasks.

Notably, the results indicate that increasing the perceived outcome utility of a task relative to its aversiveness positively influences individuals' reported likelihood of completing procrastinated tasks. Specifically, when participants perceived the desirability of task outcomes as outweighing the aversiveness of task engagement, they were more likely to report intentions to complete the task in the near future. This finding aligns with the Temporal Decision Model, which posits that procrastination persists until outcome utility surpasses task aversion as a deadline approaches (Zhang et al., 2019; Zhang & Feng, 2020). Importantly, even without significantly reducing task aversion, enhancing outcome utility was sufficient to increase participants' reported intention to act.

These findings suggest that the intervention may have influenced participants' task-related decision-making through multiple psychological pathways. The utility–aversion gap is directly aligned with the TDM's framework of cost–benefit evaluations, while mood may reflect broader emotional effects of the intervention as a whole. Given that the intervention combined Affect Labeling, subgoal generation, and reward selection, it is not possible to attribute mood improvements to any single component—subgoal generation may have reduced feelings of overwhelm, and reward selection may have introduced positive anticipatory states, either of which could plausibly account for mood benefits independently of Affect Labeling. Given that task aversion did not significantly differ between groups, the item used to assess it may have captured more cognitive or evaluative components of the task (e.g., difficulty, effort, boredom) than emotional aversion. As such, mood may have absorbed some of the emotional variance not captured by our task-specific aversion item. Future work may benefit from more granular emotion measures to distinguish between general and task-specific emotional responses.

This outcome underscores the potential of interventions that elevate outcome utility, particularly by introducing extrinsic motivators such as small rewards for completing subgoals. Such strategies can shorten the psychological distance between task engagement and goal realization, thereby increasing the perceived value of task completion in the present. Given that state procrastination reflects a momentary, context-dependent reluctance to engage with a task, interventions that shift the immediate cost–benefit appraisal (by enhancing utility or reducing aversion) appear well-suited to disrupting this temporary state of inaction. By targeting state procrastination directly, brief interventions may offer timely support when individuals are most vulnerable to task avoidance. However, it is important to note that the mediation effect of the utility–aversion gap was partial, suggesting that the effect of the intervention on task completion likelihood is not entirely explained by the change in task utility–aversion.

While outcome utility and mood partially mediated the effect of the intervention on self-reported task completion likelihood, a significant portion of the total effect remained unexplained. This residual effect suggests that other psychological mechanisms may have contributed to the intervention’s influence on participants' motivation and intention to act. One promising framework for interpreting this variance is Temporal Motivation Theory (TMT) (Steel & König, 2006), which integrates expectancy theory, hyperbolic discounting, and need theory. According to TMT, motivation is not solely a function of perceived task value (i.e., outcome utility) but is also shaped by delay sensitivity (i.e., impulsiveness), expectancy of reward achievement, and temporal proximity to reward. Because our intervention prompted participants to break down the task and visualize near-term benefits, it may have altered their temporal framing of the task, reducing the perceived delay between

effort and reward. This shift could be especially motivating for individuals high in impulsiveness, who tend to discount distant rewards more steeply (Rebetez et al., 2018; Steel & König, 2006). Additionally, by encouraging participants to choose a small reward for completing a subtask, the intervention may have increased self-efficacy by creating a sense of control and reinforcing participants' belief in their ability to take meaningful action toward task completion (Klingsieck, 2013). Research has shown that proximal, achievable goals paired with contingent rewards can strengthen self-efficacy beliefs, which in turn enhance motivation and persistence (Bandura, 1982). Future research examining additional potential mediators could help enhance the efficacy of this intervention and increase its robustness.

Another potential mechanism is learned industriousness, the idea that effort can become rewarding when consistently paired with reinforcement (Eisenberger, 1992). By encouraging subgoal planning and associated rewards, the intervention may have temporarily reactivated this effort–reward association, boosting motivation beyond shifts in utility or mood. While not directly tested here, future work could explore whether brief interventions like this one help build lasting motivation by reinforcing effort itself.

Interestingly, the intervention did not significantly impact task aversiveness. This may be due to two reasons: 1) the administration method of the technique was not explicit, or 2) the Affect Labeling technique was not robust enough to effectively reduce distress among participants. On the first point, participants were not explicitly instructed to label their emotions. When asked to reflect on reasons for task avoidance, many participants cited task-related characteristics (e.g., boring, difficult, lengthy) rather than emotional responses. This aligns with literature suggesting that task aversiveness stems from both individual and task

characteristics (Steel, 2007; Steel & Klingsieck, 2016). Explicitly directing participants to label their emotions may enhance the efficacy of Affect Labeling in reducing task aversion.

Second, prior research on Affect Labeling has yielded mixed results. For example, Ortner (2015) reported that Affect Labeling increased self-reported distress without affecting physiological arousal, whereas Matejka et al. (2013) observed decreased autonomic responses but noted that factual discussions reduced self-reported emotional intensity more effectively. Conversely, Burklund et al. (2014) demonstrated that Affect Labeling reduced distress, paralleling effects seen with cognitive reappraisal. Despite these inconsistencies, the current study found that participants in the intervention group reported significantly more positive mood states than controls. However, because the intervention was multifaceted, it is not possible to attribute this mood benefit specifically to Affect Labeling. Subgoal generation and reward selection may have independently or jointly contributed to improved mood by reducing perceptions of task overwhelm and introducing positive anticipatory states. Future research should isolate Affect Labeling from other intervention components to determine its unique contribution to emotional outcomes in procrastination contexts, potentially in combination with other strategies like mindfulness, cognitive reappraisal, or brief CBT (e.g., Rad et al., 2023).

Our final finding was that our procrastination-related dependent variables were mostly nonreactive to social desirability bias. Results indicated that social desirability bias did not interact with group assignment on any dependent variables, though it had a main effect on mood, stress, and motivation. This finding suggests that the observed improvements in outcome utility, mood, and self-reported likelihood of task completion are not artifacts of participants responding in socially desirable ways. We argue that this reinforces the validity

of the present findings. While our results presented here also suggest that social desirability bias has not confounded much of the results elsewhere in the procrastination literature, we advise other researchers to control for social desirability bias to strengthen the credibility of self-report-based procrastination studies.

Limitations

The current study is not without its limitations. First, actual task completion rates were not measured. Instead, participants self-reported their likelihood of completing the procrastinated task within the next 24 hours. This reliance on self-reports raises concerns related to the intention-behavior gap, which highlights discrepancies between individuals' stated intentions and their subsequent actions (Sheeran, 2002). Self-regulation capabilities, a key moderating factor in this gap, have also been identified as a critical individual difference influencing procrastination. Consequently, the present findings suggest that the intervention increased participants' intentions to complete the task but do not conclusively indicate actual task completion. Future research should address this limitation by examining the intention-action gap in procrastination. Specifically, employing longitudinal or two-part study designs where participants are followed up or recalled to report actual task completion, would provide more robust evidence of the intervention's effectiveness.

Second, the current study utilized a combined intervention targeting both outcome utility and task aversion simultaneously. It is uncertain which specific component of the intervention—subgoal generation, the introduction of a small reward, or the recall of task benefits—was the most influential in driving the observed improvements in outcome utility, mood, and reported likelihood of task completion. Future research should systematically

evaluate each intervention component independently to identify which strategy exerts the greatest impact on reducing procrastination.

Finally, although many results of the present study were statistically significant, the observed effect sizes were relatively small. This raises concerns about the practical significance of the findings and risks overinterpretation. The modest effect sizes suggest that while the intervention may be effective, its impact compared to the control group is limited. Replication of the current study, along with extensions incorporating more robust and explicit interventions designed to further enhance outcome utility and reduce task aversion, is recommended to strengthen the evidence base and maximize practical relevance.

Implications and Conclusion

Developing cost-effective, low-threshold interventions for procrastination remains an important goal, particularly given the barriers associated with intensive or long-term treatments. The present study contributes to this effort by demonstrating that a brief intervention can enhance perceived outcome utility and increase individuals' reported likelihood of engaging with procrastinated tasks. By applying the Temporal Decision Model to intervention design, these findings provide insight into how shifts in momentary task appraisal may influence intentions to act.

These results also suggest practical implications for scalable digital interventions. Internet- and mobile-based platforms may be particularly well suited to delivering brief, utility-enhancing strategies at the moment procrastination occurs. Incorporating proximal rewards, subgoal structuring, or personalized prompts into digital environments may provide accessible support for task initiation across educational, workplace, and clinical settings.

Study 1 demonstrates that brief, state-level interventions can shift momentary task appraisals and increase individuals' reported willingness to engage with procrastinated tasks. However, intention does not guarantee action. Procrastination is ultimately expressed through behavior, and sustained engagement requires not only willingness to begin, but persistence once effort is initiated. Moreover, while the present findings suggest that enhancing outcome utility is sufficient to influence intentions, they do not address whether repeated effort paired with reinforcement can alter engagement during ongoing task performance.

Chapter 3 extends this work by moving beyond self-reported intention to examine behavioral engagement during a real work period. Drawing on principles of reinforcement and learned industriousness, the next study tests whether structuring effort into discrete units and pairing those units with contingent feedback influences task engagement and willingness to continue working. In doing so, Chapter 3 builds directly on the state-level framework established here, advancing from decision making to persistence.

Study 2: Breaking Procrastination Down: Differential Effects of Subtasking and Reinforcement on Engagement and Persistence

This chapter is based on an under review article: Garg, A. & Schooler, J. W. (2026).

Breaking procrastination down: Differential effects of subtasking and reinforcement on engagement and persistence. *Motivation Science*. The text has been adapted for inclusion in this dissertation.

As demonstrated in Chapter 2, a brief, scalable intervention requiring only a few minutes of engagement could increase individuals' reported intention to work on a procrastinated task. Participants who completed the intervention reported higher perceived outcome utility, more positive mood, and a greater likelihood of engaging with their task compared to control conditions. These findings provided initial evidence that momentary task appraisals associated with state procrastination can be shifted through minimal cognitive intervention. However, the study also left two important questions unresolved: which components of the intervention produced these effects, and whether changes in intention translate into actual task engagement.

Addressing these questions requires moving beyond intention to examine behavior during task performance itself. Although intention is an important precursor to action, the intention–behavior gap remains well documented, with individuals frequently failing to follow through on stated goals (Sheeran, 2002). Procrastination is ultimately expressed through behavior, and sustained engagement requires not only willingness to begin a task but persistence once effort has been initiated. Consequently, understanding whether brief state-

level interventions influence ongoing engagement represents a necessary next step in evaluating their practical and theoretical significance.

The findings of Chapter 2 suggest that the intervention influenced momentary decision-making processes associated with state procrastination, but the mechanism underlying these changes remains unclear. The intervention combined three components—Affect Labeling, subgoal generation, and reward selection—making it difficult to determine which element was responsible for the observed increases in outcome utility, mood, and task completion intentions. Notably, Affect Labeling did not significantly reduce task aversion or stress, suggesting it was unlikely to be the primary driver of change. This leaves two plausible mechanisms: generating a proximal, manageable subtask or pairing that subtask with an anticipated reward. Distinguishing between these possibilities is necessary for identifying the active ingredients of brief interventions targeting procrastination.

A large body of research suggests that simply breaking a larger task into a smaller, immediately actionable subgoal could itself account for the observed improvements. Subgoals provide concrete starting points and more frequent indicators of progress, which increase self-efficacy, reduce overwhelm, and enhance momentary motivation (Bandura & Schunk, 1981; Huang et al., 2017). From a cognitive standpoint, subtask generation reduces planning complexity and lowers cognitive load by simplifying the next required action (Maisto et al., 2015). Time-chunking research similarly shows that structuring work into small, bounded segments helps individuals maintain focus and follow through on intended tasks (Gaskin & Skousen, 2016). Within the framework of the Temporal Decision Model (Zhang & Feng, 2020), generating a proximal subtask also increases perceived outcome utility by creating a near-term, achievable goal that feels less aversive to start. Taken

together, these findings indicate that subtask generation alone could plausibly have driven the improvements in task appraisals observed in Study 1, even without the addition of rewarding the subtasks.

However, the reward-selection component offers an alternative theoretical explanation for the effects observed in the intervention. Both Temporal Motivation Theory (Steel & König, 2006) and the Temporal Decision Model (Zhang & Feng, 2020) propose that procrastination arises when the benefits of completing a task are temporally distant and therefore heavily discounted. Adding a small, immediate reward increases the short-term utility of engaging with the task, thereby counteracting temporal discounting and making task engagement more appealing (Ariely & Wertenbroch, 2002; Woolley & Fishbach, 2018). From this perspective, rewarding subtask completion may have increased engagement by raising the immediate value of working.

Yet reinforcement may influence motivation through more than changes in short-term utility. Many individuals have extensive prior experience with effort–reward pairings in everyday contexts, such as completing structured assignments, checking items off a to-do list, or receiving incremental feedback for progress. Through repeated exposure to such contingencies, effortful engagement can become associated with feelings of progress, satisfaction, or accomplishment. Research on conditioned reinforcement and Pavlovian learning demonstrates that stimuli and actions previously paired with reward can later bias behavior when they again signal or precede rewarding outcomes (e.g., Wassum & Izquierdo, 2015; Williams, 1994). Once established, such learned associations can influence responding even in new but structurally similar contexts. By analogy, effort that has previously been

paired with reinforcement may acquire motivational significance that can be re-engaged when effort is again followed by positive feedback.

The theory of learned industriousness (Eisenberger, 1992) formalizes this process for effortful behavior, proposing that when effort is consistently followed by reinforcement, effort itself can acquire secondary reward value. Although learned industriousness is typically demonstrated through repeated training, it is plausible that most individuals already possess established effort–reward associations from prior learning histories. Accordingly, pairing subtask completion with immediate reward in the present intervention may have done more than increase short-term utility; it may have increased the salience of previously established effort–reward associations. If so, reinforcement could alter how effort itself is evaluated during ongoing engagement, making continued effort feel more rewarding even if the task remains objectively effortful. In this sense, the effects of reward may operate through a mechanism distinct from the utility shifts emphasized by temporal decision models—namely, through the re-engagement of prior effort–reward associations consistent with learned industriousness theory. Thus, it remains theoretically necessary to determine whether subtask structuring alone, or rewarding the completion of subtasks drove the observed changes in task appraisals and motivation.

Because most individuals likely possess pre-existing effort–reward associations from prior learning histories, the present study included a brief recall prompt in both subtask conditions designed to activate these latent associations. This ensured that any differences observed between the Subtask Only and Subtask + Reward conditions could be attributed specifically to contingent reinforcement delivered during task engagement, rather than to simple activation of prior rewarding memories associated with productivity.

A second limitation of Study 1 was the absence of behavioral outcomes. Although participants reported increased intention to complete their tasks, the study did not assess whether individuals actually engaged with or completed those tasks. Without behavioral measures, it remains unclear whether the intervention altered real task engagement or merely participants' perceptions of motivation. Evaluating behavioral engagement is therefore essential for determining whether brief, in-the-moment interventions meaningfully change procrastinatory behavior.

Taken together, these limitations in Study 1 underscore the need for follow-up work that can more precisely identify the active components of brief state-level interventions and evaluate their effects on actual behavior rather than intention alone. Separating the influence of subtask generation from the influence of adding a proximal reward will allow clearer tests of the mechanisms suggested by the TDM, TMT, and learned industriousness frameworks. Likewise, including a behavioral measure of task completion provides a more rigorous assessment of whether brief, in-the-moment interventions meaningfully change real task engagement. Addressing these gaps offers an opportunity to move beyond initial proof-of-concept findings and develop a more targeted, theoretically grounded approach to reducing state procrastination.

The Present Study

The present study was designed to clarify the mechanisms underlying brief, state-level interventions for procrastination by isolating the roles of effort structuring and reinforcement. Building on Study 1, the current study addresses two primary gaps. First, it disentangles the effects of subtask generation from the effects of pairing effort with reward, allowing for a more precise test of which components drive changes in task motivation.

Second, it moves beyond intention-based outcomes by incorporating behavioral indicators of task engagement and follow-through.

Guided by learned industriousness theory (Eisenberger, 1992), the present study examines whether pairing effort with immediate reinforcement influences how effort itself is evaluated during ongoing task engagement. Whereas temporal decision models emphasize changes in outcome utility, learned industriousness proposes that effort can acquire secondary reward value when repeatedly followed by reinforcement. Applied to state procrastination, this framework suggests that pairing subtask completion with immediate positive feedback may do more than increase short-term task value; it may increase the salience of previously established effort–reward associations, thereby enhancing the perceived rewardingness of exerting effort in the moment. The current study tests this possibility by isolating reinforcement from subtask structuring and examining whether rewarding subtask completion increases enjoyment of effort, willingness to persist, and behavioral follow-through. Accordingly, learned industriousness in the present study is indexed via participants’ momentary evaluations of effort as rewarding during task engagement.

Participants were asked to work on a real task they had been procrastinating on and were randomly assigned to one of three conditions: subtask generation only, rewarding the completion of subtasks, or a control condition without task structuring or reinforcement. Importantly, whereas Study 1 asked participants to select a future reward to receive upon completing their subtask (e.g., engaging in a leisure activity), the present study delivered immediate, in-task reinforcement in the form of brief positive feedback (e.g., “Good job!”) contingent on subtask completion. This distinction allowed us to isolate the effects of

contingent reinforcement during effort from the effects of anticipating a delayed reward. During the task, participants completed state-level measures assessing task aversiveness, enjoyment, self-efficacy, mood, fatigue, and perceived rewardingness of effort. Midway through the task, participants were interrupted and given the choice to continue working or stop, providing a behavioral indicator of immediate engagement motivation. Behavioral follow-through was assessed via a 24-hour follow-up measuring whether participants returned to and completed the task if they weren't able to do so during the experiment.

It was hypothesized that subtask generation alone would increase immediate task engagement relative to the control condition by providing a clear, proximal starting point and increasing perceived outcome utility. However, if reinforcement exerts an additional effect by altering how effort itself is evaluated—as proposed by learned industriousness theory—then pairing subtask completion with immediate reward should produce stronger effects than subtask structuring alone. Specifically, participants in the Subtask + Reward condition were expected to report greater enjoyment of exerting effort, greater desire to continue working when interrupted, and higher perceived reward from being productive compared to both the Subtask Only and control conditions.

Furthermore, if reinforcement enhances persistence by increasing the perceived rewardingness of effort rather than solely by shifting short-term utility, then increases in perceived reward from effort should mediate the relationship between condition and subsequent task engagement. Consistent with this account, participants in the Subtask + Reward condition were expected to be more likely to complete the task within 24 hours, and this effect was predicted to be explained by heightened perceptions of effort as rewarding during the initial task period.

Method

Participants

A total of 379 participants were recruited through Prolific and randomly assigned to one of three experimental conditions: Control, Subtask Only, or Subtask + Reward. The sample size was determined by budget constraints, with each participant receiving monetary compensation for completing the study.

