Less is More: Exploring Support for Time Management Planning

John R. Lund
john.r.lund@utah.edu
PeDEL Group, University of Utah
Salt Lake City, Utah, USA

Jason Wiese
jason.wiese@utah.edu
PeDEL Group, University of Utah
Salt Lake City, Utah, USA

ABSTRACT

Time management planning (TMP) is a practice where people plan what they intend to accomplish and when in a given day. The literature indicates behaviors associated with TMP, but not how people specifically engage in them or how technology is involved. We examined TMP practices of 19 graduate students, noting their methods and how they engage with tools. Students utilized different combinations of TMP behaviors, both in comparison to each other and within their own experiences. We then asked them to plan following specific guidelines over five days. Participants implemented these guidelines in unique ways using unstructured tools (paper, notes applications). Together, these findings suggest that to be useful, TMP software must not impose a specific structure. We demonstrate opportunities to incorporate these findings through the design of a flexible mobile application based on notes applications to facilitate planning while encouraging, but not requiring, the use of TMP behaviors.

CCS CONCEPTS

• **Human-centered computing** → **Field studies**; **Empirical studies in HCI**.

KEYWORDS

time management; personal informatics; diary study; planning

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1 INTRODUCTION

Time management and productivity are buzzwords in our society. Applications, blog posts, books, and podcasts describe or implement both tried-and-true and new-and-improved methods to maximize efficiency. Time management is defined as a set of "behaviors that aim at achieving an effective use of time while performing certain goal-directed activities" [15]. These skills are important and valuable. Past work has shown that the application of time management strategies is positively correlated with academic performance [13, 36] and job performance [7]. Furthermore, time management strategies have been shown to positively relate to stress-related outcomes including perceived control of time [3, 26, 35, 38], job satisfaction [35], and health [12].

Knowledge workers, students, and many remote workers face unique time management challenges due to the presence of abstract tasks and large periods of unstructured time. This work seeks to discover how people engage in time management planning (TMP) behaviors, including determining tasks, prioritizing and scheduling tasks, and estimating task length [42]. We set out to design a tool, starting with a rigid design that attempted to impose a specific structure and format on the steps of TMP. This approach was informed by the literature and a hypothesis that the main barrier to better TMP behaviors was that people were unaware of or unable to enact the important aspects of TMP. To further inform our design before we began implementing it, we posed three research questions:
RQ1: How do people currently engage in TMP?
RQ2: How do participants respond when asked to plan employing all of the TMP behaviors?
RQ3: How do they use software and paper-based tools to engage in TMP?

We explored these questions in semi-structured interviews with 19 graduate students, a 5-day planning diary activity with 17 of these students, and an end-of-study survey with 16 of these same students (see Figure 2). Our results revealed a new set of mechanics that capture the ways participants followed the TMP behaviors. Contrary to our expectations, we found that our participants did engage in TMP behaviors on a regular basis, but that the way they implemented these behaviors differed both between and within individuals. Furthermore, while it was clear that participants sometimes followed these behaviors, they actively chose whether or not to enact them depending on contextual factors. This led us to reframe the design problem we were solving, and to completely change our planned design from a rigid tool to a planning-focused text editor. We include both of these designs to provide concrete artifacts of our thinking before and after conducting the study, as well as to highlight the differences between TMP in theory and in practice. These results and the resulting design also point to a broader opportunity to leverage the flexibility of text-editing tools in domain-specific contexts to create new interactive experiences.

2 BACKGROUND AND RELATED WORK

Time management is defined as a set of "behaviors that aim at achieving an effective use of time while performing certain goal-directed activities" [15]. These behaviors include time assessment behaviors (e.g., awareness of how one spends her time), planning behaviors (e.g., setting goals, planning tasks), and monitoring behaviors. The literature shows that not all of these behaviors are

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equally important. Specifically, short-term planning behaviors show the most significant relationship to desired outcomes [15, 29].

Despite its importance, planning is described abstractly in the literature, rather than at the process level. The literature suggests that planning involves practices such as identifying goals and priorities [11, 13, 15, 29, 33, 50], balancing intentions and constraints [11, 33], making a to-do list [13, 15, 29, 50], grouping tasks [15], allocating time and scheduling [13, 15, 29, 33], and anticipating situational factors such as motivation, emotional state, and energy level [15, 48]. We refer to this type of planning as **Time Management Planning (TMP)** as it is defined in Parke et al.'s work on daily planning: **determining tasks to be performed on a particular day, prioritizing and scheduling the order of such tasks, and sketching out the approximate amount of time to be spent on each task** [42]. Other work refers to this type of planning as "short-term" [15, 29] or "short-range" [13] planning.

