Code Today, Deadline Tomorrow: Procrastination Among Software Developers

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***Abstract*—Procrastination, the action of delaying or postponing something, is a well-known phenomenon that is relatable to all. While it has been studied in academic settings, little is known about why software developers procrastinate. How does it affect their work? How can developers manage procrastination?**

This paper presents the first investigation of procrastination among developers. We conduct an interview study with (n=15) developers across different industries to understand the process of procrastination. Using qualitative coding, we report the positive and negative effects of procrastination and factors that triggered procrastination, as perceived by participants. We validate our findings using member checking. Our results reveal 14 negative effects of procrastination on developer productivity. However, participants also reported eight positive effects, four impacting their satisfaction. We also found that participants reported three categories of factors that trigger procrastination: task-related, personal, and external. Finally, we present 19 techniques reported by our participants and studies in other domains that can help developers mitigate the impacts of procrastination. These techniques focus on raising awareness and task focus, help with task planning, and provide pathways to generate team support as a mitigation means. Based on these findings, we discuss interventions for developers and recommendations for tool building to reduce procrastination. Our paper shows that procrastination has unique effects and factors among developers compared to other populations.

***Index Terms*—Developer Experience, Procrastination, Productivity**

I. Introduction

Procrastination, delaying tasks until later, is relatable to most of us. Psychologists [1]–[3] and neuroscientists [4] have explored how procrastination manifests, presenting various perspectives on procrastination. While Steel defines procrastination as "a voluntary delay of an intended course of action despite expecting to be worse off for the delay," [5], Wolters et al. frames it as a failure of self-regulatory behavior towards a desired goal [6]. This psychological phenomenon has been studied mostly in an academic setting, where studies report 80 to 95% of college students occasionally procrastinate [5] and 25–50% of college students chronically procrastinate [7], [8]. Studies also report the various impacts of procrastination among students, such as higher stress and depression [9] as well as lower grades and performance [10]. While there have been anecdotal reports from software developers on procrastination and how to overcome the related challenges [11], [12], procrastination among software developers has not been studied in detail. Software development is a unique and important area to explore procrastination. Developers often work long hours on abstract and complex tasks that require high focus, which puts high cognitive load and stress on developers, enabling procrastination. Development tasks involve frequent collaboration among people with varying interests and skills, and doing so towards building and maintaining massive intertwined software systems, procrastination by one can affect all others and the product.

Understanding procrastination in software developers is important as it might affects developers' productivity, mental health, and well-being, as well as the software produced by these developers. It is becoming increasingly important to study human aspects of software development such as happiness [13], work-life balance [14], burnout [15], [16], and ADHD [17] in the face of high pace development under immense pressure of job security and uncertainty posed by AI advances. The goal of this paper is to study the factors that instigate and the consequences of procrastination, and gather helpful strategies and techniques to mitigate the negative effects of this process while letting developers reap the positive effects. Our investigation involves asking three core questions:

RQ1 How does procrastination affect developer's work?
RQ2 What factors trigger developer's procrastination at work?
RQ3 How can developers manage procrastination?

Understanding the effects of procrastination (RQ1) on developers' work is the essential first step, as existing research in other domains shows both negative and positive outcomes but lacks exploration of its unique impacts on developers. Exploring the factors that trigger procrastination (RQ2) builds on this by examining factors specific to software development, as studies have shown that procrastination varies across work contexts [18]. Finally, RQ3 helps us to find actionable strategies and insights for the developers to mitigate procrastination.

To answer these questions, we conducted semi-structured interviews with 15 developers across seven industries. We validated our findings by member checking with the developers. Our participants identified various perceived negative effects of procrastination, but also point to some positive effects (Section IV). Procrastination has the highest negative impact on performance, affecting the quality of code and the ability of the team to deliver features on time. However, it also has some positive effects on satisfaction and well-being. Participants also identified several factors that trigger procrastination, which we categorized into three groups: task-related (e.g., vague tasks can lead to procrastination), personal

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(e.g., the mental and physical state of developer), and external (e.g., communication issues with team members) (Section V). Finally, we discuss 19 mitigation strategies that help with procrastination (Section VI), 14 that are reported by our participants, and 12 identified by other disciplines like behavioral science and clinical psychology (including overlap). These include identifying triggers and approaching day-to-day tasks with a new perspective. Based on these findings, we discuss how developers can apply these mitigation strategies, how tool builders can assist in managing procrastination, and the productivity implications of procrastination on developers.

II. Related Work

A. Developer's work-life

The demanding nature of software development has prompted extensive studies on developers' health and work-life balance. Research highlights the importance of developers' mental state and happiness [13], [19], [20]. Graziotin et al. found that unhappiness negatively affects the development process and outcomes [21]. Benlian [22] reported that agile practices, while human-centric, can lead to fatigue and reduced well-being. Sarkar et al. [23] revealed severe (66%) and frequent (59%) fatigue among developers. Liebel et al. [17] studied ADHD among engineers and proposed workplace recommendations. Similar to ADHD and burnout [15], [16], procrastination also impacts well-being but remains unexplored in software development.

B. Procrastination in other domains

Even though procrastination in software development has not been studied, academic procrastination among students has been well-researched [24], [25]. A study by Zer et al. [26] among university students found that procrastination decreases life satisfaction. However, Hen et al. [27] discovered that while academic procrastinators desire to change their habits, they do not report significant feelings of discomfort when procrastinating. Although research indicates that procrastination generally reduces academic success, the findings differ for academic staff. Asio [28] noted that academic staff members often procrastinate, but this behavior does not negatively correlate with their productivity at work. Verešová [29] found stress teachers experience is highly related to procrastination. A study by Liu et al. [30] on full-time employees in multinational corporations revealed that life satisfaction, age, and parental status are predictive factors of procrastination.

Literature often discusses two types of procrastination. Active procrastination is intentionally delaying a task, especially when deadline pressure causes satisfaction [31]. Whereas passive procrastination is an unintentional delay that leads to negative effects like reduced productivity [31]. In this paper, we explore both types of procrastination among software developers. We will identify its effects, contributing factors, different types, and potential mitigation strategies.

III. Methodology

We conducted a qualitative study and collected data from 15 professional developers through semi-structured interviews. We then analyzed the data using qualitative coding and validated our findings by member-checking with the participants. It is important to note that our findings are based on participants' perceived effects and the factors that trigger this behavior.

A. Identifying List of Factors from Literature

We reviewed recent literature on procrastination, focusing on its definitions and influencing factors in computer science and psychology. Searches were conducted in ACM Digital Library, PsycINFO, and Google Scholar using keywords related to "procrastination," "factors," and "definitions." We included English-language articles from the past ten years, published in high-quality venues, and relevant keywords in the title and abstract. A forward and backward citation search was also performed. We reviewed 29 papers on the definition of procrastination and seven on factors. Based on the categorization by Nickdoost et al. [32], we grouped the literature factors into (1) Task characteristics: Task Interest Level [3], Unclear task [3], [32], Task Workload [32], Task Urgency [3], Skill Proficiency [3], (2) Internal: Mental State [33], Physical State [3], [32], Fear of Failure [33], Other Obligations [3] , (3) External: Distractions [33]. Additionally, two researchers identified new factors (task ambiguity, importance and learning requirements) that they hypothesized to trigger procrastination in software development.