Participants were excluded in a stepwise manner. First, participants who did not provide informed consent were excluded ($n = 10$). Second, participants who did not complete 100% of the study were removed ($n = 60$). Third, participants were excluded if they reported a time spent on their selected task of less than 10 minutes or more than 20 minutes, reflecting a ± 5 -minute window around the intended 15-minute task duration ($n = 67$). Fourth, all participants completed a seriousness check, which asked them to indicate whether they had responded attentively or had simply clicked through the survey. The prompt reassured participants that they would be compensated regardless of their response to encourage honest reporting. No participants indicated that they did not complete the study seriously; thus, no exclusions were made based on the seriousness check. Finally, participants whose written task responses consisted of gibberish or were otherwise unintelligible were deemed ineligible ($n = 4$).

After applying all exclusion criteria, the final analytic sample consisted of 238 participants: 79 in the Control condition, 82 in the Subtask Only condition, and 77 in the Subtask + Reward condition.

The mean age of the final sample was 40.62 years ($SD = 12.02$). Of the participants, 55.7% identified as female, 43.9% as male, and .4% preferred not to report their gender. The

racial composition of the sample was 70.7% White, 11.8% Black, 7.3% Mixed race, 6.5% Asian, and 3.3% Other. All participants resided in the United States. Additionally, 6.5% of the sample identified as students. This composition suggests that the sample is broadly representative of an adult population beyond undergraduate students, supporting the generalizability and scalability of the intervention to non-academic contexts.

This study was approved by the University of California, Santa Barbara Human Subjects Committee (IRB approval number: 243-25-0527).

Measures

International Positive and Negative Affect Schedule - Short Form (I-PANAS-SF). Participants completed the I-PANAS-SF (Thompson, 2007), a 10-item measure of mood and feelings and includes two subscales: the positive and negative attribute subscales. Each subscale contains five positive and negative markers of emotion, measured on a five-point Likert scale (*1 = Very slightly/Not at all – 5 = Extremely*), in accordance with items that represent affect like “Inspired”, and “Upset”. The scale was modified from the original version to assess mood in the moment as opposed to as a general tendency.

NEO-Conscientiousness Scale. The 60-item NEO-FFI (McCrae & Costa Jr, 2004) assesses individual differences in 5 personality factors: Neuroticism, Extraversion, Openness to Experience, Conscientiousness, and Agreeableness, evaluated with 12 items each. For the purposes of the current study, we only evaluated the conscientiousness scale. All items were measured on a seven-point Likert scale ranging from (*1 Strongly Disagree to 7 Strongly Agree*). Example items from the conscientiousness subscale include “I keep my belongings neat and clean”, and “I’m pretty good about pacing myself so as to get things done on time”.

Learned Industriousness. In classic learned industriousness research, Eisenberger and colleagues manipulated the effortfulness and reinforcement of specific laboratory or classroom tasks (e.g., anagram solving, math work, copying tasks) and indexed learned industriousness behaviorally via persistence, time on task, and performance on subsequent transfer tasks, rather than through self-report scales. In the present study, the construct was instead operationalized via self-report in the context of a task each participant had been avoiding (rather than a single generic laboratory task). Participants completed three items designed to assess the extent to which effort itself was experienced as positively valued during that personally relevant task (e.g., “I enjoyed putting effort into this task,” “I put a lot of effort into this task,” “Being productive during this task felt rewarding”), using a 7-point Likert-type scale ranging from 1 (*Strongly Disagree*) to 7 (*Strongly Agree*). These items were constructed to capture the core theoretical claim that, when effort has acquired secondary reward value, individuals experience working hard on a task as intrinsically rewarding, even when the task is one they would typically avoid.

Dormant Learned Industriousness.

Script. Participants in the Subtask Only and Subtask + Reward conditions were prompted to read this script: *“Take a moment to think about a time when you had a list of tasks to complete, maybe for school, work, or even chores. Picture yourself crossing off each item after you complete it, one by one. Recall the burst of satisfaction and happiness with each task crossed off the list, and the feeling of progress. Notice how that sense of accomplishment builds, making it easier to keep going. Keeping that feeling of motivation when you’re in the flow in mind, please respond to the following questions.”*

Manipulation Check. Three self-report questions were asked of the participants in the Subtask Only and Subtask + Reward conditions. They were meant to assess if we were able to activate individuals' dormant industriousness (effort–reward associations they may have already developed previously) by prompting them to recall times they felt satisfaction from completing subtasks. The items included - “How rewarding did it feel to complete each subtask during the 15-minute period?”, “How much did you experience a growing sense of motivation or progress as you completed each step of your task?”, and “As you worked through your subtasks, how strongly did you feel the satisfaction of making progress?”. They were all rated on a Likert scale of 1–7, with anchors of ‘*Not at all*’ to ‘*Extremely*’.

Procedure

After providing informed consent, participants were asked to identify a task they were currently procrastinating on or anticipated procrastinating on that could realistically be completed within approximately 15 minutes. Participants were instructed to select a task that they could, in principle, begin working on immediately while completing the study. They then reported an estimated time required to complete the task.

Participants were randomly assigned to one of three conditions: Control, Subtask Only, or Subtask + Reward. Participants in the Subtask Only and Subtask + Reward conditions were prompted to first read the dormant learned industriousness script (see Measures). Participants in the Control condition did not receive this prompt.

Next, participants in the Subtask Only and Subtask + Reward conditions were instructed to break their selected task into three to five subtasks, each expected to take approximately three to five minutes to complete, and to enter these subtasks into the survey

interface. Participants in the control condition did not engage in subtask planning and proceeded directly to the baseline measures.

All participants then completed baseline assessments of task aversiveness (“how unpleasant does doing the task feel to you?”) and mood through the PANAS. Following these measures, participants were instructed to work on their identified task for a total of 15 minutes. Before beginning, participants were prompted to gather any necessary materials and to ensure that the survey screen remained accessible throughout the task period.

During the 15-minute work period, participants in the Subtask Only and Subtask + Reward conditions were guided through their task one subtask at a time. Participants advanced to the next subtask only after indicating that they had completed the current one. In the Subtask + Reward condition, participants received brief congratulatory feedback on the screen through simple text after completing each subtask (e.g., “You did it! Nice going!”), which served as immediate positive reinforcement. Participants in the Subtask Only condition advanced through their subtasks without receiving any reinforcing feedback. Participants in the Control condition were instructed simply to work on their task for the full duration, without subtask guidance or feedback.

At the midpoint of the work period (approximately 8 minutes), all participants were prompted to pause their work and complete a brief follow-up questionnaire assessing the extent to which they had been actively working on the task, and their desire to continue working on the task. Participants then resumed the task until the 15-minute period concluded.

After completing the work period, participants completed additional self-report measures. Those in the Subtask Only and Subtask + Reward conditions completed the dormant learned industriousness manipulation check, then all conditions responded to the

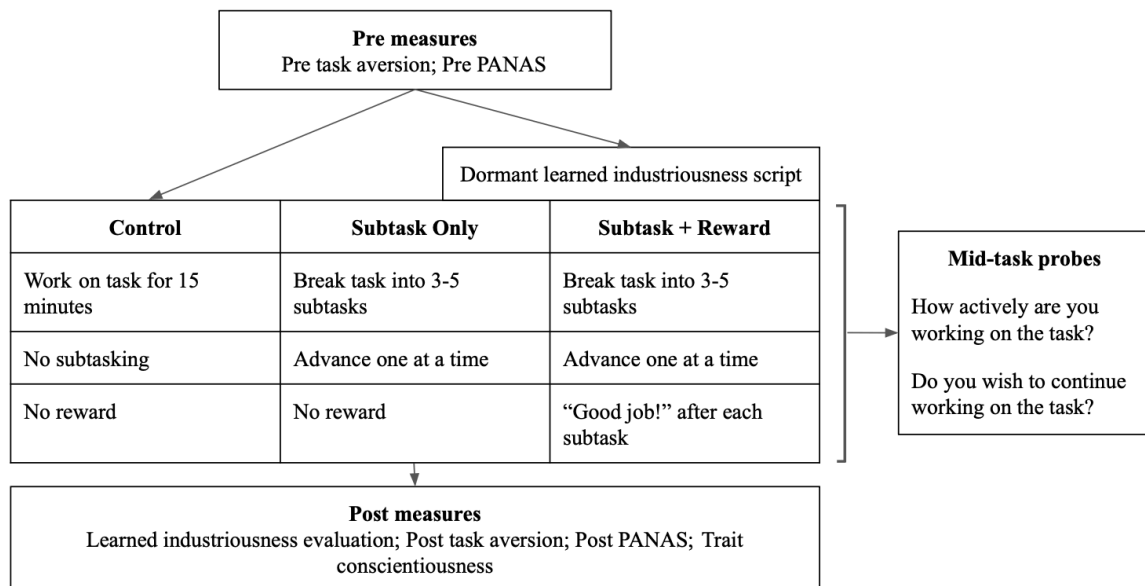
learned industriousness questionnaire, post-measure of task aversiveness and mood, and finally trait conscientiousness. Participants were also asked whether they had completed their task and to report the percentage of the task they had completed.

To assess behavioral follow-through beyond the experimental session, participants were instructed to contact the experimenter via Prolific messaging once they had fully completed their procrastinated task, whenever that occurred. Participants were informed that this message would serve as an important data point for the study but that compensation was not contingent on task completion.

Finally, all participants completed a seriousness check, were debriefed regarding the purpose of the study, and received compensation for their participation. See Figure 7 for a schematic overview of the procedure.

Figure 7

Procedure flowchart



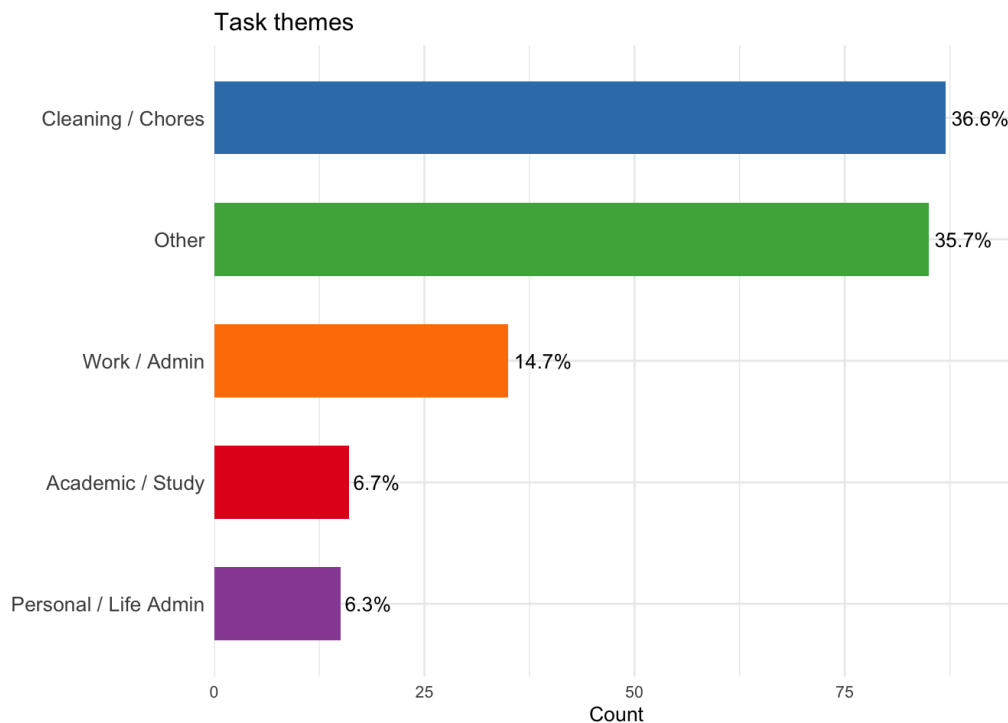
Results

Task descriptives

Participants named a task they were currently procrastinating on and could reasonably work on for approximately 15 minutes. The mean estimated task duration was 14.08 minutes ($SD = 3.07$). Tasks spanned a range of domains, including academic work, professional tasks, household chores, and personal or administrative activities, supporting the ecological validity of the task selection (Figure 8).

Figure 8

Percentage distribution of self-reported procrastinated tasks across thematic categories.



Note. Percentages are calculated as the proportion of total reported tasks within each category.

Manipulation and Baseline Checks

Baseline equivalence across conditions was first examined. Pre-task aversiveness and baseline positive and negative affect did not differ by condition, all $ps > .10$, indicating successful randomization.

A manipulation check assessed whether the dormant learned industriousness script activated memories of past rewarding effort. This check was administered only to participants in the Subtask Only and Subtask + Reward conditions. Participants in the Subtask + Reward condition reported stronger perceptions of effort–reward activation ($M = 5.60$, $SD = 1.32$) than those in the Subtask Only condition ($M = 4.99$, $SD = 1.77$), $F(1, 157) = 4.80$, $p = .030$, $\eta^2 = .03$. Dormant learned industriousness scores were strongly correlated with the learned industriousness evaluation composite, $r = .78$, $p < .001$. This suggests that while the recall prompt activated prior effort–reward memories in both subtask conditions, contingent reinforcement during task engagement further strengthened these associations.

Condition Differences for Mid-Task Evaluations and Task Completion Rates

To assess whether the experimental conditions differed significantly from the control condition, a series of one-way analyses of variance (ANOVAs) was conducted on self-reported measures related to participants' procrastinated tasks. Planned contrasts were used to compare the Subtask Only and Subtask + Reward conditions to the control condition, as well as the Subtask + Reward condition to the Subtask Only condition. Including conscientiousness as a covariate did not alter the pattern of results for either of the mid-task questions. Although conscientiousness was a significant positive predictor of both outcomes (all $ps \leq .016$), the main effects of condition remained significant after controlling for conscientiousness.

Task Engagement. During the 15-minute work period, participants were interrupted at the 8-minute mark and asked to report (a) how actively they had been working on the task and (b) how much they wanted to continue working.

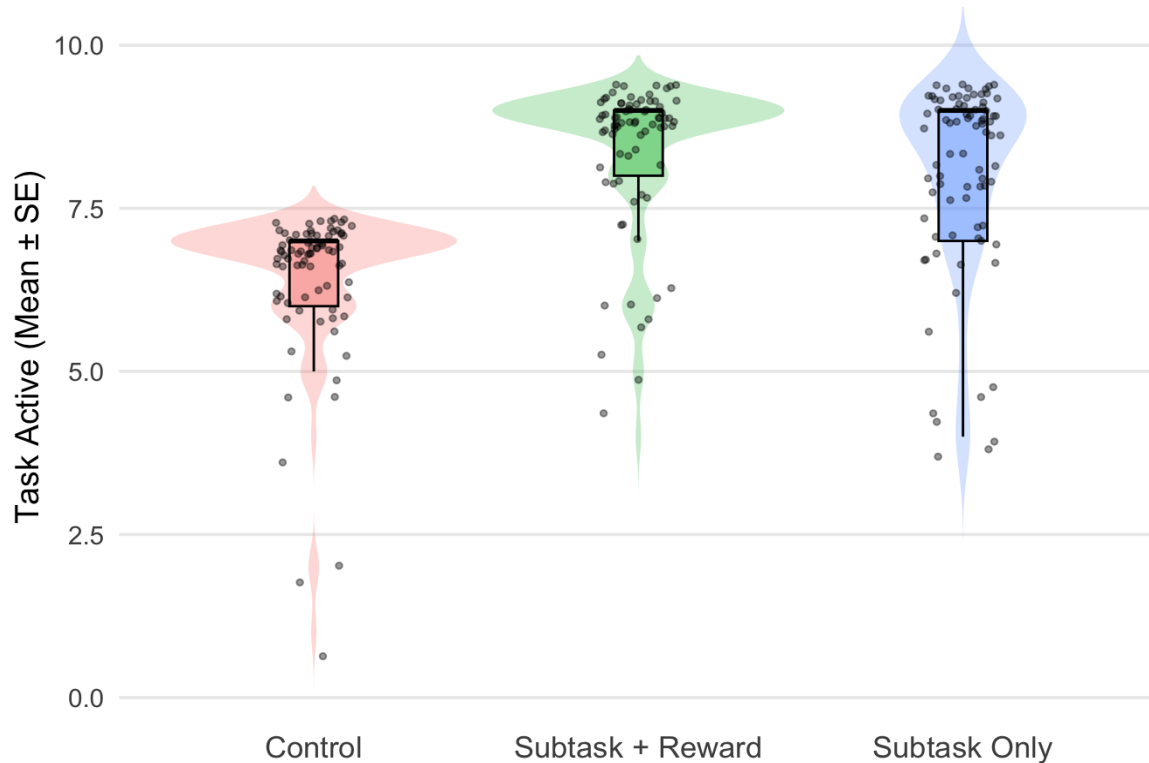
Active Task Engagement. Mean task activity was highest in the Subtask + Reward condition ($M = 8.38$, $SD = 1.17$), followed by the Subtask Only condition ($M = 8.01$, $SD = 1.42$), and lowest in the control condition ($M = 6.43$, $SD = 1.16$) (Figure 9).

A one-way ANOVA revealed a significant main effect of condition on task activity, $F(2, 235) = 53.14$, $p < .001$, $\eta^2 = .31$. Tukey's HSD post hoc tests indicated that both experimental conditions produced significantly greater task activity than the control condition. Participants in the Subtask + Reward condition reported higher activity than those in the control condition (*mean difference* = 1.95, $p < .001$, Cohen's $d = 1.67$, 95% CI [1.47, 2.42]), representing a large effect. Similarly, the Subtask Only condition exceeded the control condition (*mean difference* = 1.58, $p < .001$, $d = 1.22$, 95% CI [1.11, 2.05]), also a large effect.

The difference between the two subtask conditions was not statistically significant (*mean difference* = $-.36$, $p = .16$, $d = .28$). Taken together, these results indicate that subtask structuring substantially increased task activity, whereas the addition of explicit rewards did not significantly enhance activity beyond this benefit.

Figure 9

Distribution of self-reported active task engagement at the 8-minute interruption point across conditions.



Note. Violin plots illustrate the distribution of scores, dots represent individual participants, and overlaid boxplots indicate the median and interquartile range. Error bars reflect ± 1 standard error of the mean.

Desire to Continue Working. Mean continuation scores were highest in the Subtask + Reward condition ($M = 7.43$, $SD = 1.88$), followed by the Subtask Only condition ($M = 6.49$, $SD = 2.51$) and the control condition ($M = 4.27$, $SD = 2.22$) (Figure 10).

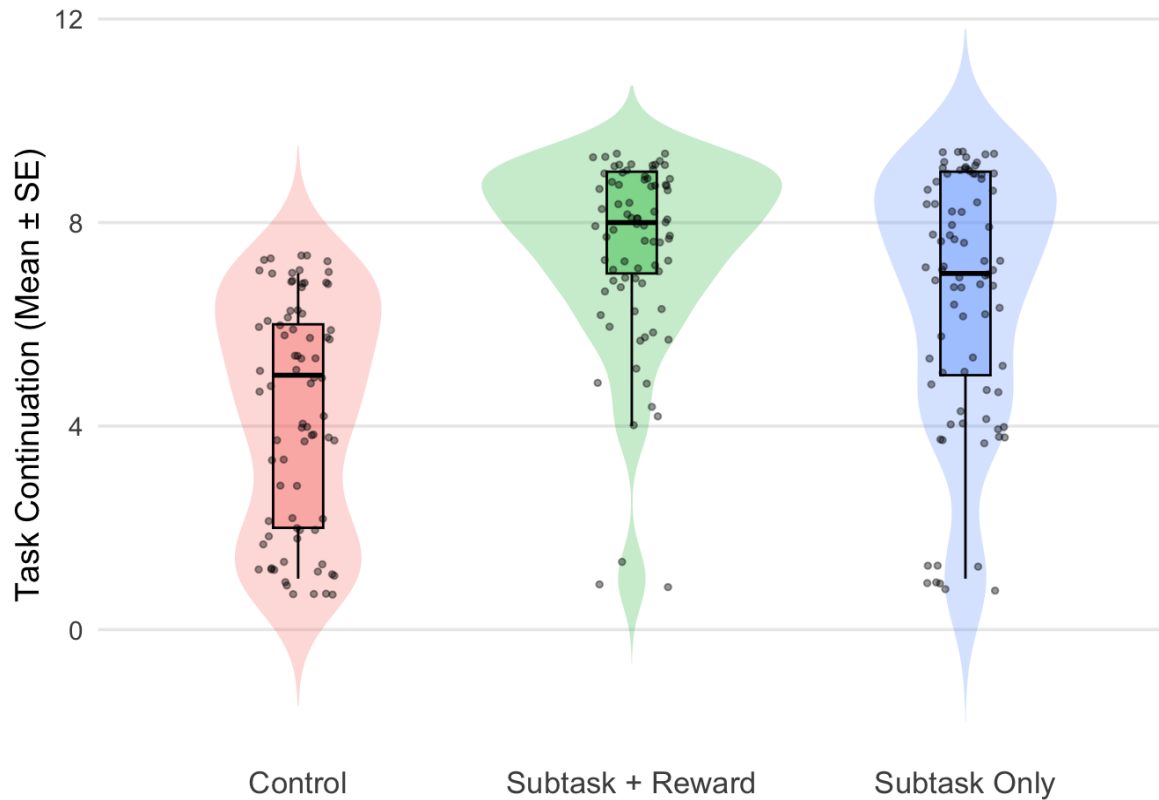
A one-way ANOVA revealed a significant effect of condition on willingness to continue working, $F(2, 235) = 41.72$, $p < .001$, $\eta^2 = .26$. Tukey post hoc tests showed that both intervention conditions differed significantly from the Control condition. Participants in

the Subtask + Reward condition reported higher continuation scores than those in the Control condition (*mean difference* = 3.16, $p < .001$, $d = 1.54$, 95% CI [2.32, 4.00]), reflecting a large effect. Participants in the Subtask Only condition also reported greater willingness to continue than those in the Control condition (*mean difference* = 2.22, $p < .001$, $d = .93$, 95% CI [1.39, 3.05]).

Importantly, participants in the Subtask + Reward condition reported significantly greater willingness to continue than those in the Subtask Only condition (*mean difference* = .94, $p = .022$, $d = .43$), indicating an additional benefit of including rewards alongside subtask structuring. These findings suggest that while both interventions increased motivation to continue, explicit rewards provided an incremental boost beyond subtasking alone.

Figure 10

Distribution of self-reported willingness to continue working at the 8-minute interruption point across conditions.



Note. Violin plots depict the distribution of scores, dots represent individual participants, and overlaid boxplots show the median and interquartile range. Error bars reflect ± 1 standard error of the mean.

Task Completion. Task completion was coded as a binary outcome ($1 = Completed$, $0 = Not completed$) based on whether participants reported completing the task within the 15-minute period. Completion rates were high across conditions: 91.1% ($n = 72/79$) in the Control condition, 92.2% ($n = 71/77$) in the Subtask + Reward condition, and 95.1% ($n = 78/82$) in the Subtask Only condition. A chi-square test of independence indicated that completion rates did not differ significantly across conditions, $\chi^2(2, N = 238) = 1.03, p = .60$.

Thus, participants in the Subtask Only and Subtask + Reward conditions were not more likely to complete their tasks within the allotted time than participants in the Control condition.

To further examine the relation between engagement and completion, Welch two-sample t-tests compared participants who completed the task to those who did not.

Participants who completed the task ($n = 221$) reported significantly higher task activity at the 8-minute mark ($M = 7.71$, $SD = 1.32$) than those who did not complete the task ($n = 17$; $M = 6.24$, $SD = 2.72$), $t(16.59) = 2.21$, $p = .041$, 95% CI [.06, 2.89].

In contrast, participants who completed the task ($M = 6.12$, $SD = 2.58$) did not report significantly greater willingness to continue than those who did not complete the task ($M = 5.18$, $SD = 2.43$), $t(18.90) = 1.54$, $p = .14$, 95% CI [−.34, 2.23]. Although the direction of the effect was consistent with expectations, willingness to continue midway through the task did not reliably predict task completion.

Task aversiveness and affect

Participants completed pre- and post-task measures of task aversiveness and positive and negative affect. Change scores were computed by subtracting pre-task ratings from post-task ratings, such that negative values indicated reductions in aversiveness or negative affect and positive values indicated increases in positive affect.

Task Aversiveness. Across all conditions, participants reported modest reductions in task aversiveness following task engagement (Control: $M = -.39$, $SD = 1.04$; Subtask Only: $M = -.56$, $SD = 1.16$; Subtask + Reward: $M = -.58$, $SD = .92$). A one-way ANOVA revealed no significant differences in aversiveness change across conditions, $F(2, 235) = .79$, $p = .46$, $\eta^2 = .007$, indicating that reductions in aversiveness did not differ as a function of subtask

structuring or reinforcement. Including conscientiousness as a covariate did not alter this pattern. Neither condition nor conscientiousness significantly predicted change in aversiveness, and the Condition $\times$ Conscientiousness interaction was not significant (all $ps \geq .46$).

Positive Affect. Participants reported small increases in positive affect from pre- to post-task across conditions (Control: $M = 2.16$, $SD = 2.95$; Subtask Only: $M = 2.65$, $SD = 3.00$; Subtask + Reward: $M = 2.87$, $SD = 3.50$). Change in positive affect did not differ significantly by condition, $F(2, 235) = 1.02$, $p = .36$, $\eta^2 = .009$. Although the Subtask + Reward condition showed the largest mean increase, this difference was not statistically significant. Controlling for conscientiousness did not change the results. Neither condition nor conscientiousness significantly predicted positive affect change, and the interaction was not significant (all $ps \geq .36$).

Negative Affect. Negative affect decreased modestly following task engagement across all conditions (Control: $M = -.86$, $SD = 2.35$; Subtask Only: $M = -1.16$, $SD = 2.20$; Subtask + Reward: $M = -.97$, $SD = 2.11$). A one-way ANOVA revealed no significant differences in negative affect change by condition, $F(2, 235) = .37$, $p = .69$, $\eta^2 = .003$. When conscientiousness was included as a covariate, conscientiousness emerged as a significant predictor of negative affect change, $F(1, 234) = 13.97$, $p < .001$, indicating that individuals higher in conscientiousness experienced larger reductions in negative affect. The main effect of condition and the Condition $\times$ Conscientiousness interaction remained nonsignificant (both $ps \geq .19$).

Learned Industriousness

Participants rated three items assessing the extent to which exerting effort during the task was enjoyable, effortful, and rewarding. The items demonstrated good internal consistency ($\alpha = .79$) and were examined both individually and as an averaged composite. Including conscientiousness as a covariate did not alter the significance or direction of the condition effects reported below.

Item level analyses.

Enjoyment of Effort. Enjoyment of putting effort into the task differed by condition, $F(2, 235) = 3.99, p = .020, \eta^2 = .03$. Participants in the Subtask + Reward condition reported greater enjoyment ($M = 5.39, SD = 1.30$) than those in the Control condition ($M = 4.67, SD = 1.80$; *mean difference* = .72, $p = .017$). The Subtask Only condition ($M = 4.90, SD = 1.71$) did not differ significantly from either condition (both $ps > .14$).

Perceived Effort. Perceived effort did not differ by condition, $F(2, 234) = .09, p = .92, \eta^2 < .01$. Participants across all conditions reported comparable levels of effort expenditure during the task.

Reward Value of Productivity. Condition significantly predicted how rewarding participants found being productive, $F(2, 234) = 3.70, p = .026, \eta^2 = .03$. Participants in the Subtask + Reward condition ($M = 6.14, SD = .87$) reported greater reward value than those in the Control condition ($M = 5.63, SD = 1.49$; *mean difference* = .51, $p = .042$). No other pairwise comparisons reached significance.

Composite Learned Industriousness. The composite learned industriousness score showed a marginal effect of condition after controlling for conscientiousness, $F(2, 234) = 2.62, p = .075, \eta^2 = .02$. Participants in the Subtask + Reward condition tended to report higher composite scores than those in the Control condition (*mean difference* = .39, $p =$

.098), whereas the Subtask Only condition did not differ significantly from either condition (both $ps > .22$).

Correlations. Both pre-task and post-task aversiveness were negatively correlated with participants' evaluation of the task as rewarding (LI_eval_final; $r = -.18, p < .01$; $r = -.42, p < .001$, respectively). Similarly, reductions in aversiveness across the task (aversion_change) were associated with higher reward evaluation ($r = -.23, p < .001$). Motivation to continue working was in turn strongly correlated with how rewarding participants later found the task ($r = .49, p < .001$). Table 8 presents a summary of omnibus test results for all dependent variables by condition.

Table 8

Means, standard deviations, and omnibus test results by condition for all dependent variables

Dependent variable	Control M (SD)	Subtask Only M (SD)	Subtask + Reward M (SD)	F / χ^2	p	η^2
Active task engagement	6.43 (1.16)	8.01 (1.42)	8.38 (1.17)	F(2, 235) = 53.14	<.001	.31
Desire to continue	4.27 (2.22)	6.49 (2.51)	7.43 (1.88)	F(2, 235) = 41.72	<.001	.26
Task completion (%)	91.1	95.1	92.2	$\chi^2(2) = 1.03$	.60	—
Task aversiveness Δ	-.39 (1.04)	-.56 (1.16)	-.58 (.92)	F(2, 235) = .79	.46	.007
Positive affect Δ	2.16 (2.95)	2.65 (3.00)	2.87 (3.50)	F(2, 235) = 1.02	.36	.009
Negative affect Δ	-.86 (2.35)	-1.16 (2.20)	-.97 (2.11)	F(2, 235) = .37	.69	.003
Enjoyment of effort	4.67 (1.80)	4.90 (1.71)	5.39 (1.30)	F(2, 235) = 3.99	.020	.03

Perceived effort	5.81 (1.14)	5.76 (1.17)	5.74 (1.21)	F(2, 234) = .09	.92	<.01
Reward value of productivity	5.63 (1.49)	5.70 (1.46)	6.14 (.87)	F(2, 234) = 3.70	.026	.03
Composite LI	5.37 (1.31)	5.45 (1.21)	5.76 (0.94)	F(2, 234) = 2.62	.075	.02

Note. Δ = change score (post – pre).

Mediation models

Subtask Only vs. Control (Figure 11). Because perceived rewardingness of effort (learned industriousness evaluation) was strongly associated with willingness to continue working, we tested whether the learned industriousness scores mediated the effect of the Subtask Only condition (vs. Control) on willingness to continue. A simple mediation model was estimated in lavaan using nonparametric bootstrap standard errors (5,000 resamples).

The Subtask Only condition did not significantly predict learned industriousness evaluation, $a = .08$, $SE = .20$, $p = .687$, indicating that subtask structuring alone did not reliably increase the perceived rewardingness of effort. Learned industriousness evaluation was, however, a strong positive predictor of willingness to continue, $b = 1.12$, $SE = .11$, $p < .001$. Despite this association, the indirect effect of Subtask Only (vs. Control) on willingness to continue through learned industriousness evaluation was not significant, $ab = .09$, $SE = .22$, $p = .689$, 95% bootstrap CI $[-.35, .54]$.

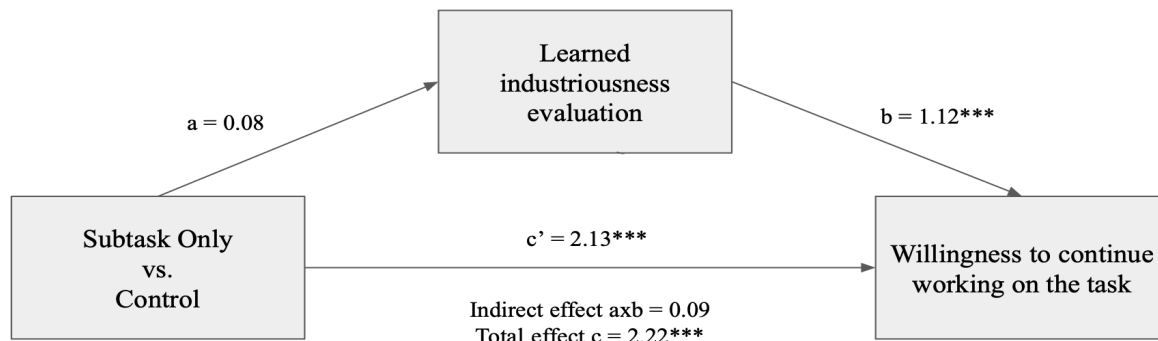
In contrast, Subtask Only had a robust direct effect on willingness to continue, $c' = 2.13$, $SE = .30$, $p < .001$, 95% bootstrap CI $[1.54, 2.74]$. The total effect was also significant, $c = 2.22$, $SE = .37$, $p < .001$, 95% bootstrap CI $[1.51, 2.98]$.

Together, these results indicate that subtask structuring increased willingness to persist, but not through increases in perceived rewardingness of effort. Instead, its effect

appears to operate through mechanisms other than effort revaluation (e.g., reduced planning complexity or increased clarity about next actions).

Figure 11

Mediation model examining whether learned industriousness evaluation mediated the effect of Subtask Only (vs. Control) on willingness to continue working.



Note. Subtask Only significantly predicted willingness to continue working (direct effect), but did not significantly predict learned industriousness evaluation. Although learned industriousness evaluation was positively associated with willingness to continue, the indirect effect was not significant, indicating no evidence of mediation in this contrast. Unstandardized coefficients are displayed. Bootstrap standard errors (5,000 resamples) were used to estimate indirect effects. $p < .05$.

Subtask + Reward vs. Subtask Only (Figure 12). To test whether adding contingent reinforcement enhanced persistence via increased perceptions of effort as rewarding, we examined whether learned industriousness evaluation mediated the effect of the Subtask + Reward condition (relative to Subtask Only) on willingness to continue working. The model was estimated using 5,000 bootstrap resamples.

Participants in the Subtask + Reward condition showed a marginally higher learned industriousness evaluation than those in the Subtask Only condition, $a = .31$, $SE = .17$, $p =$

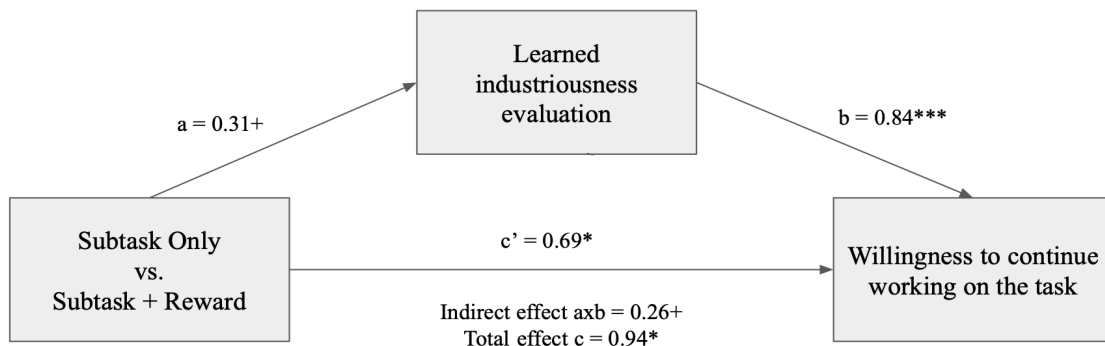
.070, 95% bootstrap CI $[-.03, .63]$. Learned industriousness evaluation was again a strong positive predictor of willingness to continue, $b = .84, SE = .17, p < .001$.

The indirect effect of Subtask + Reward (vs. Subtask Only) on willingness to continue via learned industriousness evaluation was positive but did not reach conventional significance, $ab = .26, SE = .15, p = .092$, 95% bootstrap CI $[-.03, .57]$. However, the direct effect of condition remained significant, $c' = .69, SE = .32, p = .031$, 95% bootstrap CI $[.07, 1.31]$, and the total effect was also significant, $c = .94, SE = .34, p = .006$, 95% bootstrap CI $[.26, 1.63]$.

Thus, reinforcement increased willingness to persist beyond subtask generation alone. Although perceived rewardingness of effort was strongly associated with persistence, evidence that it statistically accounted for the reinforcement effect in this contrast was marginally significant.

Figure 12

Mediation model examining whether learned industriousness evaluation mediated the effect of Subtask + Reward (vs. Subtask Only) on willingness to continue working.



Note: Subtask + Reward significantly increased willingness to continue relative to Subtask Only. Although learned industriousness evaluation was positively associated with willingness

to continue, the indirect effect did not reach conventional significance in this two-group comparison. The direct effect of condition remained significant. Unstandardized coefficients are displayed. Bootstrap standard errors (5,000 resamples) were used to estimate indirect effects. $p < .05$.

Subtask + Reward vs Control (Figure 13). To test the central prediction of the learned industriousness framework—that pairing effort with immediate reinforcement enhances persistence by increasing the perceived rewardingness of effort—we examined whether learned industriousness evaluation mediated the effect of the Subtask + Reward condition (relative to Control) on willingness to continue working. The model was estimated using maximum likelihood with 5,000 bootstrap resamples.

Participants in the Subtask + Reward condition reported significantly higher learned industriousness evaluation than those in the Control condition, $a = .39$, $SE = .18$, $p = .033$, 95% bootstrap CI [.03, .75]. In turn, learned industriousness evaluation was a strong positive predictor of willingness to continue, $b = .90$, $SE = .12$, $p < .001$.