B. Semi-structured interviews

We conducted 90-minute online interviews to gather data on participants' procrastination habits and insights. These sessions were recorded, transcribed, and de-identified. Participants completed a screening survey on demographics, attention disorders (e.g., ADHD), and procrastination factors. Participants received a $60 USD Amazon gift card as compensation.

Interview Design: Given that procrastination extends beyond work life, the interviewer reminded participants to focus on their role as developers. Participants were assured of confidentiality, and consent for audio recording was obtained. Initial questions aimed to understand the participant's work, role as a developer, typical project timelines, motivation, and the impact of deadlines. In the core section, participants were first asked to define procrastination using real-life examples. Concepts of active and passive procrastination from the literature [34] were introduced, and participants reflected on these types. Then, using the obtained list of factors from III-A, we asked participants whether these factors affect their procrastination at work,defining it as "putting off work until a later time" for clarity. The interview concluded with a summary of participants' overall perception of their procrastination habits and any mitigation techniques they had attempted (all questions in supplementary [35]). Some main questions are shown below:

> How do you define procrastination in the context of work as a developer?
> What makes you choose active procrastination?
> What type of tasks are you more likely to procrastinate on?

TABLE I
PARTICIPANT DEMOGRAPHIC INFORMATION

Pt	Age	Job Title	Exp	Work Setting	Industry
P1	24	SW Dev Intern	3-6	Hybrid	Software
P2	23	SW Engineer	3-6	In-person	Marketing
P3	35	SW Engineer	6+	Remote	Software
P4	40	Eng Manager	6+	Remote	Ins.
P5	30	SW Dev	3-6	Hybrid	Fin.
P6	31	Sr Res Engineer	6+	Remote	Software
P7	29	App. Scientist	3-6	In-person	E-commerce
P8	32	Sr Staff SW Eng	6+	Remote	Software
P9	28	Res Scientist	6+	Hybrid	A&E
P10	40	Data Engineer	3-6	Hybrid	A&E
P11	30	SW Engineer	6+	In-person	Software
P12	38	Data Eng. Manager	3-6	In-person	A&E
P13	26	Data Engineer	3-6	Hybrid	A&E
P14	26	Data Engineer	3-6	Hybrid	Fin.
P15	37	Applied Scientist	6+	Hybrid	Software

Pt: Participant Id, EXP: Years of experience, Ins.: Insurance Technology, Fin.: Personal Finance, A&E: Automotive & Energy

How does procrastination affect your productivity?
Have you ever attempted to overcome procrastination?

The interview questions and recruitment strategies were approved by the university's Institutional Review Board (IRB).

Participants: We recruited 15 participants (4 women, 11 men) strategically for a balanced gender, experience, work settings, and industry distribution, as these factors have been associated with procrastination [36]–[38]. In our study, we recruited developers from different roles that are involved in the development lifecycle and not just programming. They were recruited via convenience and snowball sampling. Table I lists details of the participants, average age was 31 years, eight participants had 3–6 years of software development experience, and seven had > 6 years. Our exclusion criteria eliminated participants with self-reported cognitive disorders and those with < 3 years of experience, as we posit they may have confounding factors driving their procrastination.

C. Data Analysis

1) Open Coding: One researcher de-identified and cleaned the transcript after each interview, and two researchers coded them using the open-coding method with no prior codes or factors. Two researchers updated the codebook after analyzing each interview. For example, in one instance, P4 mentioned, "Let's start on the negative side. I think other people are kind of waiting for you; if the other team is waiting for you to do something." This response was coded as *causing dependency*; during thematic analysis, this was categorized under negative effects, as the participant emphasized the negative aspect of their experience. To check the reliability of codes, two researchers performed IRR through multiple rounds of coding on randomly selected units of transcription until they reached an agreement of $\kappa = 0.88$ ($p = 1.13e{-}05$). Due to limited data availability, we coded one participant at a time. To mitigate this limitation, we performed subsequent rounds of IRR on units of transcripts randomly selected from participants, in all subsequent rounds we reach a $\kappa > 0.8$. After the 15th interview, we noticed that we reached data saturation as no new information or themes emerged from the interview.

2) Analysis: To address the research questions, the researcher used inductive thematic analysis [39] with open coding (inductive coding), followed by axial coding to identify the themes [40], [41]. IRR is used in the open coding step of thematic analysis to rigorously generate reliable codes [42], which combats interpretability bias in inductive coding. We only used IRR for the open inductive coding step of thematic analysis [43] and didn't use IRR in the theme generation step (Codebooks and themes in supplementary [35]).

It is worth mentioning that differentiating between prioritization and procrastination can be challenging, as both involve decisions about task management and timing. However, they stem from different motivations and lead to different outcomes. During detailed interviews, we were able to recognize participants' motivations and clearly distinguish these two behaviors.

RQ1: To answer RQ1, we looked into how literature defines various dimensions of a developer's work life. Previous studies have shown that factors such as mental health and productivity significantly impact developers' work-life [44], [45]. Building on this research, we examined the effects of procrastination on five dimensions of work crucial to software development adopted from the SPACE framework [46]: developers' satisfaction and overall well-being, activity, communication and collaboration, performance, and efficiency and flow (SPACE).

We conducted a qualitative analysis and found 50 codes representing the impact of procrastination on developers' work lives: 31 codes (62%) indicated negative effects, and 19 codes (38%) indicated positive effects. Two researchers then grouped these codes into five dimensions through axial coding. In the second round, the researchers independently analyzed the 31 negative effects, merging similar effects to finalize 15 distinct effects. For example, codes like *guilt*, *self-loathing*, *shame*, and *disappointment* were combined into *emotional distress*.

Similarly, two researchers performed independent axial coding on 19 positive effects and reached eight final themes for positive effects. For instance, the *chance to explore* and *alternative solution* merged into *finding better ideas* because both these codes indicated procrastination give a chance to find a better solution by exploring other options.

RQ2: To answer RQ2, as a result of open coding, we identified 37 codes from interviews representing factors that triggered participants' procrastination. Then, two researchers performed axial coding on the 37 codes and came to 18 thematic codes presenting various factors of procrastination. Further, two researchers categorized these factors into three groups: Task-related, Personal, and External factors.

RQ3: To find the mitigation techniques, two researchers coded participants responses to our mitigation strategy questions and identified 19 codes. Researchers merged techniques with similar contexts and agreed on the final 14 techniques.

3) Validation: After conducting the qualitative analysis, we performed member checking with our participants. Our initial

findings on the effects and factors of procrastination, as well as the types of procrastination, were sent to the participants for feedback. All participants agreed with the results, and seven participants responded with additional positive feedback, stating they found our results insightful (see supplementary [35]).

IV. How does procrastination affect Work?

In the interviews, participants elaborated on their understanding of procrastination and its positive and negative effects on their work. In this section, we discussed the effects in detail; negative effects are indicated with ✖, and positives with ✔.