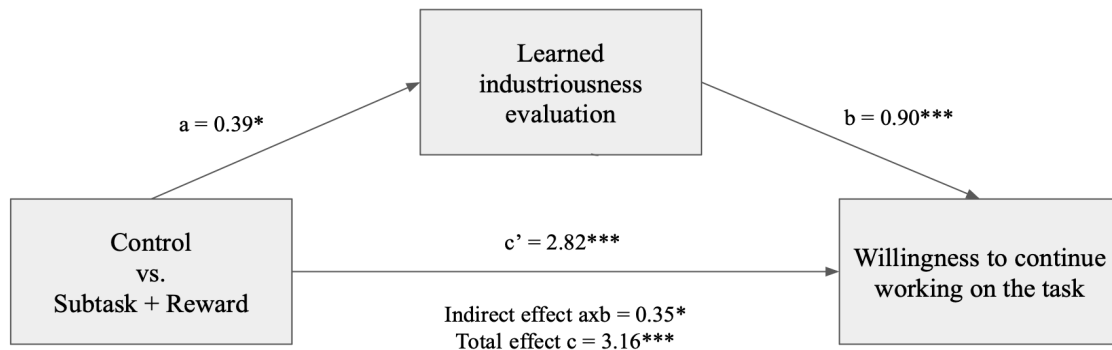
Importantly, the indirect effect of Subtask + Reward (vs. Control) on willingness to continue through learned industriousness evaluation was statistically significant, $ab = .35$, $SE = .17$, $p = .046$, 95% bootstrap CI [.02, .71]. The direct effect of condition on willingness to continue remained significant, $c' = 2.82$, $SE = .29$, $p < .001$, 95% bootstrap CI [2.23, 3.38], indicating partial mediation. The total effect was also significant, $c = 3.16$, $SE = .33$, $p < .001$, 95% bootstrap CI [2.51, 3.81].

Together, these findings indicate that adding explicit reinforcement increased willingness to persist both directly and indirectly via increased perceptions of effort as

rewarding. Consistent with learned industriousness theory, reinforcement appears to enhance persistence in part by shifting how effort itself is evaluated.

Figure 13

Mediation model examining whether learned industriousness evaluation mediated the effect of Subtask + Reward (vs. Control) on willingness to continue working.



Note. Subtask + Reward significantly increased learned industriousness evaluation and willingness to continue relative to Control. Learned industriousness evaluation positively predicted willingness to continue, and the indirect effect was significant, indicating partial mediation. The direct effect of condition remained significant. Unstandardized coefficients are displayed. Bootstrap standard errors (5,000 resamples) were used to estimate indirect effects. $p < .05$.

Discussion

Procrastination is often conceptualized as an individual difference, yet many instances emerge from moment-to-moment decisions about whether to engage with effortful tasks. Building on the results of Chapter 2 showing that brief, in-the-moment interventions can shift motivation to work on procrastinated tasks, the present study examined how such interventions operate. Study 1's intervention increased intentions to work on procrastinated

tasks but did not disentangle whether subgoal generation or rewarding the subtask primarily drove changes in behavior. The present findings indicate that these components influence state procrastination through distinct but complementary motivational pathways. Relative to the control condition, both the Subtask Only and Subtask + Reward conditions produced significantly greater mid-task activity, indicating that structuring tasks into concrete subtasks increased immediate behavioral engagement. In contrast, when comparing the Subtask + Reward condition directly to the Subtask Only condition, the addition of reinforcement significantly increased willingness to continue working and showed a trend toward increasing the perceived rewardingness of effort. Together, these contrast-specific findings indicate that subtask structuring primarily facilitates initiation and engagement, whereas reinforcement contributes additional effects on persistence by altering effort valuation.

Consistent with predictions of the Temporal Decision Model (Zhang & Feng, 2020), creating concrete subtasks robustly increased immediate task engagement. Importantly, unlike Study 1, which reported on intention-based outcomes, the present study included an in-task behavioral index of engagement, demonstrating that subtask structuring translates into observable differences in task involvement. Participants in both intervention conditions reported higher mid-task activity than participants in the control condition, providing direct evidence of increased behavioral engagement during the work period. Within the TDM framework, this effect reflects a shift in engagement utility. Breaking a task into proximal, achievable steps reduces uncertainty about how to begin, lowers cognitive and planning demands, and provides immediate cues of progress.

A different pattern emerged for the motivation and desire to continue working. Participants who received reinforcement after completing subtasks reported greater desire to

persist than those who generated subtasks alone, even though both conditions showed comparable levels of mid-task activity. Additionally, post-task evaluations showed that reward selectively increased enjoyment of exerting effort and the perceived reward value of being productive. These changes partially mediated the effect of reinforcement on willingness to continue working when compared to the control condition, with suggestive evidence of a similar indirect pathway when reinforcement was compared directly to subtask structuring alone. This indicates that reinforcement does not simply amplify task initiation and engagement. Instead, it alters how effort itself is evaluated once engagement has begun.

This interpretation is consistent with learned industriousness theory (Eisenberger, 1992), which proposes that effort can acquire secondary reward value when consistently paired with reinforcement. Whereas classic learned industriousness paradigms rely on repeated reinforcement across extended training to produce durable shifts in effort valuation, the present findings suggest a more immediate process. Rather than demonstrating new learning within a single session, the results are more consistent with the increased salience and re-engagement of previously established effort–reward associations. Most individuals have prior histories in which effortful engagement has been followed by progress feedback or symbolic reinforcement. By delivering contingent feedback during subtask completion, the present manipulation may have activated these existing associative structures, leading effort to be experienced as more rewarding in the moment and thereby supporting continued engagement. Notably, although a brief recall prompt activated prior effort–reward memories in both subtask conditions, only contingent reinforcement during task engagement produced significant increases in the perceived rewardingness of effort relative to the control condition.

This pattern supports the interpretation that reinforcement re-engaged and strengthened existing associations rather than the recall prompt alone producing the observed effects.

The present findings also clarify the distinction between task aversiveness and the rewardingness of effort. Although these constructs were moderately correlated, they showed different sensitivity to the experimental manipulations. Neither subtask structuring nor reinforcement produced differential changes in pre–post task aversiveness or mood relative to the control condition. In contrast, reinforcement reliably increased the extent to which exerting effort and being productive were experienced as rewarding in post-task evaluations. As a result, motivation and persistence increased despite stable levels of task aversiveness across conditions.

This dissociation suggests that task aversiveness and effort rewardingness reflect related but distinct components of task appraisal. These findings suggest that increases in the rewardingness of effort, rather than reductions in task aversiveness, may play a central role in sustaining engagement during ongoing work. This pattern mirrors Study 1’s finding showing that state-level interventions can increase outcome utility without reducing task aversion and aligns with findings that increases in task–outcome value, but not decreases in aversiveness, predict reductions in procrastination behavior (Chen et al., 2025). Extending this work, the present results indicate that value-based routes to reduced procrastination can operate not only through enhanced outcome value but also through increased rewardingness of effort, even when task aversiveness remains unchanged.

Taken together, these findings provide a more precise account of how brief, state-level interventions influence procrastination. Task structuring appears sufficient to facilitate initiation by lowering barriers to action. Reinforcement, in contrast, selectively enhances

persistence by increasing the perceived value of effort. By isolating these mechanisms, the present study advances theoretical models of state procrastination and informs the design of scalable interventions that target the specific motivational processes underlying momentary delay.

Limitations and Future Directions

Although the present study clarifies how task structuring and reinforcement influence state procrastination, several limitations should be noted. First, although task completion within the 15-minute window did not differ across conditions, robust differences emerged at the midpoint in both behavioral engagement and willingness to continue working. The high overall completion rate (91–95%) likely restricted variability and reduced sensitivity to detect between-condition differences in final completion. Participants were instructed to engage with their procrastinated task during the 15-minute timer, and most complied with this instruction. As a result, the structured work period may have constrained opportunities for differential initiation or disengagement across conditions. Future studies could use more flexible or open-ended work periods to provide a more sensitive test of how subtask structuring and reinforcement influence spontaneous initiation and sustained persistence.

Second, the single-session design limits conclusions about enduring change. Although reinforcement increased the perceived rewardingness of effort and motivation to persist, the study cannot determine whether these effects reflect transient activation or durable learning. Learned industriousness theory emphasizes gradual changes in effort valuation through repeated reinforcement (Eisenberger, 1992). Such processes cannot be fully captured within a brief task. Future work should therefore examine repeated exposure to subtask-reward pairings across multiple sessions or days. Longitudinal designs would allow

stronger tests of cumulative change in effort valuation, persistence, and procrastination behavior.

Finally, the reinforcement manipulation was intentionally minimal and consisted of brief, symbolic feedback. While this allowed for a conservative test of reinforcement effects, it remains unclear how variations in reward type, magnitude, or personalization might influence motivation. More salient or individualized rewards may produce stronger or qualitatively different effects, particularly for individuals with entrenched procrastination habits. Systematic variation of reinforcement properties would help identify the minimal conditions under which effort valuation can be altered without undermining intrinsic motivation.

Conclusion

The present study advances the dissertation's central argument by demonstrating that state-level interventions influence procrastination through multiple mechanisms that unfold over time. Whereas Chapter 2 showed that brief interventions can shift momentary appraisals and increase willingness to begin a task, the current findings indicate that reinforcement may play a distinct role in sustaining engagement by increasing the perceived rewardingness of effort itself. These results suggest that initiation and persistence represent separable stages of goal-directed behavior, each responsive to different forms of intervention. In doing so, the present findings begin to answer the question left open by existing theoretical accounts: not only does procrastination unfold at the state level, but it can be interrupted at that same level through targeted manipulation of task structure and reinforcement contingencies.

However, an important question remains unresolved. Learned industriousness theory predicts that repeated pairing of effort with reinforcement should gradually alter how effort is

experienced, leading to more durable changes in engagement and reduced avoidance over time. The present study demonstrates only the immediate effects of such pairing within a single session. Whether repeated exposure produces lasting changes in effort valuation and procrastination behavior remains an open empirical question.

Chapter 4 addresses this question directly by moving from single-session engagement to longitudinal change. Building on the mechanisms identified here, the next study examines whether repeated opportunities to structure effort and receive reinforcement across an academic context can produce sustained reductions in procrastination and increases in engagement over time. In doing so, Chapter 4 tests the central prediction underlying the learned industriousness account: that effort, when consistently reinforced, may become progressively less aversive and more intrinsically rewarding.

Study 3: Reinforcing Over Time: A Longitudinal Test of Learned Industriousness in Academic Procrastination

Academic procrastination, defined as the voluntary delay of academic tasks despite expecting negative consequences (Steel & Klingsieck, 2016), is highly prevalent among university students, with estimates ranging from 50% to 95% (Day et al., 2000). It is associated with a host of negative outcomes, including lower academic performance (van Eerde, 2003; Tice & Baumeister, 1997), increased stress and exhaustion (Grunschel et al., 2013), and adverse emotional consequences (Rahimi et al., 2023). Given its widespread impact, extending intervention research to academic procrastination is both theoretically and practically significant. Because academic work often occurs on predictable schedules, it also provides a natural environment in which procrastination decisions recur across time.

In university courses, students often repeatedly encounter the same effortful task across time. One common example is assigned course readings. At the beginning of a semester, many students intend to keep up with readings. However, engagement often declines as weeks pass. Students delay reading until just before exams or skip readings entirely, even when they know this may negatively affect their performance. This pattern reflects a recurring decision: each week, students must decide whether to begin an effortful task whose benefits are delayed.

Academic reading therefore provides a useful context for studying procrastination as a repeated behavior rather than a single failure of motivation. Readings are typically effortful, require sustained attention, and provide little immediate reward. Their benefits—such as improved understanding or exam performance—are delayed, while failing to complete a single reading often carries few immediate consequences. This combination of

immediate effort cost and delayed reward makes academic reading especially vulnerable to procrastination (Steel & König, 2006; Zhang & Feng, 2020).

Studies 1 and 2 demonstrated that state-level interventions can influence procrastination within single task episodes. Specifically, Study 1 showed that a brief intervention could increase individuals' intention to work on a procrastinated task by shifting how the task was evaluated in the moment. Study 2 moved beyond intention and examined behavior during task performance, finding that structuring work into subtasks increased immediate engagement, and that pairing subtask completion with contingent reinforcement increased willingness to continue working once effort had begun. Together, these findings establish that procrastination is sensitive to momentary intervention—but they leave open whether such effects can accumulate when individuals repeatedly encounter the same effortful task over time.

Testing this accumulation process requires a design that extends beyond single task episodes. Studies 1 and 2 established that reinforcing effort can shift appraisals and increase persistence within a bounded session, but learned industriousness theory makes a stronger prediction: that the motivational value of effort is not fixed but can be progressively shaped through repeated experience. A single pairing of effort and reward may activate existing effort–reward associations, as Study 2 suggested, but durable change in how effort is experienced requires those pairings to recur across time. This is precisely the condition that naturalistic academic contexts provide. Each week, students encounter a structurally similar task under comparable effort demands, creating repeated opportunities for reinforcement to accumulate. If effort valuation is indeed malleable through reinforcement, its effects should become more pronounced across successive encounters rather than remaining constant—a

prediction that cross-sectional and single-session designs are structurally unable to test. This longitudinal design also speaks directly to a question raised in Chapter 1: if procrastination unfolds at the state level, repeated intervention at that same level may be the most tractable route to producing the kind of cumulative behavioral change that ultimately gives rise to more stable patterns of engagement.

The present study addresses this question by examining whether embedding subtask structure and immediate reinforcement into recurring academic tasks produces progressive increases in engagement across an academic quarter. Within the framework of learned industriousness (Eisenberger, 1992), repeated pairings of effort with reward are expected to gradually increase the experienced value of effortful engagement. In early exposures, reinforcement increases the likelihood of engagement through operant conditioning; over time, effort itself may acquire positive value, supporting persistence even when rewards are no longer salient. Academic reading provides a naturalistic context for testing this prediction: the task recurs weekly, effort demands are consistent, and the decision to engage or delay arises repeatedly across time.

The Present Study

The present study extends Study 2 by examining effort structuring and reinforcement in a longitudinal academic context. Students enrolled in an undergraduate psychology course were assigned weekly readings. Weekly readings are particularly well suited for examining repeated engagement. Each week presents a similar task with comparable effort demands. Students must repeatedly decide whether to begin reading, postpone it, or skip it altogether. This repeated structure allows examination of whether interventions that influence

engagement in single sessions continue to operate when applied across multiple encounters with effort.

Building on the findings of Chapter 3, the intervention used in the present study divides readings into smaller subtasks and provides immediate positive feedback when each subtask is completed. This approach does not change the difficulty of the reading itself. Instead, it changes the timing of feedback associated with effort. By pairing effort with immediate reinforcement repeatedly across weeks, the intervention creates conditions under which engagement may be sustained across time.

It was hypothesized that students in the treatment condition would demonstrate greater engagement with assigned readings across the duration of the study. Treatment participants were also expected to complete a greater proportion of assigned readings relative to the control condition. Consistent with findings from Study 2, effects were expected to emerge through increased interaction with task structure and reinforcement rather than through reductions in baseline task aversion.

Method

Participants

Participants were undergraduate students enrolled in Psychology 108 (Introduction to Cognitive Psychology) at the University of California, Santa Barbara who participated in the study for extra credit in the course. Students who chose not to participate completed a two-page paper summarizing two academic articles to receive equivalent extra credit. A total of 181 students initially enrolled in the study. Five participants who did not complete any weekly reading completion reports were excluded from analyses, resulting in a final sample

of 176 participants contributing data to the primary analyses. Of these, 104 participants were randomly assigned to the control condition and 72 to the treatment condition.

Participants ranged in age from 18 to 32 years ($M = 20.25$, $SD = 1.98$). The sample was predominantly female (67.6%), with 48 participants identifying as male (27.3%), 7 indicating a preference not to disclose gender (4.0%), and 2 identifying as another gender (1.1%). Participants reported diverse ethnic backgrounds, including Hispanic or Latino (28.4%), White (19.9%), Asian (14.2%), Multiracial (8.0%), Black or African American (4.0%), American Indian or Alaska Native (1.7%), and Middle Eastern or North African (1.7%), with 38 participants (21.6%) not reporting ethnicity and 1 participant (.6%) indicating a preference not to disclose. Participants were primarily in their junior (41.5%) and sophomore (34.7%) years of study, with smaller proportions of seniors (18.2%) and freshmen (5.7%).

This study was approved by the University of California, Santa Barbara Human Subjects Committee (IRB approval number: 245-25-0614).

Measures

Conscientiousness. Conscientiousness was assessed using the Conscientiousness subscale of the NEO Five-Factor Inventory (NEO-FFI; Costa & McCrae, 1992), consisting of 12 items rated on a 5-point Likert scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). An example item is “I keep my belongings neat and clean”. Items 2, 5, 8, and 10 were reverse scored, and responses were summed such that higher scores indicated greater conscientiousness. Internal consistency in the present sample was good (pre-intervention $\alpha = .81$; post-intervention $\alpha = .84$).

General Procrastination Scale-9 item version. General procrastination tendencies were measured using the General Procrastination Scale (Sirois et al., 2019), consisting of 9 items rated on a 5-point Likert scale ranging from *1 (Strongly Disagree)* to *5 (Strongly Agree)*. An example item from this scale is “In preparing for some deadlines, I often waste time by doing other things”. Items 2, 4, and 5 were reverse scored, and scores were computed as the mean of all items, with higher scores indicating greater procrastination. Internal consistency in the present sample was good (pre-intervention $\alpha = .84$; post-intervention $\alpha = .86$).

Pure Procrastination Scale-Academic Adaptation. Trait procrastination was also assessed using the Pure Procrastination Scale (Wu & Fan, 2017), an 11-item measure assessing academic procrastination tendencies. Items were rated on a 5-point Likert scale ranging from *1 (Strongly Disagree)* to *5 (Strongly Agree)*, and responses were summed such that higher scores indicated greater procrastination. An example item is “In preparing for some deadlines, I often waste time by doing other things”. Internal consistency in the present sample was excellent (pre-intervention $\alpha = .91$; post-intervention $\alpha = .91$).

Covariates. To account for baseline levels of aversion to doing readings in courses and whether they typically complete the readings in the course, participants were asked two questions - “Typically, how averse do you feel regarding doing weekly readings for a course?” scored on a 7 point likert scale (*1 - Not at all averse, 7 - Extremely averse*). They were also asked “How typical is it for you to keep up with your weekly readings for a course?”, again scored on a 7 point likert scale (*1 - Not at all typical, 7 - Extremely typical*).

Procedure

Upon providing informed consent, students were instructed to download an iOS application developed for the study. The application served as the primary platform for intervention delivery and data collection. For all students, the application was downloaded in Week 2 (of 10) of the academic quarter. Participants first completed an onboarding survey through the app, which included demographic questions, baseline assessments of trait conscientiousness, general procrastination, academic procrastination, and study covariates (typical rate of reading completion and aversion to completing course readings). See the Measures section for additional details. Students were encouraged to complete onboarding during lecture time, and reminder notifications were sent via Canvas announcements and email to students who had not completed the survey. The onboarding survey remained open for one week.