A. Negative effects of procrastination on participants's work

We examine the negative effects of procrastination, which were discussed in the interviews. Table II lists 15 negative effects with definitions and examples. The *Pts* column uses a dot plot to show which participants mentioned each effect: the first row represents P1-P5, the second row P6-P10, and the third row P11-P15. The *Freq* column shows the total mentions per effect, e.g., ✖*Personal Life Disruption* was cited six times by P2 and P5. Effects are grouped into five work dimensions, indicated by row separators. We discuss the negative impact of procrastination for each dimension.

Satisfaction & Well-being. All participants mentioned suffering from ✖*Emotional Distress* stemming from a nagging discomfort [P8,10,11], *"personal disappointment"* [P3], *"guilt"* [P9,15], or *"frustration"* [P12]. Beyond the impact on personal values, P11 mentioned feeling *"social shame"* that impacted their perception of how others judge them: "I don't know where shame is coming from other than my sense of feeling I should be doing this and not being able to fulfill that."

10 participants experienced high levels of ✖*Anxiety & Stress* due to procrastination. Seven participants [P1-3,9,10,12,13] reported it led to experiencing a *"huge amount of stress"* [P3] due to *"not starting the task sooner"* [P13]. P2 mentioned, *"It could be stressful, like coming up to the deadline for the thing that you're procrastinating [on]. It was a lot."* Stress and anxiety created a downward spiral, intensifying each other and ultimately causing not being able to finish the task [P3,6]. Three participants [P2,4,5] mentioned frequent procrastination at work could convert to the habit of delaying things, and over time, it reduced their ✖*Work-life Balance*. P2 said,

> *"If you're delaying stuff enough and you're doing it too often, then you just kind of become lackadaisical."*

Performance. 13 out of 15 participants mentioned four negative effects of procrastination on the performance dimension. 13 participants mentioned that procrastination caused ✖*reduced individual performance* at work for writing low-quality code [P1-4,6-9,13,15] or delayed delivery [P2-4,6-9,13,15]. Further, six participants directly associated procrastination with reduced performance evaluation ratings [P1,7,9,10,11,15]. P2 explained the relation between procrastination and performance, stating:

> *"I think [procrastination] affects the quality. And that, in turn, affects productivity. Because if something has less quality, I'll have to work more on it."*

Seven participants [P3-5,7,9,13,14] reported procrastination caused ✖*more technical debt* through delays and unresolved dependencies, hindering *"test[ing] or other dependent tasks"* [P5,7,9] and leaving issues unresolved [P13,14]. Eight participants highlighted procrastination's role in ✖*team performance degradation*. Three participants [P3,7,12] described how one member's procrastination delayed team tasks, negatively impacting the team or business [P2]. P4, a manager, shared that procrastination in some team members caused the whole team to wait to *"give [them] feedback on the designs"* for subsequent tasks. Participants who experienced these delays shared that the team *"has to work a lot harder to finish the task"* [P10,15] to avoid missing a deliverable and eventually *"hurting the image of the team,"* [P12] in other's perception. Five participants reported that procrastination at work results in ✖*missed deadlines*. Participants emphasized the notion that procrastination created a chain of delays, where subsequent tasks and overall projects *"become late"* [P1,2,5] or *"aren't going to be met!"* [P1,9,10]. P11 summarized the effect of procrastination on performance, stating, *"You hear of people getting lower ratings for not having a significant impact through the year [which] might be a direct result of procrastinating on important projects."*

Activity. Seven participants directly linked their procrastination to ✖*producing less code*. Eventually, they didn't have enough time to implement everything necessary for the task, writing fewer *"lines of code they committed"* [P3,5,6]. Participants noted that this resulted in *"finishing fewer features"* [P8] or *"not completing the number of story points"* [P10] they committed to. Beyond these, procrastination affects team activities like code reviews. P9 explained in this:

> *"If you're procrastinating on reviewing someone's code, you're not leaving a lot of comments."*

P11 associated procrastination with *"all the [tasks] that didn't get done,"* resulting in reduced activity.

Communication & Collaboration. 14 participants noted that procrastination✖*strained team culture* [P2,9,12] and created a negative social reputation [P2,4,9,13,14] for the procrastinator, which all generates an obstacle in having effective and good communication [P1-15] with team members or reduced collaboration opportunities with other teams [P2-4,7,9]. Participants further linked procrastination to lowered quality of team communication due to causing stress [P2,6], inconsistent update [P4]. P2 elaborated as *"[she's] going to be communicating better if [she's] not as stressed because of procrastination "*. Delayed delivery of a task, or waiting until the last minute, can cause ✖*weakening of trust* between coworkers [P4,10,12]. P4 shared:

> *"I know from now on this person is going to take longer to get back on something."*

P12 shared how he felt*"people lose trust"* in his contributions when he *"procrastinates during a collaboration."*

Efficiency & Flow. 14 participants mentioned negative effects on their efficiency and flow. Nine participants cited the need to make a ✖*compensatory effort* for delays caused by procrastination. When participants' procrastination made them

TABLE II
NEGATIVE EFFECTS (✖) OF PROCRASTINATION, GROUPED INTO FIVE DIMENSIONS OF WORK.

Negative Effect	Definition	Example	Pts	Freq
SATISFACTION & WELL-BEING				
Emotional Distress	Experiencing feelings of guilt, shame, frustration, and dissatisfaction.	"I generally don't feel good if I miss a deadline and knowing that I do my best to meet them." [P5]		38
Anxiety & Stress	Increased levels of anxiety and stress resulting from close deadlines and incomplete tasks.	"The negative effect is that I feel more anxious, so the increase the level of anxiety." [P6]		18
Lower Work-life Balance	Negative repercussions on personal life manifesting as poor work-life balance.	"The effect is on me especially and as regards my personal life." [P5]		6
PERFORMANCE				
Reduced Indiv. Performance	Lower individual performance such as low-quality code and performance ratings.	"You know, it's kind of like becomes a performance issue, and that person is going to have a lower performance." [P4]		60
More Technical Debt	Creating unresolved issues or dependencies that complicate future project stages.	"In that situation, I think it is a dependency, and things are getting left behind." [P14]		14
Reduced Team Performance	The aggregated impact on team performance and morale when individual delays affect group projects.	"There are some consequences for the team and the business." [P7]		6
Missed Deadlines	Direct outcomes of procrastination lead to delayed deliverables and failure to meet deadlines.	"Effect is the delay on the deliverable. The one thing that everything becomes late" [P1]		7
ACTIVITY				
Less Produced Code	Reduced number of delivered code or features that need to be delivered by the deadline.	"Sometimes I produce less code, finish fewer features." [P8]		10
COMMUNICATION & COLLABORATION				
Strained Team Culture	Strained relationships and disrupted team dynamics due to inconsistent task completion and delay in delivery.	"Procrastinating and not getting anything done for no reason or multiple times in a row is definitely going to affect their image and reputation particularly." [P13]		34
Weakening of Trust	Destruction of trust among team members and supervisors due to recurrent procrastination.	"Trust also gets a little hurt." [P12]		5
EFFICIENCY & FLOW				
Compensatory Effort	The necessity to make additional efforts to compensate for delays caused by procrastination.	"And you wind up pulling late nights and working extra hours, and the whole process is not particularly fun." [P8]		15
Workflow Disruption	Breaks or interruptions in the flow of work due to delaying tasks.	"If I delay it, it might interrupt something else that I have to do" [P2]		15
Cascading Delays	A cascading effect where initial delays lead to further delay in the project timeline.	"If I'm procrastinating and I can't finish the task, then that story has to get moved to the next sprint" [P10]		9
Financial Implications	Increased cost allocation to tackle missed deadlines.	"...because this deadline was missed. We missed this many millions of dollars in hypothetical revenue" [P11]		7