Following completion of the onboarding measures, participants were immediately randomly assigned within the app to one of two conditions in a between-subjects design: a control condition or a treatment condition. Participant identities were anonymized within the app through the assignment of participant identification numbers.

Across the academic quarter, participants in both conditions completed weekly course readings assigned as part of PSY 108. The assigned readings themselves were identical across conditions; only the presentation and interaction format within the application differed. Participants could interact with the application at any time during the week while completing assigned readings.

In the control condition, students saw only the title of the assigned reading within the application. In the treatment condition, readings were presented as a structured list divided into smaller sections corresponding to headings within the assigned material. Students were

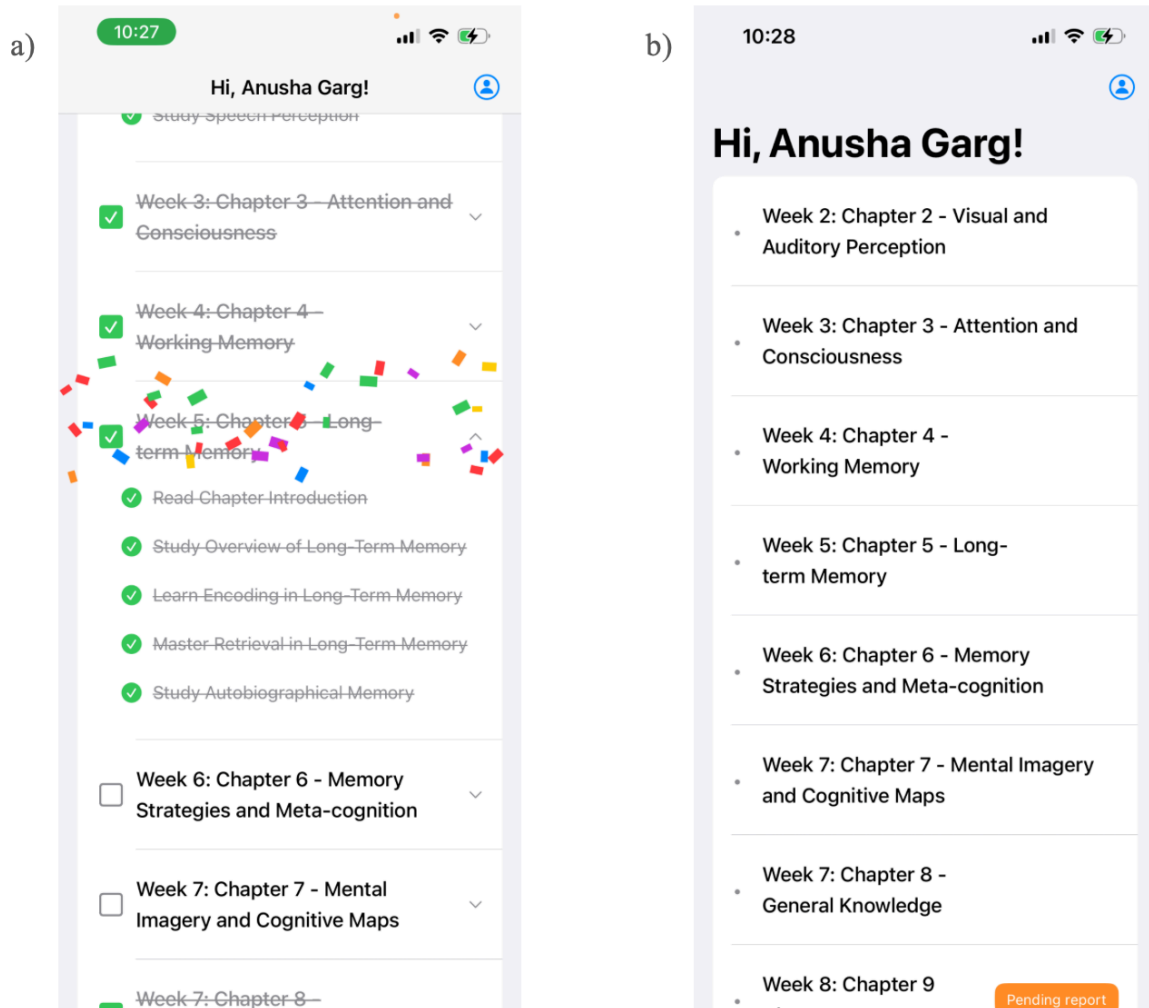
instructed to press a checkmark each time they completed a section. Pressing the checkmark triggered a brief congratulatory animation, providing immediate positive feedback following effort completion. This design resulted in repeated pairings between task completion and immediate positive feedback across multiple weeks. The application recorded the date and time of each subtask completion. Participants in the control condition completed the same assigned readings but did not receive subtask breakdowns or reinforcement. Figure 14 shows example screens from each condition.

Each Monday, immediately prior to class, participants received an automated notification through the application asking them how much of the readings they had completed during the previous week. Participants responded weekly to a single question assessing reading completion: “To what extent have you completed the readings assigned for this week?” ($I = 0\%$, $10 = 100\%$). These weekly assessments were administered from Week 3 through Week 10 of the quarter.

At the end of the academic quarter, participants completed a post-test assessment battery that included the same trait-level measures administered at baseline. Participants who completed the study protocol received course extra credit. Students who opted out of participation completed an alternative assignment of equivalent time and effort to receive equivalent credit. All participants were debriefed at the conclusion of the study.

Figure 14

Example images from the iOS app used by students in the a) treatment condition and b) control condition



Results

Baseline Comparisons

Independent-samples t-tests were conducted to evaluate baseline equivalence between conditions. Conscientiousness did not differ significantly between the control ($M = 44.20$, $SD = 7.43$) and treatment conditions ($M = 43.01$, $SD = 7.98$), $t(163) = 1.10$, $p = .272$. General

procrastination scores (GPS) were also comparable across groups (control: $M = 3.11$, $SD = .77$; treatment: $M = 3.21$, $SD = .75$), $t(168) = -.88$, $p = .381$. However, participants in the treatment condition reported significantly higher baseline scores on the Pure Procrastination Scale – Academic Adaptation version ($M = 34.40$, $SD = 9.27$) than those in the control condition ($M = 30.90$, $SD = 8.17$), $t(164) = -2.53$, $p = .012$. Baseline PPS scores were therefore included as a covariate in subsequent analyses.

Baseline reading aversion and typical reading completion were also comparable between conditions. Reading aversion did not differ significantly between the control ($M = 3.90$, $SD = 1.44$) and treatment conditions ($M = 4.18$, $SD = 1.50$), $t(172) = -1.24$, $p = .216$. Typical reading completion likewise did not differ between conditions (control: $M = 3.97$, $SD = 1.48$; treatment: $M = 3.83$, $SD = 1.64$), $t(172) = .59$, $p = .559$.

Taken together, baseline measures were largely equivalent across conditions, with the exception of the PPS, which was statistically controlled for in subsequent analyses.

Randomization Balance and Attrition

To address concerns regarding unequal sample sizes (control $n = 104$; treatment $n = 72$), additional analyses examined whether the imbalance arose from differential attrition following assignment or from the randomization procedure itself.

Initial randomization counts were retrieved directly from the Firebase `experiment_assignments` collection. At assignment, 105 participants were allocated to the control condition and 77 to the treatment condition (42.3% treatment), indicating that the unequal allocation was present prior to participant engagement with the intervention. Thus, the group size imbalance did not arise from post-assignment dropout.

An attrition funnel was constructed to examine retention across study stages. Profile creation rates did not differ significantly by condition, Fisher's exact $p = .423$. Treatment participants exhibited a numerically higher rate of early non-engagement prior to submitting their first weekly reading report (5 vs. 1 participants), although this difference did not reach statistical significance, Fisher's exact $p = .084$.

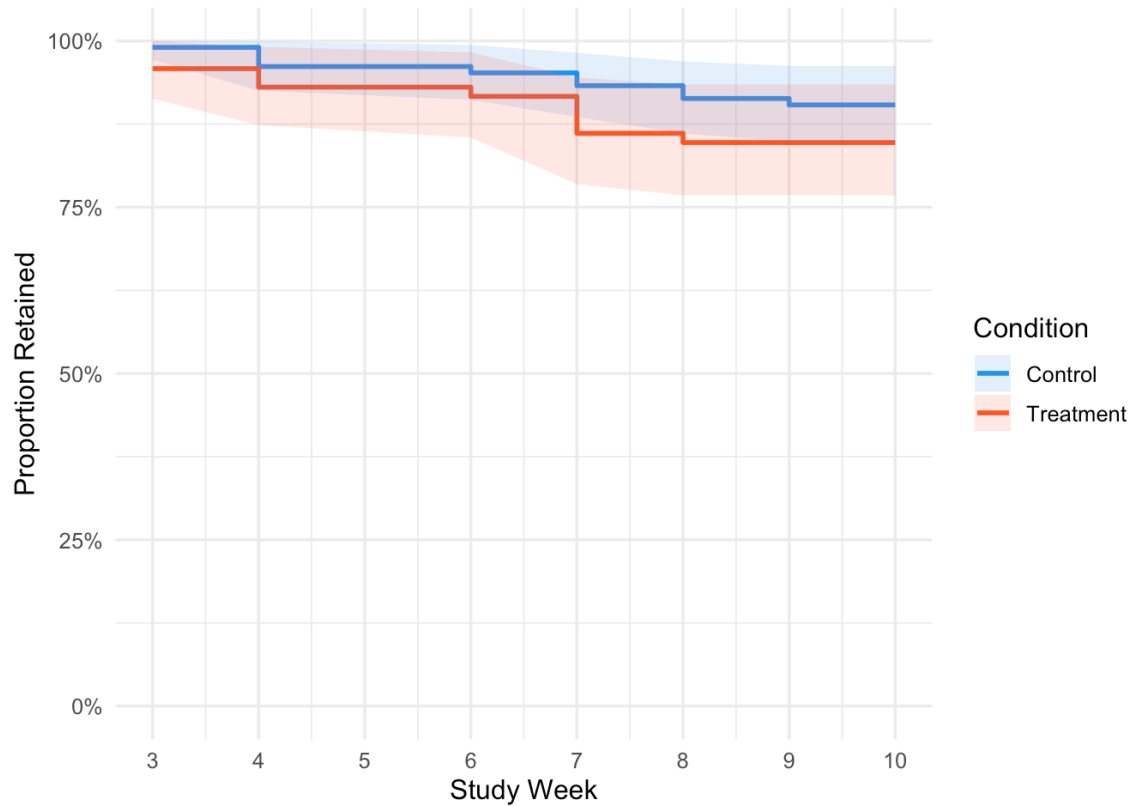
Among participants who submitted at least one weekly reading report (the analysis sample), retention through Week 10 did not significantly differ between conditions. Completion rates were 90.4% in the control condition and 84.7% in the treatment condition, $\chi^2(1) = .82, p = .367$. A logistic regression predicting dropout from condition likewise yielded a non-significant effect, $b = .53, SE = .47, z = 1.13, p = .258, OR = 1.70, 95\% CI [.68, 4.23]$.

A Kaplan–Meier survival analysis examining time to last reading submission further indicated no significant difference in attrition trajectories across conditions, log-rank $p = .243$. Survival curves for control and treatment participants overlapped substantially across study weeks (Figure 15).

Together, these analyses indicate that the unequal group sizes were attributable to allocation imbalance at the point of randomization rather than to differential attrition following exposure to the intervention.

Figure 15

Kaplan–Meier survival curves showing retention across study weeks by condition



Note. Survival curves depicting the proportion of participants still submitting reading reports across weeks 3–10 for the control (blue) and treatment (red) conditions. Shaded bands represent 95% confidence intervals. The y-axis represents the proportion of participants still submitting weekly reading reports at each study week (survival probability).

Baseline Predictors of Differential Dropout

To examine whether dropout was selectively associated with baseline motivational traits as a function of condition, logistic regression models were estimated predicting dropout from condition, each baseline trait, and their interaction term. Separate models were estimated for baseline general procrastination (GPS), conscientiousness, and Pure Procrastination Scale (PPS) scores.

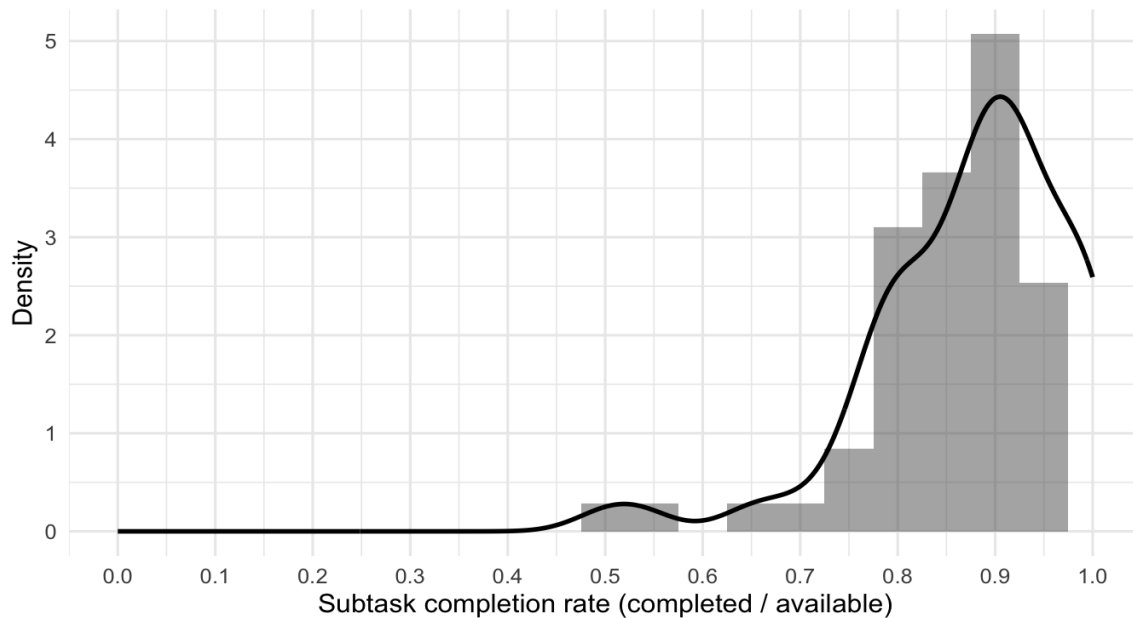
None of the interaction terms were statistically significant, including Condition $\times$ GPS, $b = -.55$, $SE = .65$, $z = -.85$, $p = .395$; Condition $\times$ Conscientiousness, $b = -.06$, $SE = .08$, $z = -.73$, $p = .464$; and Condition $\times$ PPS, $b = -.03$, $SE = .06$, $z = -.53$, $p = .595$. These results indicate that baseline motivational traits did not differentially predict dropout across conditions.

Engagement with the Subtask-Based Reinforcement System

To assess engagement with the intervention, descriptive statistics were computed for participants in the treatment condition. Participants completed a high proportion of available subtasks across the study period ($M = .88$, $SD = .10$), completing an average of 88.72 out of 100.73 available subtasks. As shown in Figure 16, engagement levels were generally high, with most participants completing the majority of available subtasks. These results indicate that participants actively engaged with the subtask-based reinforcement system throughout the study period.

Figure 16

Distribution of subtask completion rates among treatment condition participants



Note. Histogram with overlaid kernel density estimate depicting the distribution of individual subtask completion rates (number completed divided by number available) across the study period for treatment condition participants.

Change in Reading Engagement Over Time

To examine whether the intervention influenced reading engagement over time, a linear mixed-effects model was estimated predicting weekly reading completion from week (treated as a continuous variable), condition (control vs. treatment), their interaction, and baseline PPS scores, with random intercepts for participants. Baseline PPS was included as a covariate to account for the pre-existing difference in trait procrastination between conditions. All available observations were retained in the analysis.

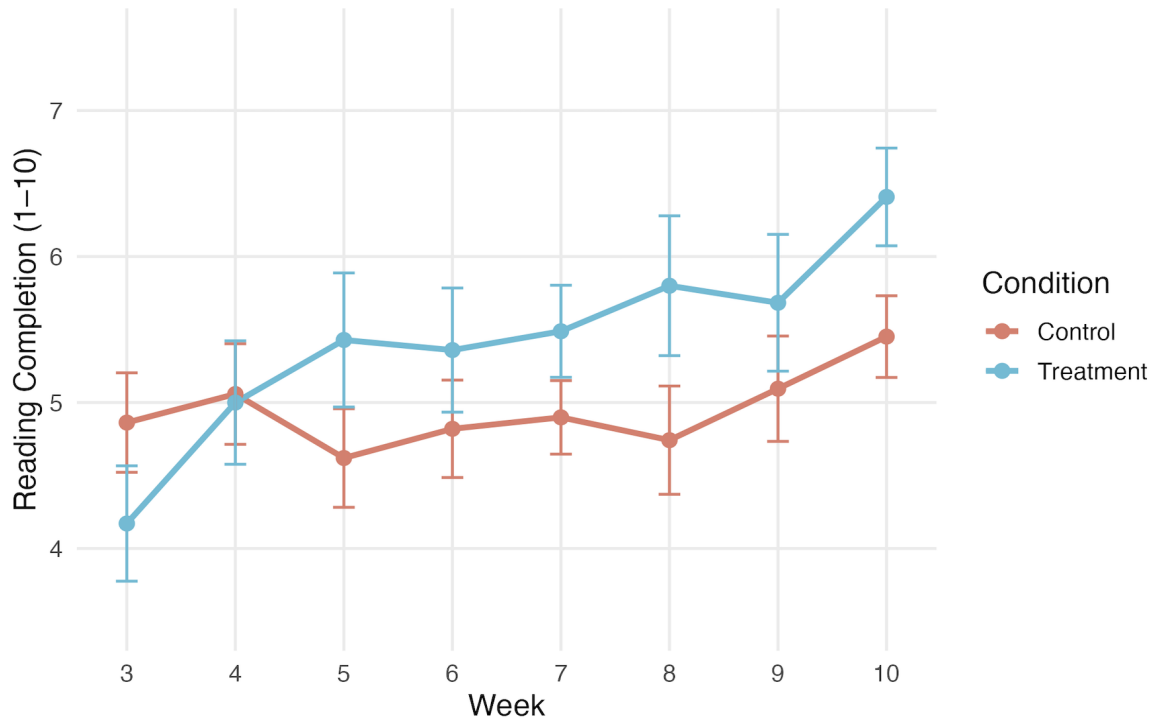
Results indicated a significant main effect of week, such that reading completion increased modestly over time in the control condition, $b = .07$, $SE = .03$, $t(1371.10) = 2.21$, p

= .027, 95% CI [.01, .13]. Baseline PPS was negatively associated with overall reading completion, $b = -.07$, $SE = .03$, $t(160.15) = -2.85$, $p = .005$, 95% CI $[-.13, -.02]$, indicating that participants higher in trait procrastination completed less of the assigned reading on average. The main effect of condition was not significant, $b = -.36$, $SE = .57$, $t(358.45) = -.62$, $p = .53$, 95% CI $[-1.48, .77]$, indicating that the groups did not differ significantly at baseline.

Critically, the Week $\times$ Condition interaction was significant, $b = .19$, $SE = .05$, $t(1376.31) = 3.79$, $p < .001$, 95% CI $[.09, .29]$, indicating that participants in the treatment condition showed greater increases in reading completion across weeks than those in the control condition, even after accounting for baseline differences in trait procrastination. As shown in Figure 17, reading completion increased modestly in the control condition but rose more steeply in the treatment condition over time.

Figure 17

Mean weekly reading completion by condition across study weeks



Note. Mean reading completion scores (1–10 scale) for control (orange) and treatment (blue) conditions across weeks 3–10. Error bars represent 95% confidence intervals.

Covariate-Adjusted Model. To examine whether the observed effects could be attributed to baseline reading attitudes or trait procrastination, the primary mixed-effects model was re-estimated controlling for baseline reading aversion, typical reading completion, and baseline PPS scores.

Typical reading completion was positively associated with overall reading completion, $b = 1.06$, $SE = .13$, $t(160.74) = 7.93$, $p < .001$, 95% CI [.80, 1.32]. Reading aversion, $b = -.04$, $SE = .14$, $t(161.95) = -.28$, $p = .77$, 95% CI [-.30, .23], and baseline PPS, $b = .003$, $SE = .02$, $t(157.06) = .13$, $p = .89$, 95% CI [-.05, .05], were not significantly associated with reading completion.

Importantly, the Week $\times$ Condition interaction remained significant after controlling for these covariates, $b = .19$, $SE = .05$, $t(1378.66) = 3.75$, $p < .001$, 95% CI [.09, .28], indicating that the increase in reading completion observed in the treatment condition was not attributable to baseline differences in reading attitudes or trait procrastination.

Inspection of model residuals indicated no substantial deviations from normality or homoscedasticity.

Engagement with the Subtask System and Changes in Engagement

Exploratory analyses examined whether engagement with the subtask system was associated with changes in reading completion over time. A linear mixed-effects model conducted within the treatment condition predicted weekly reading completion from week, subtask completion rate, and their interaction, with random intercepts for participants. Higher subtask completion rates were not significantly associated with overall reading completion, $b = 6.90$, $SE = 4.21$, $t(166.19) = 1.64$, $p = .10$, 95% CI [-1.35, 15.14]. Likewise, the interaction between week and subtask completion rate was not significant, $b = .23$, $SE = .40$, $t(582.71) = .59$, $p = .55$, 95% CI [-.55, 1.01], indicating that variability in subtask engagement within the treatment condition was not reliably associated with differential changes in reading completion across weeks.

Change in Trait Measures

Exploratory analyses examined whether participation in the intervention was associated with changes in trait conscientiousness and procrastination. Linear regression models were conducted predicting post-intervention scores from baseline scores and condition.

Baseline levels strongly predicted post-intervention scores across all measures. Baseline conscientiousness significantly predicted post-intervention conscientiousness, $b = .81$, $SE = .07$, $t(140) = 11.62$, $p < .001$. Similarly, baseline general procrastination significantly predicted post-intervention general procrastination, $b = .67$, $SE = .11$, $t(142) = 6.08$, $p < .001$, and baseline Pure Procrastination Scale scores significantly predicted post-intervention PPS scores, $b = .75$, $SE = .07$, $t(142) = 11.02$, $p < .001$.

Condition did not significantly predict post-intervention conscientiousness, $b = .62$, $SE = .73$, $t(140) = .84$, $p = .40$, general procrastination, $b = -.03$, $SE = .10$, $t(142) = -.36$, $p = .72$, or pure procrastination, $b = -1.72$, $SE = 1.21$, $t(142) = -1.42$, $p = .159$. These findings suggest that the intervention influenced task engagement without producing measurable changes in trait-level conscientiousness or procrastination over the duration of the study.

Academic performance did not differ significantly between conditions. Students in the control condition scored an average of 74.45% ($SD = 19.29$) on Midterm 1, 77.31% ($SD = 20.92$) on Midterm 2, and 80.70% ($SD = 15.25$) on the final exam. Students in the treatment condition scored an average of 72.22% ($SD = 21.07$), 71.81% ($SD = 23.48$), and 76.85% ($SD = 20.28$), respectively.

Linear regression analyses indicated no significant effect of condition on Midterm 1 scores, $b = -1.93$, $SE = 3.33$, $t(156) = -.58$, $p = .563$, Midterm 2 scores, $b = -3.89$, $SE = 3.62$, $t(156) = -1.07$, $p = .284$, or final exam scores, $b = -4.33$, $SE = 2.92$, $t(156) = -1.48$, $p = .140$.

Reporting Validity

A further concern was that confetti-based reinforcement might have incentivized clicking behavior, thereby inflating or introducing noise into self-reported reading completion in the treatment condition. If so, the association between reported reading

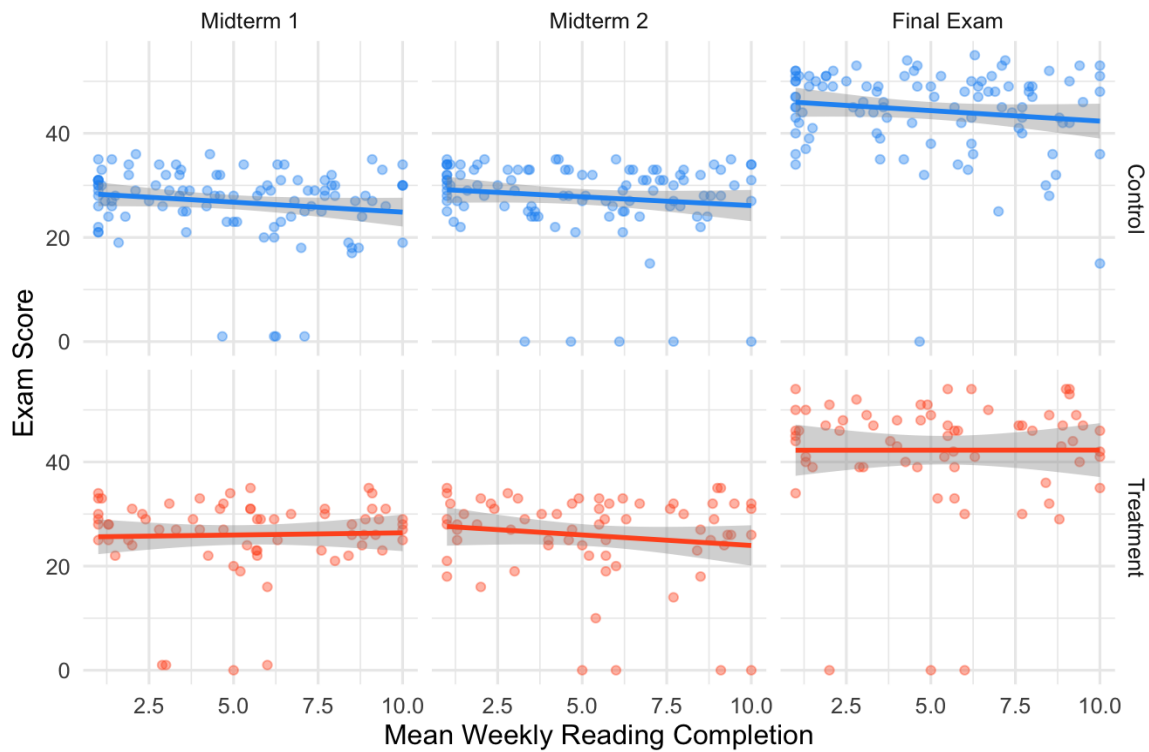
completion and objective academic performance would be expected to weaken in the treatment group relative to the control group.

To evaluate this possibility, Pearson correlations were computed separately by condition between mean weekly reading completion and exam performance. In the control condition ($n = 101$), correlations between reading completion and exam scores were small and non-significant: Midterm 1, $r(99) = -.16, p = .112$; Midterm 2, $r(99) = -.13, p = .196$; Final Exam, $r(99) = -.14, p = .167$. In the treatment condition ($n = 67$), correlations were similarly small and non-significant: Midterm 1, $r(65) = .03, p = .795$; Midterm 2, $r(65) = -.14, p = .255$; Final Exam, $r(65) < .01, p = .995$.

Fisher r-to-z tests comparing correlations across conditions indicated no significant differences for any exam (all $ps \geq .231$). These results provide no evidence that confetti-based reinforcement compromised the validity of self-reported reading completion (Figure 18).

Figure 18

Scatterplots of mean weekly reading completion and exam performance by condition



Note. Association between mean weekly reading completion and exam scores (Midterm 1, Midterm 2, and Final Exam) displayed separately for control (blue, top row) and treatment (red, bottom row) conditions. Regression lines with 95% confidence bands are shown.

Discussion

The aim of the present study was to extend the findings of the previous experiments by examining whether the principles of learned industriousness can reduce academic procrastination in a longitudinal setting. Studies 1 and 2 examined the effects of brief, state-level interventions on intentions and momentary task engagement. In contrast, the present study tested whether repeatedly pairing effort with reinforcement could sustain engagement with an effortful academic task across time. Specifically, the intervention divided weekly

course readings into smaller subtasks and provided immediate positive feedback following completion of each section, thereby repeatedly pairing effort with reinforcement across the academic quarter. Results indicated that participants in the treatment condition demonstrated greater increases in reading completion over time compared to those in the control condition. This pattern remained after controlling for baseline reading attitudes, suggesting that the observed changes were not attributable to preexisting differences in reading aversion or typical reading behavior. At the same time, the intervention did not produce measurable changes in trait-level conscientiousness or procrastination, nor did it significantly influence exam performance. Taken together, these findings suggest that structuring effortful academic tasks into subtasks and pairing effort with immediate reinforcement can increase engagement with recurring academic tasks over time, even in naturalistic educational environments.

The present findings indicate that being in the treatment condition led to increased engagement with readings over time, compared to the control condition. Academic reading is particularly vulnerable to procrastination because it involves immediate effort costs and delayed benefits, with few immediate penalties for postponing a single reading. Under such conditions, individuals may repeatedly delay engagement despite intending to complete the task, contributing to recurring intention–action gaps in academic contexts. The present intervention may have altered the structure of this decision environment by introducing immediate reinforcement during task engagement. Each completed reading subtask triggered a positive reinforcement event in the form of confetti flying across the screen, effectively reducing the temporal distance between effort and reward.

From a motivational perspective, these changes may help counter the imbalance between immediate effort costs and delayed task benefits that contributes to procrastination

(Steel & König, 2006; Zhang & Feng, 2020). By dividing readings into smaller components and pairing effort with immediate feedback, the intervention may have made engagement with the task more psychologically manageable and rewarding in the moment. Rather than attempting to change individuals' beliefs about reading or their long-term academic goals, the intervention altered the experiential structure of engaging with the task itself. Structuring tasks and environments to provide more proximal incentives may therefore help reduce repeated postponement of effort in ongoing academic work.

From a learned industriousness perspective, the present findings are also consistent with the idea that repeated pairings of effort and reward can support sustained engagement with effortful tasks over time (Eisenberger, 1992). Learned industriousness theory proposes that when high effort is consistently followed by rewarding outcomes, effort itself can acquire secondary reinforcing properties. As a result, individuals may become more likely to persist on demanding tasks even when explicit rewards are minimal or absent.

In the present study, each completed reading subtask was followed by brief positive feedback, creating repeated effort–reward pairings embedded within weekly academic work. The significant Week $\times$ Condition interaction suggests that the benefits of the intervention accumulated across repeated encounters with the task rather than reflecting a one-time increase in motivation. In early weeks, the feedback may have functioned primarily as an operant reinforcer, directly increasing the likelihood of completing additional subtasks during a given reading session. Over time, however, the progressive increase in reading engagement in the treatment condition suggests that interacting with a structured and reinforced task environment may have supported greater persistence across weeks.

Although the present findings are consistent with predictions derived from learned industriousness theory, the current design does not directly test whether effort itself acquired reinforcing properties. Future work incorporating direct measures of effort valuation, or examining whether persistence transfers to novel tasks, would provide stronger tests of the mechanisms proposed by learned industriousness theory.

Notably, even though the intervention produced state-level behavioral changes in reading engagement over time, it did not produce detectable changes in trait conscientiousness or procrastination. This pattern is consistent with theoretical models that distinguish between relatively stable individual differences and state-level or environment-level influences on behavior (Neal et al., 2006; Steel & König, 2006). Interventions that modify task structure and immediate reinforcement are therefore expected to influence behavior within specific contexts before producing measurable changes in broader personality traits.

Research on personality change further supports this interpretation. Traits such as conscientiousness show substantial stability over short time periods, and meta-analytic evidence indicates that interventions typically produce only small-to-moderate trait changes even over several months (Roberts et al., 2017). Meaningful shifts in traits generally require repeated practice across multiple domains of daily life, explicit goals related to self-concept change, and durations exceeding 10-24 weeks at least (Hudson & Fraley, 2015; Stieger et al., 2021). In contrast, the present intervention operated over 7 weeks, and targeted a specific behavioral context—engagement with weekly course readings. Under such conditions, behavioral change would be expected to occur at the level of task engagement rather than at the level of global personality traits. This is particularly true because trait measures capture

broad, cross-situational tendencies rather than context-specific behavioral patterns (Briley & Tucker-Drob, 2014).

Similarly, the intervention did not result in differences in exam performance between conditions. Consistent with this, reading completion was not significantly associated with exam scores in either the control or treatment condition, suggesting that differences in self-reported reading engagement did not translate into detectable differences in academic performance. One possible explanation is that completing more assigned readings does not translate directly or linearly into higher exam scores. Reading completion reflects engagement with course material but does not necessarily capture depth of processing or conceptual integration, which are more directly related to exam performance. Meta-analyses of college students find only small-to-moderate correlations between reading comprehension test performance and course grades, suggesting that while reading supports learning, exam success depends more heavily on active processing, prior knowledge integration, and study strategies beyond text exposure (Clinton-Lissel et al., 2022). Variability in baseline ability, prior knowledge, and alternative study strategies may further weaken the relationship between reading completion and exam scores. Prior meta-analytic work has similarly found that procrastination-related behaviors often show relatively modest associations with objective academic outcomes such as GPA (van Eerde, 2003; Steel, 2007). Thus, while the intervention successfully increased engagement with assigned readings, changes in reading behavior alone may be insufficient to produce measurable improvements in exam performance over a single academic term.

Limitations

Several limitations should be considered when interpreting the present findings. First, the study was conducted within a single undergraduate course at one institution, focusing on weekly readings delivered through a custom mobile application. Replication across diverse courses, disciplines, and educational contexts will be necessary to determine the generalizability of the effects. Future work could also examine whether similar reinforcement-based task structures influence engagement in other types of academic work, such as writing assignments, problem sets, or collaborative projects.

Second, the primary outcome measure—weekly reading completion—was assessed using self-report. Although analyses suggested that reinforcement did not simply encourage superficial “button-pressing,” self-reported measures of study behavior remain susceptible to bias and memory errors. Future research could incorporate objective indicators of engagement, such as logged reading time, embedded comprehension checks, or in-app quizzes tied to specific course material.

Third, the duration and scope of the intervention likely limited its ability to influence broader outcomes. Reinforcement was confined to one course across a single academic quarter, which may be insufficient to detect changes in global traits or distal academic outcomes. Longer-term interventions spanning multiple courses or semesters would provide stronger tests of whether reinforcement of effort generalizes across contexts and contributes to broader academic and personality-level change. Such designs would also allow researchers to examine whether repeated effort–reward pairings accumulate over time to produce more stable patterns of persistence, as predicted by learned industriousness theory (Eisenberger, 1992).

Implications of the Intervention Design

The present findings have implications for the design of procrastination interventions, particularly in digital learning environments. Much of the existing literature focuses on cognitive or self-regulatory approaches—such as cognitive behavioral therapy, implementation intentions, or episodic future thinking—that aim to change individuals’ beliefs, intentions, or motivational evaluations (van Eerde & Klingsieck, 2018; Rozental & Carlbring, 2014). While these approaches can be effective, they often require sustained motivation, training, or therapist involvement, which may limit their scalability in everyday academic settings.

In contrast, the present intervention shows that simple structural changes to how tasks are experienced can increase engagement over time. Dividing work into subtasks and pairing completion with brief positive feedback increased reading engagement without requiring changes in students’ beliefs or self-concept. Because these features operate at the level of interface design, they can be implemented at relatively low cost within digital learning platforms such as Canvas or Blackboard. Recent work similarly suggests that app-based micro interventions—such as just-in-time prompts or gamified progress tracking—can improve study consistency when delivered repeatedly across large user groups (Kirchner-Krath, 2025).

More broadly, the findings suggest that procrastination interventions may benefit from modifying the structure of task engagement rather than focusing solely on changing individuals’ beliefs or intentions. Introducing small reinforcers during effortful work may help offset the imbalance between immediate effort costs and delayed rewards that contributes to procrastination (Steel & König, 2006). Digital platforms are particularly well

suited to delivering these forms of low-cost, repeated feedback during routine academic tasks.

Taken together, the studies in this dissertation examine procrastination across progressively broader temporal scales. Study 1 showed that a brief intervention targeting task appraisals can increase intentions to begin a procrastinated task. Study 2 extended this work by examining behavior during task engagement, demonstrating that structuring work into subtasks increases immediate engagement and that pairing effort with reinforcement increases willingness to continue working. The present study further shows that repeated exposure to these features can increase engagement with recurring academic tasks over time. Collectively, these findings suggest that procrastination is shaped not only by momentary evaluations of tasks but also by reinforcement structures that accompany repeated encounters with effortful activities. Chapter 5 integrates these findings to examine their theoretical and practical implications, and proposes a reinforcement-based account of procrastination as a speculative framework for future research—one informed by, but distinct from, the empirical findings of the present studies.