inefficient, spending less time than needed on a task during work hours, they had to spend their non-work time to meet the deadline. Participants had to *"put in all-nighters"* [P1,8], *"stay up later at work with coworkers"* [P2], and *"stay at work after 5 pm"* [P7,9,10,13]. P12 indicated that compensation for the delay was at the expense of his personal time as well.

Nine participants shared how procrastination caused ✖*workflow disruption*. Some participants reported that procrastination interrupted their flow [P1,2,5], while others shared how procrastination eventually prolonged the flow by *"making more work for later"* [P7,10,14]. P11 shared his struggles with maintaining flow due to procrastination:

> *"I'm missing out on not sustaining tasks for an hour or two hours at a time."*

Five participants found procrastination caused ✖*cascading of delays* throughout the project [P1,6]. Participants mentioned that delaying one task creates a *"domino effect of delays"* [P9], and sometimes *"the [task] gets moved to the next sprint."* [P10] This decreases the efficiency of the sprint and overall project progress. Four participants shared that procrastination caused ✖*negative financial implications*, including missed deadlines leading to *"financial consequences"* [P1], and *"less revenue"* for the organization [P7,8,11].

B. Positive effects of procrastination on work.

Table III lists the eight positive effects of procrastination, along with their definition and examples. Here, we discuss the positive of procrastination along each dimension.

Satisfaction & Well-being. Overall, 12 out of 15 participants mentioned one of the positive effects in this dimension.Eight participants reported improvement in their mental state when they procrastinated by ✔*taking breaks*. Taking breaks helped to *"avoid burnouts"* [P1,5,15] caused by complex and long-term projects. It also improved their mood [P7], brought happiness, and refreshed their mind [P12]. P11 summarized this effect, stating:

> *"taking a step away from this and delaying your work on it can actually allow you to come back with a fresh mindset."*

Four participants found procrastination beneficial when used as a ✔*short term stress relief* technique. Participants highlighted the role of following the *"immediate feelings and impulses to procrastinate"* [P7] in increasing their *"overall satisfaction and well-being."* When faced with stressful scenarios

TABLE III
POSITIVE EFFECTS (✔) OF PROCRASTINATION, GROUPED INTO FIVE DIMENSIONS OF WORK.

Positive Effect	Definition	Example	Pts	Freq.
SATISFACTION & WELL-BEING				
Taking Breaks	Mental and Physical recovery due to long tasks.	"Maybe I'll have a better day of working if we stay like an extra couple minutes at lunch" [P2]		18
Short Term Stress Relief	Temporary relief from stress through brief avoidance of the task.	"I have noticed the benefits would probably be more of a de-stressing kind of tool . . . short-term de-stressing." [P5]		13
Time for Personal Tasks	Completing personal responsibilities contributing to a better work-life balance.	"Meanwhile, someone else is doing the work. So, I'm procrastinating. But, like, I'm benefiting from it indirectly." [P1]		4
Increased Confidence	Enhanced self-confidence by managing delayed tasks in a short time near the deadline.	"You get to realize how, like, how good you are at working things really quickly." [P1]		3
PERFORMANCE				
Better Creativity	Having more time for reflection, exploration and generating ideas.	"During an eight-hour day, aside from a lunch break, taking a five to ten-minute break every hour can be very beneficial." [P7]		9
ACTIVITY				
Avoiding Unnecessary Work	Delays in addressing a task leads to the issue resolving itself, saving effort and resources.	"Somebody makes a decision that overrides what you were going to build anyway, where there's unstable decision making in a company like that can resolve itself." [P4]		8
COMMUNICATION & COLLABORATION				
Socializing at Work	Engaging in conversations, and building relationships at work.	"If we are really talking about interesting topics and to me, that is kind of procrastination for work that needs to get done." [P12]		4
EFFICIENCY & FLOW				
Near-deadline Efficiency	Increased short-term efficiency close to the deadline.	"Definitely, if there is a deadline, it's gonna be peak efficiency." [P13]		14

or complex tasks, participants delay starting the task to gain short-term happiness [P2,5,11]. However, they noted that *"in the long term [procrastination] probably won't be good"* as it *"decreases productivity"* [P2], with P7 acknowledging initial comfort turning into frustration as deadlines loomed and tasks remained incomplete. Three participants stated procrastination helped them to *"focus on [non-development] tasks."* [P1] and have time [P14] for *"equally important things from the personal side,"* even at the expense of delaying the task at work [P3]. Two participants claimed *"doing a task in a short amount of time"* [P1,15] gives them some *"self-confidence"* [P15] of being *"capable of doing the task."* [P1]

Performance. Five participants mentioned the positive impact of procrastination on their performance at work. Five participants credited procrastination with ✔*Better Creativity* for their problem or solution approach [P2,3,6]. Participants found procrastinating on a task earned them *"more time to think a lot about [the task] before actually writing the code"* [P2] and *"explore other ideas"* [P6]. Participants also shared that procrastinating by switching to a familiar task triggered a novel solution in their minds [P7,10]. P10 illustrated:

> *"[he's] working on task A, in the back of [his] brain, [he's] thinking, maybe [he] could do task B like this, like this, and [he] already sort of [has] an idea!""*

Activity. Five participants recognized that procrastination helps to ✔*avoid unnecessary work* on tasks: they *"didn't actually need that feature"* [P2], *"the group solved the problem themselves"* [P10], or the task was *"no longer a big priority"* [P13]. Additionally, delaying tasks due to *"unstable decision-making"* [P4] or unclear project scope turned out to be beneficial, as it helped avoid *"redoing stuff"* [P6].

Communication & Collaboration. Three participants found procrastination increases ✔*socializing at work* [P5,9,12,16]. P15 elaborated *"If you're procrastinating and engaging in conversation with your coworkers, you're socializing and improving your social connections."* Participants found spending extra time during breaks to talk to team members or having lunch together helped *"build their network"* [P9] and have a *"super engaged"* [P12] team.

Efficiency & Flow. Eight participants experienced increased short-term ✔*near-deadline efficiency* as their deadlines approached [P1,7-9,11,13-15]. P7 explained when he procrastinated and *"[he is] near the deadline, [he] tries to be as efficient as possible; [he] spends more time on that."*

Summary: Our findings revealed that procrastination has both negative and positive effects. It negatively impacted developers' well-being, leading to lower performance, reduced code quality, and fewer delivered features. However, some participants highlighted benefits, such as enhanced creativity and near-deadline efficiency.