From Delay to Learned Patterns: Toward a Reinforcement-Based Theory of Procrastination

Procrastination—defined as the voluntary delay of an intended course of action despite expecting negative consequences (Steel, 2007)—is a widespread phenomenon associated with negative academic, professional, and psychological outcomes (e.g., Rozental et al., 2018a; Tice & Baumeister, 1997). Much of the existing literature has conceptualized procrastination primarily as being stable, linking chronic procrastination to enduring dispositional traits in self-regulation and personality (e.g., van Eerde, 2003; Steel, 2007). Yet this trait-level focus has produced a notable mismatch: procrastination is theorized as a momentary process but has predominantly been measured and targeted as a stable disposition—and while existing theories accurately describe the state-level decision processes through which procrastination unfolds, few specify how to intervene at the moment of delay. While this perspective has yielded important insights, it leaves open a complementary question: how procrastination unfolds in the moment when individuals decide whether to engage with an effortful task. The present dissertation therefore examined procrastination from a state-level perspective, exploring whether brief interventions targeting momentary task evaluations and reinforcement processes can influence task initiation, engagement, and patterns of behavior over time.

Study 1 (Chapter 2) provided an initial test of whether brief, in-the-moment interventions can influence decision processes underlying state procrastination. The intervention combined affect labeling, subgoal generation, and reward selection to alter how a procrastinated task was evaluated at the moment of decision. Participants who completed the intervention reported greater perceived outcome utility, a larger gap favoring outcome

utility over task aversion, more positive mood, and a higher likelihood of beginning the task compared to controls. Although the study did not measure behavioral follow-through, these findings suggested that brief strategies targeting momentary task evaluations can alter task appraisal, and increase individuals' readiness to initiate work on a delayed task. However, Study 1 could not determine which components of the intervention drove these effects, nor whether changes in intention translated into actual behavior.

Study 2 (Chapter 3) extended these findings by examining behavioral engagement rather than intention alone. Because Study 1 left open the question of mechanism, Study 2 was designed to separate subtask structuring from reinforcement, isolating the contribution of each to task motivation and persistence. Participants worked on a real procrastinated task assigned to either a subtask structuring condition, a subtask-plus-reward condition, or a control condition. Both subtask conditions increased mid-task engagement relative to the control group, suggesting that breaking tasks into concrete subtasks facilitates initiation by lowering barriers to action. However, the addition of reinforcement increased participants' willingness to continue working and showed a trend toward increasing the perceived rewardingness of effort. Together, these findings indicate that subtask structuring primarily supports task initiation and early engagement, whereas reinforcement contributes additional effects on persistence by altering how effort itself is evaluated. Yet because Study 2 was confined to a single session, it could not determine whether reinforcement effects would accumulate across repeated encounters with effort.

Study 3 (Chapter 4) extended the earlier findings by examining whether reinforcement of effort can support sustained engagement over time in a naturalistic academic context. Because Studies 1 and 2 established single-session effects, Study 3 was

designed to test whether the same principles could produce progressive change across repeated opportunities to act. Whereas Studies 1 and 2 focused on intentions and momentary task engagement, this study tested whether repeatedly pairing effort with reinforcement could influence behavior across repeated opportunities for engagement. Students completed weekly course readings using a mobile application that divided readings into smaller subtasks and provided immediate positive feedback following completion of each section. Over the academic quarter, participants in the intervention condition showed greater increases in reading completion compared to those in the control condition. Importantly, these effects emerged without measurable changes in trait-level conscientiousness or procrastination, suggesting that reinforcing effort at the state level can increase engagement with recurring academic tasks even in the absence of broader trait change.

Taken together, the three studies suggest that procrastination is responsive to interventions that alter how effortful tasks are evaluated in the moment. Study 1 demonstrated that brief strategies targeting task appraisal can increase individuals' intentions to begin working on a procrastinated task. Study 2 extended these findings by showing that structuring work into subtasks facilitates engagement, while pairing effort with reinforcement increases individuals' willingness to persist once effort has begun. Study 3 further demonstrated that repeatedly pairing effort with reinforcement can increase engagement with recurring academic tasks over time. Collectively, these findings suggest that procrastination may be shaped not only by stable individual differences but also by reinforcement processes that influence how effort is experienced during task engagement. Over repeated opportunities to act, these experiences may shape patterns of engagement with effortful tasks. The

following sections examine the empirical, theoretical, and methodological contributions of these findings and consider their implications for future research on procrastination.

Empirical Contributions

The present dissertation provides empirical evidence that procrastination is responsive to brief interventions targeting momentary task evaluations and reinforcement experiences during effortful activity. Whereas much prior research has conceptualized procrastination primarily as a relatively stable individual difference associated with enduring self-regulatory dispositions (van Eerde, 2003; Lay, 1986; Steel, 2007), the current studies demonstrate that decisions about whether to engage with effortful tasks can be experimentally influenced at the moment of choice. Across studies, altering how individuals evaluated a procrastinated task or structuring the reinforcement surrounding effort changed intentions to begin work, engagement during task performance, and behavioral patterns across repeated opportunities to act.

A first empirical contribution is demonstrating that brief strategies targeting task appraisal can influence readiness to begin a procrastinated task. In Study 1, participants completed a short intervention combining affect labeling, subgoal generation, and reward selection prior to deciding whether to begin working on a task they had been postponing. This intervention shifted perceived task aversion and outcome utility and increased participants' reported likelihood of initiating work relative to control conditions. These findings provide experimental evidence that momentary evaluations of effortful tasks can be altered through short interventions and that such changes are associated with increased readiness to act.

A second contribution concerns mechanisms operating during task engagement. Prior empirical work has often operationalized procrastination primarily as delayed task onset or failure to begin work (Steel et al., 2001; Steel, 2007), leaving the processes sustaining effort during ongoing engagement comparatively underexplored. Study 2 addressed this gap by examining behavioral engagement with a task participants had been procrastinating on. Structuring the task into concrete subtasks increased engagement relative to the control condition, suggesting that breaking work into manageable components can facilitate entry into effortful activity. At the same time, pairing effort with reinforcement increased participants' willingness to continue working beyond the initial task period. These results indicate that structuring tasks and reinforcing effort can influence different aspects of task engagement during ongoing activity.

A third empirical contribution concerns the role of reinforcement in shaping engagement with effortful tasks over time. Study 3 examined whether reinforcing effort across repeated opportunities to act could influence behavior in a naturalistic academic context. Participants used a mobile reading platform that divided course readings into smaller sections and provided immediate positive feedback following completion of each section. Across the academic quarter, this reinforcement structure was associated with increased completion of course readings despite no measurable change in trait-level procrastination. This finding demonstrates that altering reinforcement contingencies during task engagement can influence patterns of behavior across repeated episodes of effort.

Finally, the present research contributes to longitudinal work on procrastination interventions by focusing specifically on reinforcement structures embedded within naturalistic task contexts. Existing intervention programs have demonstrated that

procrastination can be reduced over weeks or months through cognitive-behavioral or motivational training (e.g., van Eerde & Klingsieck, 2018; Rozental et al., 2018b). However, these approaches typically aim to reduce trait-like procrastination or improve general self-regulation skills. In contrast, the present studies show that reinforcing discrete episodes of effort within ongoing tasks can influence behavioral engagement even in the absence of changes in trait-level procrastination.

Taken together, these empirical findings indicate that procrastination is responsive to interventions that alter task appraisal, task structure, and reinforcement during effortful activity. By demonstrating that these mechanisms can influence both task initiation and persistence, the present research provides new empirical insight into how engagement with effortful tasks can be shaped in the moment and across repeated opportunities to act.

Theoretical Contributions

Beyond documenting these empirical patterns, the present findings also have implications for several theoretical frameworks that have been used to explain procrastination.

First, the results refine temporal and motivational models of procrastination by showing that the cost–benefit evaluations they describe are not only descriptive but also experimentally malleable at the state level. Temporal Motivation Theory (Steel & König, 2006) and the Temporal Decision Model (Zhang & Feng, 2020) propose that procrastination arises when the immediate aversiveness of a task outweighs the discounted value of its outcomes. Prior work has largely inferred these evaluations from patterns of behavior or self-report. The present findings suggest that such evaluations can be shifted through brief appraisal-based interventions, indicating that the decision processes described in temporal

models may be directly influenced by interventions targeting momentary task evaluations. In doing so, the present studies move beyond description toward prescription—providing not only an account of when procrastination occurs but a set of principles for intervening at that same moment, addressing the gap that existing theoretical accounts leave open.

Second, the findings clarify how existing motivational models may benefit from distinguishing between initiation and persistence within effortful activity. Many theoretical accounts implicitly treat starting and continuing work as governed by a single valuation process. However, the present findings suggest that these phases of task engagement may rely on partially distinct mechanisms. Structuring work into subtasks appeared to facilitate entry into effortful activity, whereas reinforcement delivered during ongoing engagement more strongly influenced willingness to continue exerting effort. This distinction suggests that theoretical models of procrastination may benefit from explicitly differentiating processes that govern the initiation of effort from those that sustain persistence once effort is underway.

Third, the present findings highlight the importance of reinforcement processes within theoretical accounts of procrastination. Emotion-regulation models emphasize that procrastination often serves to alleviate negative affect in the short term (Sirois & Pychyl, 2013), and prior research has shown that delay can function as a strategy for avoiding anticipated discomfort (Pychyl & Flett, 2012; Tykocinski & Pittman, 1998). These perspectives emphasize the functional role of procrastination but typically stop short of specifying how repeated experiences of relief shape future behavior. The present findings suggest that reinforcement processes operating during task engagement may play a complementary role: not only can avoidance be reinforced through emotional relief, but

effort itself can acquire value when systematically paired with positive outcomes. This perspective aligns with learned industriousness theory (Eisenberger, 1992; Eisenberger & Shanock, 2003) and suggests that models of procrastination may benefit from treating both avoidance and effort as behaviors shaped by reinforcement contingencies.

Finally, the findings contribute to theoretical discussions regarding the relationship between state and trait procrastination. Trait procrastination is often conceptualized as a relatively stable disposition reflecting enduring self-regulatory tendencies (van Eerde, 2003; Steel, 2007). At the same time, empirical work has documented substantial within-person variability in procrastination across tasks and time (e.g., Bäumke et al., 2021; Wieland et al., 2018). Personality process perspectives propose that stable behavioral tendencies can emerge from the accumulation of repeated state-level enactments in everyday contexts (Fleeson, 2001; Fleeson & Jayawickreme, 2015; Wrzus & Roberts, 2017). The present findings are consistent with this perspective: altering reinforcement contingencies during task engagement changed patterns of behavior across repeated opportunities to act even in the absence of changes in trait procrastination. This suggests that trait-like patterns of procrastination may partly reflect reinforcement histories operating across repeated episodes of task engagement.

Together, these theoretical implications highlight the importance of integrating motivational decision processes with reinforcement dynamics when explaining procrastination behavior. Whereas many existing models emphasize cognitive appraisals or dispositional tendencies, the present findings suggest that reinforcement experiences during task engagement may play a critical role in shaping how individuals respond to effortful tasks over time.

The Theory of Learned Procrastination

Building on these theoretical implications, the following section proposes a speculative conceptual framework — the theory of learned procrastination — that integrates the present findings with reinforcement-learning principles to account for how procrastination may develop and stabilize over time. The preceding theoretical implications point toward a broader question regarding how procrastination develops and persists over time. Existing theories of procrastination primarily focus on the processes that lead individuals to delay tasks in the moment, including affect regulation (Sirois & Pychyl, 2013), temporal discounting (Steel & König, 2006), and dynamic cost–benefit evaluations of task aversion and outcome utility (Zhang & Feng, 2020). While these frameworks explain why individuals may choose to postpone tasks at a particular point in time, they offer comparatively less explanation for how repeated episodes of delay might accumulate into stable patterns of procrastination behavior.

Building on reinforcement and personality-process perspectives, the present dissertation proposes a conceptual framework referred to as the theory of learned procrastination. This framework suggests that procrastination may develop and persist through reinforcement-learning processes that strengthen avoidance behavior across repeated episodes of task engagement.

In many situations, postponing an aversive task produces immediate emotional consequences. Delaying a task can temporarily reduce anxiety, frustration, or anticipated difficulty, thereby providing relief from negative affect. At the same time, postponement often creates opportunities to engage in alternative activities that are more immediately rewarding, such as social interaction, entertainment, or other enjoyable pursuits. From a

reinforcement-learning perspective, these outcomes can function as rewards that increase the likelihood of similar avoidance behavior in the future.

Core Proposition of the Theory. *The theory of learned procrastination proposes that repeated episodes of task avoidance become reinforced through short-term emotional rewards—such as relief from negative affect or access to more immediately rewarding activities—and that these reinforcement experiences gradually strengthen avoidance tendencies over time.* As avoidance is repeatedly followed by relief or pleasure, the behavior becomes increasingly likely to recur in future situations, eventually contributing to stable patterns of procrastination.

Through repeated cycles in which avoidance is followed by reward, procrastination may gradually become more automatic. Over time, familiar internal cues—such as boredom, discomfort, fatigue, or anticipated effort—may begin to trigger delay with little conscious deliberation. Such transitions from deliberate to automatic responding are well documented in research on habit formation, which shows that behaviors repeated in stable contexts can come to be triggered by environmental and internal cues with minimal cognitive effort (Wood, 2019). This process aligns with broader models of habit formation suggesting that behaviors repeated in stable contexts can become increasingly automatic responses to situational cues (Mahy et al., 2024; Verplanken, 2006; Wood & Neal, 2007).

The theory of learned procrastination is conceptually informed by the theory of learned industriousness (Eisenberger, 1992). Learned industriousness proposes that effort can acquire positive motivational value when repeated experiences of effort are paired with reward (Eisenberger & Shanock, 2003). Over time, individuals who repeatedly experience

reinforcement following effortful activity may develop a generalized tendency to persist in effortful tasks because effort itself becomes associated with positive outcomes.

The theory of learned procrastination can be viewed as a conceptual counterpart to this process. Whereas learned industriousness describes how reinforcement can make effort itself rewarding, learned procrastination suggests that reinforcement can also make avoidance rewarding when delay repeatedly produces emotional relief or access to more desirable alternatives. A related perspective is offered by Svartdal and Løkke (2022), who apply a functional-analytic framework to academic procrastination and argue that delay can be understood as a learned habit reinforced by the immediate emotional relief that follows avoidance. In this sense, industriousness and procrastination may represent opposing behavioral tendencies shaped by different reinforcement histories.

Importantly, the present studies do not directly test the full theory of learned procrastination. Rather, they provide complementary evidence on the opposing side of this proposed learning dynamic. By reinforcing effort during task engagement, Studies 2 and 3 demonstrated that altering reinforcement contingencies can increase persistence and engagement with effortful academic tasks without necessarily producing changes in trait-level procrastination. These findings are consistent with learned industriousness principles and suggest that reinforcement experiences during task engagement can influence patterns of behavior across repeated opportunities to act.

Taken together, these results point toward reinforcement dynamics as a potentially important mechanism in the development and modification of procrastination behavior. If repeated reinforcement of avoidance can strengthen procrastination tendencies, then altering reinforcement structures—such as by rewarding incremental progress or structuring effort

into manageable subtasks—may provide a pathway for shifting engagement patterns over time. From this perspective, learned procrastination may serve as a useful organizing framework for understanding how repeated experiences during task engagement contribute to the persistence or reduction of procrastination behavior.

Directly testing the theory of learned procrastination would require experimental paradigms that manipulate reinforcement contingencies for avoidance behavior across multiple sessions and track the downstream effects on delay. One such approach would involve a multi-session reinforcement-learning design in which participants repeatedly face the opportunity to begin or postpone an effortful task. In a learned procrastination condition, avoidance would be followed by immediate access to a rewarding alternative activity, simulating the short-term emotional relief that naturally accompanies delay. In a neutral control condition, avoidance would produce no such consequence. Across sessions, the key predictions are that participants in the avoidance-reinforcement condition would show progressively shorter latencies to postpone, greater frequency of delay, and reduced perceived effort value relative to controls. Computational reinforcement learning models (e.g., Daw & Tobler, 2014) could be used to estimate the rate at which avoidance acquires subjective value across trials, providing a mechanistic account of how procrastination tendencies strengthen over time. Such a paradigm would constitute a direct empirical test of the core proposition of learned procrastination—that delay can be incrementally shaped through reinforcement, analogously to the way industriousness has been shown to develop through effort-reward pairings (Eisenberger, 1992).

A second line of proposed research would more directly connect the learned procrastination framework to the intervention approach taken in the present dissertation.

Specifically, a within-subject crossover design could first expose participants to a learned procrastination induction—using the multi-session avoidance-reinforcement paradigm described above—and then administer the subtask-plus-reinforcement intervention developed in Studies 2 and 3. The critical question is whether reinforcing effort, in the manner tested here, can counteract or reverse the behavioral tendencies instilled by prior avoidance reinforcement. If participants whose procrastination has been experimentally strengthened show recovery of task engagement following the effort-reinforcement intervention, this would provide convergent evidence that industriousness and procrastination represent opposing poles of the same reinforcement-learning dynamic, and that the intervention strategies examined in this dissertation operate on the same mechanisms proposed by the theory of learned procrastination. Such a design would help the reader understand not only how the theoretical framework relates to the empirical work presented here, but also why targeting reinforcement at the state level may be a particularly powerful strategy for interrupting established patterns of avoidance.

Methodological Contributions

In addition to its empirical and theoretical implications, the present dissertation contributes to methodological approaches used to study procrastination. Across the three studies, the research design incorporates features that address common limitations in prior work, including reliance on hypothetical tasks, exclusive use of self-report measures, and a focus on single time scales of analysis (e.g., van Eerde, 2003; Rozental et al., 2018a; Steel, 2007).

A first methodological contribution concerns the use of participant-selected tasks that participants had been actively procrastinating on. Much experimental research on

procrastination has relied on hypothetical vignettes, experimenter-assigned laboratory tasks, or global self-report measures of procrastination tendencies (e.g., van Eerde, 2003; Steel, 2007; Zhang & Feng, 2020). While these approaches have yielded important insights into dispositional tendencies and decision processes, they may not fully capture the motivational dynamics associated with real-world procrastination. In the present studies, participants identified tasks they had been postponing in their everyday lives and, in Studies 1 and 2, were asked to evaluate or work on those tasks within the experimental context. This approach increases ecological validity by situating interventions within the context of participants' own goals and obligations and parallels recent efforts to study procrastination using real-life tasks and outcomes, such as completion of assigned coursework or delays in fulfilling academic requirements (e.g., Giguère et al., 2016; Rozental et al., 2018b).

A second methodological contribution involves the use of behavioral measures of task engagement alongside self-report. Many studies examining procrastination rely primarily on trait scales or intentions to act, which capture perceived tendencies but do not necessarily reflect how individuals behave during ongoing task engagement (van Eerde, 2003; Steel, 2007). In contrast, the present dissertation incorporates several behavioral indicators, including mid-task engagement during a work session, willingness to continue working beyond the required period, and longitudinal measures of reading completion across an academic quarter. This approach is consistent with recent calls to supplement self-report measures with objective behavioral indicators of procrastination, such as assignment submission times, which capture how interventions influence real study behavior rather than perceived tendencies (Miyake & Kane, 2022). Similar to prior work that uses assignment submission times or delays in completing course-related tasks as behavioral indicators of

procrastination (e.g., Giguère et al., 2016; Tice & Baumeister, 1997), these measures provide a more direct assessment of how interventions influence effortful activity in real time. This design helps bridge the gap between self-reported motivation and observable behavior, an issue that has been highlighted in both intervention studies and experience-sampling research on procrastination (e.g., Bäumle et al., 2021; Rozental et al., 2018b).