V. WHAT FACTORS TRIGGER PROCRASTINATION AT WORK?

To understand how we can mitigate the negative effects of procrastination while preserving positive ones, we need to first identify the factors that trigger procrastination. During the interview, participants identified and elaborated on new factors that triggered procrastination. From the qualitative analysis, we identified 22 distinct factors, which we grouped into three categories as shown in Table IV.

Task-Related factors. All participants noted that their ↯*interest in the task* influenced procrastination. Three par-

TABLE IV
PROCRASTINATION FACTORS WITH THEIR CATEGORIES*.

Category	Factors	Frequency
Task-Related	Task Interest Level (56×, 15P), **Subjective Importance** (35×, 13P), Task Difficulty Level (28×, 13P), Task Vagueness (30×, 12P), Task Complexity (22×, 9P), Skill Proficiency (17×, 7P), **Dependency on Others** (4×, 3P)	192
Personal	Mental State (18×, 12P), Physical State (12×, 11P), **Uncertainty** (18×, 9P), Fear of Failure (13×, 5P), Personal Responsibilities (4×, 4P), **Fear of Judgment** (6×, 5P), Deadline Pressure (6×, 3P)	77
External	Distractions (19×, 11P), **Work Relationships** (6×, 3P), **Task Hierarchy** (11×, 5P), **Communication Issues** (16×, 9P)	52

*The frequency of each factor during the interview and the number of participants is shown next to each factor in parenthesis with × and P deceptively; bolded factors reported by participants and are not found in the literature (Section III-A).

ticipants [P1,10,15] procrastinated more when they lacked interest or intrinsic motivation [P15], with P5 stating, *"I like coding more than writing, so I procrastinate less on coding."* Additionally, 13 participants procrastinated more on tasks they considered of low ϟ *subjective importance* or value [P1-4,6,8,9,11,12,15]. P13 observed, *"I've seen a pattern that if the task is not as important as they make it sound, then I tend to procrastinate sometimes."*

12 participants procrastinated differently based on ϟ *task difficulty*. Some participants procrastinated on easy tasks that they were confident they could finish quickly or had done before [P7,9]. Two participants mentioned they started working early on tasks they *"have not done before"* [P2] or are not good at [P8], as it was difficult to estimate how long the task would take. Whereas six participants mentioned that they procrastinated on both too-hard and too-easy tasks. P11 clarified, *"If the task is super easy or the task is super hard, I think I'm more likely to procrastinate it."* When a task was too easy, participants delayed working on it as they could make a *"good time estimation"* [P4,5] and were confident they could finish it in time [P4,13]. Whereas if the task was too difficult, they delayed it until another developer joined [P1] or they lost interest in the task [P11]. 12 participants mentioned ϟ *vagueness* in task definitions or project scope triggered procrastination. Participants specifically mentioned that committing to a task with *"undefined goals"* [P2,7] or *"unclear project scope"* [P6] is unwise. Participants tended to delay working on vague tasks until further information was provided [P3,15] as P15 indicated that:

> *"I was procrastinating and just waiting for other people to give me some guideline or instruction."*

Additionally, P12 highlighted vagueness is more prevalent in the initial phases of the project since "everything is not well-defined." Eight participants tended to procrastinate more on time-consuming [P3,5] and complex tasks that needed more effort, like *"reviewing the whole code base"* [P1] or *"finding more information on"* task [P10]. Five participants mentioned that whether they delayed a task was affected by their ϟ *skill proficiency*, e.g., the level of their knowledge of the task [P5] or skill [P8,9] in the task. P5 indicated that he found himself procrastinating more on tasks *"where [he has] little knowledge of what [he's] doing,"* while P15 procrastinated on tasks that did not align with her background. Four participants mentioned that the learning requirement was another factor; when the *"number of resources"* for learning [P1,7] was high, or the content was complex to learn [P1,2,14], they postponed it to a later time. 20% participants mentioned they procrastinate on a task that doesn't impact or help a lot of users [P10,12,13]. Additionally, procrastination in two participants depended on deadlines. For instance, P1 mentioned, *"because there are no fixed deadlines and no strict deadlines, then [he was] delaying stuff too"* [P1]. Another participant mentioned if the task had a *"faraway deadline,"* he had a safe feeling of *"still having more time until deadline"* that triggered him to delay [P5].

Three participants postponed tasks that had ϟ *dependencies on others* [P4,13,14]. As P13 explained, when *"[she] needs help from someone, [she] tends to delay just because it depends on somebody else."*

Personal factors. 13 participants noted distorted ϟ *mental state* gave rise to procrastination. Participants mentioned not being in the mood to do a task [P4,7,9-11,13,14] or having stress and anxiety [P5,11,12] provoked procrastination. P5 clarified that procrastination in such situations is *"the shutdown kind of procrastination. Like [he's] too stressed. [He] can't deal with this [task]"*. Compromised ϟ *physical health* was also noted by nine participants as procrastination factor. Sickness [P3,6,10,15] and fatigue [P2,13] set off procrastination as P13 explained,

> *"It's not a task I can do right now because I have had less sleep; I can't focus. So I tend to procrastinate."*

ϟ *Uncertainty* about how to approach a task also initiated procrastination for seven participants. The uncertainty stemmed from not knowing *"how to start the task"* [P1,10], *"how long it will take"* [P2,3], or when participants *"don't know what to do"* to finish the task [P4,6,13]. Five participants reported procrastinating due to ϟ *fear of failure* from missing deadlines [P5,10] or making mistakes [P6,11]. P1 noted, *"When [he] fears [he] may not accomplish [the task] right away, [he] leaves it for tomorrow and, like, the day after."* ϟ *Personal duties* like parenting [P3,4], personal crises [P12,14], and family time [P15] were also cited as factors by five participants. Four participants mentioned ϟ *fear of judgment* from colleagues as a trigger, such as concerns about being criticized for their knowledge [P2,14] or task performance [P2]. Surprisingly, four participants justified procrastinating until the deadline as they *"respond positively and well to* ϟ deadline pressure.*"* Participants intentionally procrastinated to create urgency [P9,11,14] as pressure brought a sense of *"enjoyment"* [P11] or *"fun to burn through and get it all done"* [P4].

External factors. 12 participants noted ϟ *distraction* form various sources prompted procrastination, like browsing on

social media platforms [P1,2,5,6,7,11,14], colleagues dropping by their desks [P1,2,5,9], and prolonged chat during lunch breaks [P2]. Additionally, participants found working remotely caused more distraction, hence more procrastination [P4,15]. ϟ *Relationship dynamics* among team members influenced nine participants' procrastination. Lack of compatible relationship between participants and team members [P10] or the manager [P14] increased the likelihood of procrastination. Participants elaborated more on this factor by indicating that conflicts over task implementation [P7-9] or task priority [P12] led to prolonged unclear projects [P6], which in turn increased procrastination [P3]. Five participants cited that ϟ *task hierarchy*, i.e., assigned by high-ranking individuals, were prioritized to avoid delaying critical work [P9,12,13] or to gain visibility from those individuals [P10,11]. P10 implied

> *"I'm more likely to procrastinate [on] something that gives me less visibility to leadership. So if a leader is more likely to notice the work that I did, I'm not going to procrastinate [on] that"."*

ϟ *Bad communication* with colleagues elicited procrastination in three participants. Participants mentioned that consistent direct communication prevented procrastination [P1,10]. P4 experienced less procrastination, in the office as he could easily go to talk to his colleagues about tasks.

Procrastination types. By clustering the factors that trigger procrastination, we identified three additional procrastination types that further refine active and passive procrastination.

Task Aversion. We observed that participants often engaged in procrastination when they were adverse to a task. This aversion could stem from several aspects of the task: lack of interest, the task's nature, perceived value, or lack of immediate rewards. *Task Avoidance.* Participants reported avoiding and delaying task due to overwhelming anxiety or fear of failure, driven by internal pressures affecting their mental state, rather than strategic or logical reasoning. *Strategic procrastination.* Participants also engaged in strategic procrastination, intentionally delaying tasks not due to distractions or lack of motivation but as a deliberate strategy to enhance productivity.

Summary: We identified task-related, personal, and external factors triggering procrastination, which manifested in three forms. Developers avoided tasks that misaligned with their interests (Aversion), delayed complex tasks to recover mentally (Avoidance), and prioritized high-visibility tasks while strategically delaying others (Strategic).

VI. How can developers manage procrastination?

With an understanding of the triggers and effects of procrastination, we investigate strategies and techniques to manage this phenomenon. We asked participants "What strategies do you use to mitigate procrastination at work?" Participants identified 14 procrastination mitigation techniques, which we further categorized into Awareness, Task Focus, Task Planning, and Team Support groups (Section III). The mitigation techniques are presented in Table V along with their Implications and specific productivity dimensions (Prod.) the techniques help, 👤 in the source column indicates participants who mentioned, along with the total frequency of mention (×); 📄 lists literature from other domains supporting some of the techniques discussed in Section VII-A.

Awareness. 🛡 *Progress Patterns.* Three participants mentioned that keeping track of their progress helped discover the onset of procrastination and modify their behavior. P11 elaborated that by keeping his progress pattern *"[he] can look back and say, at one o'clock when [he] did this [he] was procrastinating, and maybe [he] can learn from that in the future."* 🛡 *Proactive Measures*, suggested by four participants, suggests being conscious of procrastination before committing to it. P2 and P10 indicated proactively controlling the effect, stating, *"once I'm aware that I'm procrastinating, I'm always trying to figure out how to prevent that from happening again in the future"*. Finally, 🛡 *Informing others of the delay*, caused by procrastination, helped mitigate the future consequences, as mentioned by three participants. The notification allows other team members to devise new strategies to see if they *"can still do something about it"* [P12]. P10 emphasized:

> *"You have to communicate very early on that the deadline will be missed and then justify why. As long as you can do those things, you can keep your job."*

Task Focus. 🛡 *Daily Task Planning.* Following a daily personalized task list helped 10/15 participants to avoid procrastination by prioritizing tasks [P8,9,15] and avoid deviating toward prevalent tasks [P5,7-9,11,12]. P7 highlighted that he has a schedule that prevents him from delaying things. 🛡 *Interest-Performance trade-off.* Five participants prevented procrastinating on a task they don't like by balancing it with other tasks they like in their daily schedule [P5,7,9,11]. P3 mentioned doing uninteresting tasks during the energetic times of the day helped limit procrastination. P7 illustrated:

> *"Let's say 50% of your tasks are very likable, 50% not that much. You choose one task you like and one you don't each day. If you start doing it for a while, you get used to it."*

🛡 *Timeboxing/Fake Deadlines.* Five participants mitigated procrastination by applying the time boxing [P2,10,11,14] and creating artificial deadlines closer than the actual deadline to avoid the perception of having plenty of time. P2 exemplified that, if *"the actual deadline is three weeks from now, I write down [on his task list] that I can only work on this for the next two weeks, that helps with the procrastination."* 🛡 *Removing Distractions.* Six participants noted they mitigated procrastination by achieving focus and *removing distractions*. Participants physically removed the sources of distraction, reducing the temptation to engage with it [P2,4,12-15]. P4 stated when he got distracted by his phone, *"[he] would literally just throw [his] phone in a drawer and say, now I can't open that drawer until this task is done."*

Task Planning. 🛡 *Breaking tasks into smaller ones.* Five participants used *Task Decomposition*, especially on large development tasks, to manage tasks better [P1,11] and reduce stress [P7]. Decomposing one deadline into smaller ones ensured that meeting each new deadline didn't allow enough time

TABLE V
IDENTIFIED MITIGATION TECHNIQUES OF PROCRASTINATION FROM THE INTERVIEWS AND EXISTING TECHNIQUES FROM OTHER DOMAINS

Techniques	Implications	Prod.	Sources (Freq.)
Awareness			
Progress patterns	Tracking progress at work improves performance by identifying past time losses and easing deadline pressure.	S,P	[P2,11,12] (6×)
Proactive Measures	Identifying and preventing procrastination early, often through increased self-awareness. Self-coaching improves well-being and overall work satisfaction.	S	[P2,5,8,10] (6×) Mgmt [47], BS [48]
Inform others of the delay	Informing team members promptly when procrastination occurs helps prevent damage to team communication and dynamics.	C	[P7,10,12](6×)
Cognitive learning	Increase the awareness of neural mechanism of procrastination and reduce the pressure of procrastination.	S	Nr [49]
Neuropsychological Prevention	Improves well-being by addressing academic procrastination through self-regulation and reward for success.	S	Nr [50]
Cognitive-behavior therapy	Helps reframe negative thoughts by self-administered psychological intervention, improving time management and procrastination.	S	ClP [51]
Paradoxical interventions, Coherence therapy	Involve encouraging procrastination intentionally to increase self-awareness and disrupt avoidance patterns, facilitating behavior change.	S	CoP [52]
Task Focus			
Daily Task Planning	Enhances developers' performance by improving focus, prioritization, and task management, reducing stack of undone tasks near the deadline.	P	[P3-5,7-9,11,12,15](14×) AP [53]
Interest-performance trade-off	Minimizes procrastination by balancing disliked tasks with enjoyable ones, maintaining motivation, and ensuring the completion of less appealing tasks.	A	[P3,5,7,9,11](5×) Mgmt [32]
Timeboxing/Fake deadline	Creates a sense of urgency, improving focus and ensuring tasks are completed more efficiently.	P	[P2,10,11,14](9×) AP [53]
Removing distractions	Helps developers achieve flow by minimizing interruptions and maintaining focus.	E	[P2,4,12-15](12×) OB [54]
Task Planning			
Task Decomposition	Helps developers manage large tasks by breaking them into smaller parts, reducing overwhelm, clarifying priorities, and enabling steady progress.	E	[P1,7,11,13,15](7×)
Avoid task dependency	Enables developers to work independently, reducing delays, minimizing bottlenecks, and ensuring smoother progress despite procrastination.	E	[P4,5,7](7×)
Interdependence	Joining a workgroup can reduce procrastination by fostering teamwork and motivation, while consistent communication improves collaboration and workplace dynamics.	C	EP [55]
Thorough project planning	Thorough project planning, with clear goals, timelines, and responsibilities, enhances focus, ensures steady progress, and reduces overwhelm.	S	[P7,12](4×) AP [53]
Team Support			
Adaptive Deadlines	Communicating with developers on setting deadlines can help by reducing stress and anxiety associated with rigid timelines, which can otherwise lead to missed deadlines.	S	[P6,8,10,12](7×)
Update meetings	These meetings foster accountability, enhance collaboration, and provide social interaction, motivating individuals to stay on track and complete tasks efficiently.	E	[P1,6,7,9,11,13,14](7×)
Interruption management	Minimizes unplanned disruptions, helping maintain flow, prevent procrastination, and sustain focus during work.	E	[P2,10,12](3×) OB [54]
Seeking help	Seeking help for chronic procrastination helps find the best mitigation strategies or find a new work approaches that reduce their procrastination individually.	C	[P4,5,7,10,11,13](6×)