A third methodological contribution involves examining procrastination-related processes across multiple temporal scales within a single program of research. Much of the existing literature focuses either on momentary decision processes—often studied through laboratory paradigms or experience sampling (e.g., Bäumle et al., 2021; Wieland et al., 2018)—or on trait-level tendencies measured through questionnaires and longer-term interventions (e.g., van Eerde & Klingsieck, 2018; Rozental et al., 2018b). Fewer studies simultaneously consider how procrastination unfolds from immediate task decisions to patterns of engagement that develop across repeated opportunities to act. The present dissertation addresses this gap by examining procrastination at three complementary levels: Study 1 focuses on momentary task decisions and readiness to begin a procrastinated task; Study 2 examines engagement within a single work session, allowing investigation of mechanisms supporting both initiation and persistence; and Study 3 extends this work by tracking patterns of engagement with recurring academic tasks across an academic quarter using a mobile platform.

A fourth methodological contribution involves the explicit focus on state procrastination as a target for experimental investigation. Much prior work has studied procrastination primarily as a trait-level disposition, relying on self-report questionnaires that aggregate tendencies across situations and time (e.g., van Eerde, 2003; Steel, 2007). While

such measures are useful for characterizing individual differences, they are less suited for studying the dynamic, moment-to-moment processes through which procrastination is enacted or interrupted. The present dissertation operationalized procrastination at the state level—targeting the specific moment when an individual is deciding whether to engage with or avoid a particular task—and examined whether brief interventions could shift that decision in real time. This approach offers two related methodological advantages. First, it identifies a precise and accessible point of intervention: rather than attempting to change stable personality characteristics, state-level targeting focuses on what can be altered in the moment of choice, making it possible to design brief, scalable strategies that operate where procrastination actually occurs. Second, focusing on state procrastination enables the study of clinically and theoretically relevant processes within short experimental time windows. Because state procrastination can be elicited and measured within a single session or across a brief longitudinal period, it provides an efficient vehicle for investigating mechanisms—such as appraisal change, effort valuation, and reinforcement learning—that have historically been difficult to study in real time. Together, these features suggest that state-level operationalizations of procrastination represent a valuable methodological addition to the field, complementing trait-level approaches by enabling experimental analysis of the proximal processes that drive delay.

Taken together, this multi-level, behaviorally anchored approach provides a more comprehensive view of how procrastination operates across time and contexts than designs that focus solely on hypothetical tasks, trait questionnaires, or single-session outcomes (e.g., Bäumle et al., 2021; Rozentel et al., 2018b; Steel, 2007). By integrating ecologically valid task contexts, behavioral indicators of engagement, multiple temporal scales of analysis, and

an explicit state-level operationalization of procrastination, the present research offers a methodological framework for studying procrastination as a dynamic process that unfolds across both immediate decisions and repeated opportunities to act—one that complements existing trait-level approaches by enabling experimental analysis of the proximal processes that drive delay.

Practical Contributions

The present dissertation highlights several mechanisms that can be leveraged in applied settings to reduce procrastination and support sustained engagement with effortful tasks. The findings point to the promise of brief interventions targeting task appraisal, structural strategies that support task initiation, and reinforcement mechanisms that sustain engagement during ongoing activity.

A first practical implication concerns the design of brief interventions that target the moment of task initiation. Study 1 demonstrated that simple strategies—such as affect labeling, identifying concrete subtasks, and selecting small rewards—can shift individuals' evaluations of a procrastinated task and increase their reported readiness to begin working on it. These results suggest that relatively lightweight interventions delivered at or near the moment of decision may meaningfully influence whether individuals initiate effortful activity, complementing prior work on implementation intentions and “if-then” planning to bridge the intention-behavior gap (Gollwitzer, 1999; Gollwitzer & Sheeran, 2006).

Such micro-interventions may be particularly useful in contexts where individuals frequently encounter brief windows of opportunity to begin work but experience hesitation or avoidance, such as academic environments, remote work, or self-paced projects. Digital productivity tools, learning management systems, and clinical or coaching interventions

could incorporate brief prompts that guide users to articulate emotions about a task, identify a manageable starting point, or specify a small reward for completion (e.g., Eckert et al., 2016; Sirois & Pychyl, 2013). Because these strategies require minimal time and cognitive effort, they are well suited for real-time delivery within everyday environments, including mobile applications and just-in-time adaptive interventions.

A second practical implication concerns the role of task structure in supporting both initiation and early engagement. The present findings suggest that breaking larger tasks into concrete subtasks can facilitate the initiation of effort by reducing perceived barriers and providing clear entry points for action. Once individuals begin working, the presence of identifiable subtasks may also provide ongoing signals of progress, helping to reduce feelings of overwhelm that often accompany large or ambiguous goals (Bandura, 1997; Locke & Latham, 2002).

These insights have implications for the design of study strategies, task management systems, and productivity tools. Educational settings may benefit from explicitly encouraging students to decompose complex assignments into smaller, clearly defined components and to plan work at the level of actionable units rather than broad intentions (Solomon & Rothblum, 1984; Wäschle et al., 2014). Similarly, productivity platforms and planning tools could support engagement by helping users generate subtasks, set proximal goals, and visualize incremental progress toward larger objectives. Structuring tasks in this way may help transform abstract intentions into concrete steps that are easier to initiate and maintain, particularly for individuals who are prone to procrastination.

A third practical implication concerns the role of reinforcement during ongoing task engagement. The present findings indicate that providing positive feedback or salient signals

of progress during effortful activity can increase individuals' willingness to continue working, in line with evidence that performance feedback and perceived progress support persistence and goal attainment (Harkin et al., 2016; Klingsieck, 2013). These results are also consistent with the broader principle from learned industriousness that effort can acquire motivational value when it is consistently paired with rewarding experiences (Eisenberger, 1992; Eisenberger & Shanock, 2003). A key insight from the present research—and one that distinguishes it from existing extended approaches such as CBT or skills training—is that these reinforcement mechanisms can be delivered at the precise moment procrastination occurs, rather than requiring access to a therapist, a training program, or a sustained behavior change regimen. The delivery context, not just the content, is what makes these strategies tractable for everyday use.

In practical contexts, reinforcement may take many forms, including progress indicators, completion cues, visual feedback, or brief messages acknowledging task advancement. Digital applications, educational platforms, and behavioral intervention programs may benefit from incorporating such signals to highlight progress and reinforce engagement with effortful tasks, particularly when users are working on self-directed or long-term projects (Eckert et al., 2016; Rozental et al., 2018b). When combined with task-structuring strategies, these reinforcement mechanisms may help sustain effort across longer periods of work and across repeated opportunities to engage with challenging activities.

This view is consistent with Fiorella's (2020) argument that the science of habit holds substantial untapped promise for supporting student self-regulation, particularly through interventions that embed repeated reinforcement of effortful behavior within everyday academic routines.

A fourth practical implication concerns the potential for state-level interventions to produce cumulative trait-level change over time. Personality process perspectives propose that stable dispositional tendencies emerge through the accumulation of repeated state-level enactments across everyday contexts (Fleeson, 2001; Fleeson & Jayawickreme, 2015; Wrzus & Roberts, 2017). Applied to procrastination, this suggests that an effective route to reducing trait procrastination may be to increase the frequency with which individuals experience its opposite at the state level—that is, to repeatedly shift them from momentary avoidance into momentary effortful engagement. If each successful state-level intervention transforms an instance of state procrastination into an instance of state industriousness, accumulating such instances across time may gradually shift the underlying trait. Empirical support for this general logic comes from research on volitional personality change, which has shown that deliberately increasing the frequency of targeted state-level behaviors can produce measurable shifts in self-reported traits over periods of weeks to months (Hudson et al., 2019; Wrzus & Roberts, 2017). This hypothesis is directly testable using the methods developed in this dissertation: a long-term intervention study could administer state-level effort-reinforcement procedures repeatedly across weeks or months and track whether changes in trait-level procrastination emerge over time—and whether the rate of change is mediated by the frequency with which state procrastination is successfully interrupted. Such a finding would not only validate the practical value of the present intervention approach but would also provide a mechanistic account of how state-level change translates into enduring behavioral difference.

The state-to-trait pathway described above also suggests that the most effective deployment of these principles may be in platforms capable of delivering repeated, brief

state-level interventions across everyday life. The Dawdle app (Garg, 2024) is an anti-procrastination application designed around the core mechanisms identified in the present research. The app incorporates an AI chatbot trained on procrastination research that helps users engage in cognitive reframing and task decomposition when they are actively avoiding a task—directly instantiating the appraisal-alteration mechanisms tested in Study 1. A central feature is a focus timer that allows users to select a task, specify the duration of their work session, and choose a small, self-selected reward for completing it—such as a brief walk or a sip of coffee. During the timer, all other phone applications are blocked to reduce competing reinforcement from alternative activities. Upon completion, the user is congratulated by an animated AI mascot and offered a choice: claim the pre-selected reward, or begin the next task. This design mirrors the learned industriousness paradigm directly: repeated pairing of effortful engagement with positive outcomes is intended to increase the motivational value of effort itself. The choice to continue to the next task, rather than claiming the external reward, is interpreted as a behavioral indicator that effort is becoming intrinsically rewarding—consistent with the prediction from learned industriousness that effort can function as a secondary reinforcer. The app also incorporates a streak feature for completing at least five minutes of focused work daily, targeting the longitudinal reinforcement accumulation examined in Study 3. Together, these features operationalize the intervention components examined across all three studies in a single, scalable consumer platform. The present dissertation and associated empirical work provide scientific grounding for the app’s theoretical underpinnings, and the Dawdle platform offers a naturalistic setting in which the state-to-trait change hypothesis described above could be tested at scale.

Taken together, these practical implications suggest that effective approaches to reducing procrastination may benefit from focusing not only on changing individuals' long-term dispositions but also on shaping the immediate environments in which task decisions and effortful activity occur. By designing systems that support task initiation, structure effort into manageable units, and reinforce progress during engagement, practitioners, educators, and designers may be able to create contexts that make productive action more likely in everyday settings (Rozenal et al., 2018b; Sirois & Pychyl, 2013).

Limitations

Although the present dissertation provides new insights into mechanisms that influence task initiation and engagement, several limitations should be considered when interpreting the findings.

A first limitation concerns the scope of procrastination processes examined in the present studies. The interventions tested here primarily targeted the moment of task initiation and early engagement with effortful tasks. While these moments represent critical decision points in procrastination, procrastination can also involve additional processes such as long-term planning failures, time misestimation, and conflicts between competing goals. The present findings therefore speak most directly to mechanisms operating at the point of action rather than to all factors that contribute to procrastination across extended time horizons.

A second limitation concerns the form of reinforcement implemented in the present studies. In Studies 2 and 3, reinforcement consisted primarily of informational feedback and progress signals associated with completing subtasks. Although these cues were sufficient to influence engagement and persistence, they represent only one form of reinforcement that may shape effort-related behavior. In real-world contexts, reinforcement may also take the

form of social recognition, performance evaluations, deadlines, or tangible rewards. Future research could examine how different types and intensities of reinforcement interact with task structure to influence procrastination-related behavior.

A third limitation involves the reliance on self-report measures for key constructs in some parts of the dissertation. Study 1, in particular, focused on task appraisals and readiness to begin without directly observing subsequent behavior on the target task. Although these measures provide valuable insight into perceived task utility, aversion, and intention, they may not fully capture how individuals behave when facing competing demands or distractions outside the experimental context. Later studies in the dissertation addressed this limitation by incorporating behavioral indicators, but future work could further strengthen inferences by combining self-report, behavioral, and possibly physiological or passive-sensing measures within the same designs.

A fourth limitation concerns the specificity and duration of the interventions examined. The brief strategies tested in Study 1 and the subtask-plus-reinforcement procedures in Studies 2 and 3 were designed for relatively specific contexts, such as a single procrastinated task during a work session or weekly readings in a particular course. Although Study 3 followed participants across an academic quarter, it remains unclear how long the observed changes in engagement would persist once the intervention is removed, whether effects would generalize to other tasks, or whether repeated exposure might eventually produce diminishing returns. Long-term follow-up studies and designs that track behavior across multiple courses or life domains would help clarify the durability and generalizability of these intervention effects.

Finally, the theory of learned procrastination proposed in this dissertation represents a conceptual extension of the present findings rather than a model that has been directly tested experimentally. Although the studies demonstrate that reinforcing effort can influence engagement across repeated opportunities to act, they did not directly manipulate reinforcement contingencies associated with avoidance behavior itself. As a result, the theory of learned procrastination should be viewed as a framework for integrating motivational and reinforcement perspectives that requires further empirical examination.

Taken together, these limitations suggest that the present findings should be interpreted as identifying mechanisms that influence specific phases of procrastination—particularly task initiation and early engagement—while leaving important questions about long-term reinforcement processes, measurement approaches, and the durability of intervention effects open for future investigation.

Future Directions

The present findings open several promising directions for future research on procrastination, particularly in relation to habit formation, reinforcement mechanisms, individual differences, and the scaling of behavioral interventions.

A first avenue for future work involves examining the role of reinforcement processes in the development of longer-term procrastination habits. The current dissertation suggests that reinforcing effortful engagement can influence behavior across repeated opportunities to act, as demonstrated in increased reading completion over an academic quarter in Study 3. Longitudinal research is needed to determine whether similar reinforcement structures can produce durable changes in procrastination tendencies over months or years, and whether effects extend beyond the specific tasks or domains targeted by the intervention. Integrating

this work with habit-formation and automaticity frameworks (e.g., Verplanken, 2006; Wood & Neal, 2007) could clarify how repeated experiences of reinforced effort contribute to the emergence—or attenuation—of trait-like procrastination patterns.

A second direction concerns the mechanisms through which reinforcement and task structure influence motivation and effort-based decision making. Research in cognitive and affective neuroscience has linked effort valuation and delay-related decisions to neural systems involved in reward processing and cognitive control (e.g., Botvinick & Braver, 2015; Kool & Botvinick, 2018). Future studies could examine whether interventions that reinforce effortful engagement or structure tasks into subtasks influence neural markers of effort valuation, reward sensitivity, or control allocation during procrastination-relevant decisions. Combining behavioral interventions with neuroimaging, psychophysiological measures, or computational modeling of cost–benefit integration may provide a deeper mechanistic understanding of how these strategies alter individuals’ willingness to engage with effortful tasks.

A third promising area for future research involves examining individual differences in responsiveness to procrastination interventions. Prior work suggests that traits such as procrastination, conscientiousness, impulsivity, and emotion regulation difficulties are associated with variability in delay behavior and response to intervention (e.g., Rozental et al., 2018a; Sirois & Pychyl, 2013; Steel, 2007). Not all individuals may benefit equally from strategies such as subtask structuring, affect labeling, or reinforcement-based feedback. Future studies could systematically test moderators—such as baseline trait procrastination, self-control, temporal discounting, or emotion regulation abilities—to identify which individuals benefit most from particular components. Such work would support more

personalized or adaptive intervention approaches, where intervention content is tailored to individual profiles or dynamically adjusted based on ongoing response.

Future research may also explore how the mechanisms identified in the present dissertation can be implemented and evaluated at larger scales. Digital platforms, educational technologies, and workplace productivity systems offer opportunities to embed behavioral interventions directly within environments where procrastination frequently occurs (e.g., Eckert et al., 2016; Rozental et al., 2018b). Building on the mobile platform used in Study 3, scalable systems could deliver real-time prompts that support task initiation, assist users in decomposing complex tasks into manageable subtasks, and provide immediate feedback or progress signals that reinforce ongoing engagement. Large-scale field trials and A/B tests in educational or organizational settings would be valuable for assessing effectiveness, user engagement, and long-term impact under real-world conditions, as well as for examining potential unintended consequences such as overreliance on external reinforcement.

Finally, the multi-session and crossover designs proposed in the Theoretical Contributions section provide concrete starting points for directly testing the learned procrastination framework, and the Dawdle platform offers a naturalistic setting in which the state-to-trait change hypothesis could be examined at scale. Together, these converging lines of inquiry have the potential to advance a more comprehensive, mechanistic account of how procrastination develops, persists, and changes over time.

Conclusion

Procrastination is often framed as a failure of self-control or a reflection of stable personality differences. While these perspectives capture important aspects of the

phenomenon, the present dissertation suggests that procrastination may also be understood as a dynamic behavioral pattern shaped by momentary evaluations and reinforcement processes.

Across three studies, the findings demonstrate that brief interventions can influence how individuals evaluate effortful tasks, increase their readiness to begin working, and sustain engagement once effort has started. Structuring tasks into concrete subtasks appears to facilitate initiation by reducing perceived barriers to action, whereas reinforcing effort during task engagement can increase individuals' willingness to persist. Over repeated opportunities to act, such reinforcement structures may influence broader patterns of engagement with effortful tasks.

These results suggest that procrastination may not solely reflect a deficit in motivation or self-regulation, but may also be understood—speculatively—as a pattern potentially shaped by reinforcement histories in which avoidance has been repeatedly followed by relief. Importantly, what the present findings demonstrate directly is the obverse: that effort, too, can acquire motivational value when systematically paired with positive outcomes, and that this shift can occur at the state level within brief experimental windows.

What this capacity to shift effort valuation at the state level means for intervention is the dissertation's most consequential implication. A central contribution of this dissertation is the demonstration that procrastination can be meaningfully studied and altered at the state level—at the precise moment when an individual decides whether to engage or delay. This state-level focus is both a theoretical commitment and a practical strategy. Theoretically, it locates the mechanisms of procrastination not in stable personality structures alone, but in the dynamic, moment-to-moment interplay between task demands, emotional responses, and reinforcement history. Practically, it opens the possibility of brief, scalable interventions that

operate at the point of action rather than requiring sustained behavior change programs.

Across the three studies, the consistent finding was that even small changes in how tasks were structured, appraised, or reinforced at the state level were sufficient to shift behavior—without requiring measurable change in trait procrastination. This suggests that the state is not merely a symptom of the trait, but an active site of change in its own right.

Understanding procrastination therefore requires not only examining why individuals avoid effort in the moment, but also recognizing that the moment itself is where intervention is most tractable. Patterns of engagement and avoidance are reinforced across repeated encounters with effortful tasks—and each of those encounters is a state. By intervening at the level of state procrastination, the present research suggests that the path from chronic delay to sustained engagement may begin not with a change in who someone is, but with a change in what happens in a single moment of decision. If those moments can be reliably shifted, accumulated across time and context, the state may gradually become the trait.

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