Mgmt: Management, BS: Applied Behavioral Science, Nr: Neuroscience, ClP: Clinical Psychology, CoP: Counseling Psychology, AP: Applied Psychology, OB: Organizational Behaviour

to procrastinate [P13,15]. Additionally, each completing subtask motivated them with immediate rewards. As P8 shared his experience of using this strategy:

> *"During my day there is a small payoff like, the function works, the query works, sure the whole feature might not be done yet but I found some immediate satisfaction."*

Avoid Task Dependency. Reducing dependency between tasks across the team was reported to be helpful by three participants. Participants tried *"not to define the project in a sequential way"* [P7], which helped them procrastinate less since they were working independently [P4,5]. *Thorough Project plan.* A well-structured project plan helped two participants with procrastination. Following a plan reduced vagueness [P12] and uncertainty [P7], leading to limited procrastination.

Team support. *Adaptive Deadlines.* Four participants pointed out realistic [P8,10] and communication-based [P6,12] deadlines mitigated procrastination. As P6 emphasized, *"a developer, who is getting deadlines from their managers should be able to very clearly communicate the workload to their manager and come up with the right timeline"* [P6]. *Update Meetings.* Update meetings in the form of weekly agile meetings [P6,7,13,14] or one-on-one meetings with the manager [P9,11,12] reduced procrastination for nine participants. Participants mentioned this technique motivated them [P1] and was an effective way to track their progress [P6,13]. *Interruption Management.* Unplanned social interruption was a factor of procrastination, which three participants managed by addressing them directly with coworkers.

> *"If a coworker is talking to me a lot, I might have a conversation with them, telling them, 'Hey, we can talk after work is done.'"*

Seeking Help. Six participants sought help to tackle procrastination. Help from experts resolved obstacles in tasks [P4,5,7,10,11] and improved personal performance [P4,13].

Summary: Developers mitigate procrastination by task decomposition for better planning, setting fake deadlines to maintain focus, and communicating early to seek help on technical and performance issues. Being self-aware of procrastination habits and tracking one's activities, like the amount of code written, can help limit procrastination.

VII. DISCUSSION

We discuss how developers can apply mitigation techniques, opportunities for new tools to manage procrastination within

teams, and other implications on education and productivity. We also discuss procrastination across demographic factors and novelty of our findings.

A. Interventions for developers to deal with procrastination

Awareness: Techniques to enhance awareness of procrastination rely on individual self-awareness and informing team members of any resulting delays. In other domains, shown in Table V, like applied behavior science or neuroscience, techniques exist to increase individual awareness by educating people [48], [49] or for neuropsychological preventions [50]. In the management domain, managers are suggested to be proactive toward their employees' procrastination [47]. Research has explored tools that automatically track and identify changes in developer activities [56], with some offering visual interfaces to explore these activities [57]. Annotating progress and perceived procrastination in activity visualization tools can facilitate reflection and highlight high-risk activities.

Task Focus: Various smart to-do lists and daily planners/calendars integrated into IDEs or GitHub can assist developers in task management. AI-powered calendars can automatically schedule tasks based on user patterns, but developers must ensure these schedules align with team deliverables. Frameworks like the Eisenhower Matrix [58] and SMART goals [59] help further balance personal interests with deliverables. Timeboxing using the Pomodoro technique which is also prevalent in applied psychology domain [53] is accessible for developers directly on their IDEs. Studies about managing and removing distractions [54] (Table V) for developers have led to specialized tools, like dimming irrelevant windows [60] or AI-based music recommenders can help maintain focus.

Task Planning: A well-crafted plan helps prevent procrastination by addressing bottlenecks from dependency issues, task orders, and technical debt. Popular software management platforms, such as JIRA for bug and issue tracking and GitHub for version management, facilitate project planning using calendar and Gantt charts. In addition, research from applied psychology emphasized the effectiveness of tracking a daily task plan to avoid procrastination on "unpleasant tasks" in a day [53]. Research on task decomposition [43] has shaped tools and solutions to reduce dependencies and conflicts. Even though some of our participants mentioned being dependent on someone else for a task as procrastination factor, education psychology domain showed being a part of a team in students is an effective mitigation technique of procrastination [55].

Team support: Enhancing team support in software development involves fostering positive, open communication both among team members and across organizational levels. Research on interruption management in software engineering [61] and organizational behavior domains [54] suggests that subtle signaling methods, such as using a desklight or wearing headphones, can minimize disruptions from colleagues. Additionally, practices like knowledge sharingand pair programming can help developers recognize when and from whom to seek assistance.

B. Recommendations for future tool builders

Not all mitigation strategies have sufficient tool support. For instance, the 🛡 *Progress Pattern* mitigation strategy is more effective when developers track their progress alongside self-reported procrastination episodes. Tools that allow developers to track perceptions of procrastination along with their activity will help to more effectively identify and mitigate procrastination triggers. Alternatively, tracking the cognitive activity (e.g., EEG, heart rate) of developers along with their development activities could help to identify if they are distracted, anxious, stressed, or bored. Certain tools are more effective for specific procrastination types. For example, when a skill mismatch causes aversion due to lack of interest, emphasizing the 🛡 *Benefit of the Task* can help. Conversely, when avoidance stems from feeling overwhelmed, 🛡 *Seeking Help* and 🛡 *Task Decomposition* are more effective. Tools should balance task interest and performance by incorporating varied tasks and using AI-driven recommenders to adapt schedules based on developers' skills, interests, and performance, enhancing motivation and productivity.

C. Connection between our findings and literature

TABLE VI
COMPARING OUR FINDINGS WITH RESEARCH IN OTHER DOMAINS

Our Findings	Psyc							Mgmt		Edu	Gov
	Stu			Emp			Adu	Org	Emp	Stu	Stu
NEGATIVE EFFECTS											
	[62]	[63]	[5]	[64]	[65]	[66]	[18]	[67]	[68]	[69]	[70]
Emotional Distress	✔	—	—	—	—	✔	—	—	✔	—	—
Anxiety & Stress	✔	—	—	✔	✔	—	—	✔	✔	✔	✘
Lower Work—Life Balance	✔	—	—	—	—	—	✔	—	—	—	—
Reduced Indiv. Performance	✔	✘	—	—	✔	✔	—	—	—	✔	✘
Reduced Team Performance	—	—	—	✘	—	—	—	—	—	—	—
Missed Deadlines	✔	—	—	—	—	—	—	✔	—	✔	—
Team Culture & Trust	—	—	—	—	✔	—	—	✔	—	—	—
Compensatory Effort	—	—	—	—	—	—	—	—	—	—	—
Flow Disruption	—	✔	—	—	—	—	—	✘	—	—	—
POSITIVE EFFECTS											
Emotional Relief	—	—	✔	—	—	—	—	—	—	—	—
Boost Confidence	—	✔	—	—	—	—	—	✔	—	—	—
Avoid Unnecessary Work	—	—	—	—	—	—	—	✔	—	—	—
Better Creativity	—	—	—	✔	—	—	—	✔	✔	—	✔
Near Deadline Efficiency	—	✔	✔	—	—	—	—	✔	—	—	—

Psyc: Psychology, Mgmt: Management, Edu: Education, Gov: Governance, Stu: Student, Emp: Employee, Adu: Adults, Org: Organization

Table VI compares the negative and positive effects we found with those found in other domains. Five negative effects (Table II) and three positive effects (Table III) not shown in this table are unique to software development as we didn't find any sources discussing those effects in the literature (— across all columns). The nine negative and five positive effects in the comparative table are marked with ✔ to indicate alignment and ✘ to indicate contradiction with listed references.

While negative effects, such as emotional distress and missed deadlines, are consistent across all studies, some effects in software development contradict findings in other domains. Studies in psychology and governance [63], [70] report no significant correlation between procrastination and individual or team outcomes, whereas developers reported reduced individual and team performance from procrastination. While other domains focus on one or two positive effects, developers in our study present a more complete list of positive effects.

We also identified procrastination factors unique to software development, such as subjective importance, task hierarchy,

and dependency on others (bolded text in Table IV). Developers reported that unclear task requirements and reliance on team collaboration lead to delays, cascading disruptions, and workflow issues. Communication gaps between roles also exacerbate misunderstandings and project delays, highlighting the collaborative challenges inherent in software development.

D. Productivity Implications of the Findings along SPACE

As discussed in Section IV, participants mentioned negative effects on **P**erformance most frequently, followed by **S**atisfaction & Well-being. However, albeit with lower frequency, most participants also reported higher positive effects along **S**atisfaction & Well-being. This polarity can indicate that depending on the combination of effects and specific tasks developers procrastinate on, they might experience both satisfaction and dissatisfaction from procrastination. Table V also reports how developers can adopt various mitigation techniques to reduce the impact of procrastination along the productivity dimensions. Most techniques in the *Awareness* category can help productivity by improving **S**atisfaction & Well-being, focusing on preparing developers mentally to combat or bypass procrastination. Two techniques in *Task Focus* category can help improve developer **P**erformance; the *interest-performance trade-off* technique in this category can also help developers manage their **A**ctivity. Techniques in the *Task Planning* and *Team Support* categories can help developer productivity by improving their **E**fficiency in managing tasks and deadlines and encourage them to **C**ommunicate early and consistently with their colleagues and working groups.

E. Development culture and education

Organizations should create a culture of openly discussing procrastination, reducing stigma. We found that procrastination often reflects task or organizational issues, beyond personal failings. As P7 noted, it can signal problems by: "If you deviate from your schedule, it indicates a problem." Training and onboarding could raise awareness, teach mitigation strategies, and promote early, judgment-free discussions. Incorporating lessons on managing procrastination into software development courses can help future developers address these patterns.

F. Contextual Analysis of Procrastination Factor & Effects

We compared the average number of factors and effects mentioned by participants along demographic dimensions of gender, work setting, experience, and roles. Table VII shows that remote workers mentioned higher personal factors, which might be an effect of their isolated environment. Developers reported more task-related factors than managers. Surprisingly, hybrid workers mentioned positive effects the most, highlighting the potential benefits of blended work models.

We conducted Chi-square χ^2 tests of independence for each dimension to examine whether the number of factors and effects mentioned by participants differ. The χ^2 test revealed a significant difference between women and men; women mentioned more external factors than men, indicating they might be more affected by factors like distractions and communication issues (detailed table in the supplementary [35]).

TABLE VII
AVERAGE NUMBER OF FACTORS AND EFFECTS PER PARTICIPANT

	Gender		Work Setting			Exp		Role	
	M	**W**	**H**	**I**	**R**	**3-6**	**>6**	**Dev.**	**Mg.**
FACTORS									
Task	6.8	5.2	6.7	7.0	5.2	7.1	5.5	6.6	4.5
Personal	4.8	3.5	4.2	4.5	4.7	4.0	5.0	4.5	4.0
External	2.9	4.5	3.4	4.0	2.5	3.5	3.1	3.1	4.5
EFFECTS									
Negative	13.4	10.5	12.1	14.7	11.5	12.7	12.5	12.6	13.0
Positive	4.1	3.2	4.0	4.7	3.0	4.0	3.8	4.0	3.0

M: Men, W: Women, H: Hybrid, I: In-person, R: Remote, Exp: Years of experience, Dev: Developer, Mg: Management

VIII. LIMITATIONS

Following empirical standards [71], we addressed credibility by providing a chain of evidence, final codes, interview quotations with assigned themes, and the codebook in the supplementary material. To mitigate interpretation biases during the open coding process, two researchers conducted IRR.

Despite rigorous data collection, fully understanding procrastination among developers remains challenging due to its complexity, individual variability, and unmeasurable cognitive mechanisms from self-reported data. Recall bias during the interview may have influenced participants' recollections of past procrastination experiences. To address this, the interviewer explored both positive and negative effects along all five dimensions of productivity. While our findings reflect participants' experiences, sample imbalances may limit their *resonance and generalizability* with all individual developers. To mitigate this, we discussed how our findings connect with prior research from other domains and populations. While some of our findings are context-specific to software development, some findings might be *transferable* to other professions after verification from specific in-context research. The study offers actionable insights into the factors, effects, and mitigation strategies related to procrastination among developers which makes it *useful* for managers and developers.

IX. CONCLUSION

This paper takes a first look into the effects and factors of procrastination on developers. Our in-depth interviews reveal insights about how procrastination creates positive and negative effects on both the developers and the code they produce. We uncover that while procrastination brings some benefits to developer well-being, it negatively impacts their performance and the quality and quantity of code they produce. We identify various development tasks, developer, and environment-related factors that trigger procrastination. Our results enlist mitigation techniques that participants found useful to limit and manage procrastination. We discuss how these mitigation techniques can be used in software teams using existing tools and identify where developers need support.

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