TMP is related to, but distinct from, other concepts in the literature such as time management, task management, and action planning. Planning is often lumped in with other terms (e.g., "task management and planning") without disentangling their differences, so we provide definitions of these distinctions here. Prior work in each of these areas provides important context for or principles of TMP and will be discussed later.

Time management refers to the broad category of behaviors and methods that contribute to spending one's time wisely [15]. This includes aspects such as planning one's time, managing one's tasks, and monitoring and making effective use of available time when engaged in tasks.

Task management refers to how one records tasks, remembers tasks, and maintains and organizes task lists [23]. Notably, while TMP does involve some form of task management (determining, prioritizing, scheduling tasks), it occurs on a daily or similarly short-term basis with a limited scope of one's tasks. Task management, on the other hand, encompasses all the many tasks one is responsible for and is less of a recurring event than an ongoing effort.

Action planning refers to breaking down a task into the concrete actions leading to its completion [32] and linking these actions or intentions with a specific context (when, where, etc.) they might be performed in [21, 37, 45]. A specific form of action plan prevalent in broader behavior change literature is *implementation intentions*, which follow a general format of "If situation Y is encountered, then I will initiate goal-directed behavior X!" [20]. TMP shares important principles with action planning such as associating a specific time (context) with actions, but is distinct because it is concerned with coordinating and reconciling the completion of several tasks in a short-term time frame rather than a single task or goal.

2.1 Planning Principles

As described earlier, TMP is an important time management behavior with similarities to general time management, task management, and action planning. Work in each of these domains provides context for and important principles of planning although it does not directly address TMP. Other work has specifically examined TMP and its general effects on individuals' performance or perception of time, but does not examine the mechanics of TMP — how do people engage in TMP, what tools do they use, and how can they best be supported? In the following paragraphs, we italicize principles that we drew from this literature which guided our initial design (see section 3).

Behavior change literature, mostly health-related, describes planning focused on the concept of implementation intentions - the idea that associating a specific trigger or context with a specific action makes it more likely to be carried out [1, 20, 21, 27, 46]. By *assigning specific contexts to tasks*, people are more likely to perform the planned action (such as flossing, eating vegetables, or engaging in physical activity). Other work has shown that simply *being reminded that one has a plan for their actions*, even before it is time to perform them, makes following through on intentions more likely [53].

Some work in the HCI community also looks at supporting people in creating plans for a specific task or goal. Agapie et al.'s work focused on supporting the creation of physical activity plans found that *providing scaffolding for plan structure and components* regarding which activities to include and/or how much or how little to plan was helpful to those creating them [4]. Paruthi et al. introduced the concept of "sweet spots" based on multiple contextual factors combining favorably for an intended task or action to take place and further pointed out that software might aid in *identifying or anticipating opportunities to take action* [43]. These works also identified that *accounting for and communicating contextual information*, such as routines in one's schedule and other constraints, made plans more approachable and accurate [4, 5, 43].

Similar, but within the time management domain, is work studying how breaking down abstract tasks can make their completion more likely to happen. For example, Kokkalis et al.'s TaskGenies application used crowd-sourced suggestions to assist users in identifying the steps to completing a task on their to-do list [32]. They found that, especially for high-level, low-contextual-demand tasks, users were able to complete more tasks with the action plans provided by others. Kaur et al.'s work with action plans targeted the highly contextual task of writing by providing a "vocabulary" of specific, common tasks to scaffold the process of planning the next steps to take in writing/editing [28]. In both cases, assisting users in the process of *determining specific tasks to engage in* made it easier for them to carry out their plans.

2.2 Planning Outcomes

Some studies in time management and productivity have broadly examined TMP's effects. Kocielnik et al.'s Robota prompted workplace users to reflect on their work and develop plans for what they would accomplish during the day and reflect on their progress, among other topics, via a Slack chatbot and an Alexa device [31]. They found some participants increased their awareness of their progress and motivated them to be more productive, while others benefited from more indirect effects such as more organized time tracking and prioritization of tasks. In a more explicit examination of TMP, Parke et al. surveyed employees to understand the relationship of TMP and contingency planning with work engagement and daily performance over 10 consecutive workdays and found that TMP behaviors positively related to both engagement and daily performance [42].

Leshed and Sengers took a different approach, exploring how different time management practices and tools play a role in contributing to or helping people cope with busyness [33]. Their participants' experiences revealed that planning helps organize and prioritize tasks and events and also makes coordinating with others or anticipating conflicts easier, even if their plans ultimately weren't followed. They suggest part of planning's value is in creating a feeling of control and facilitating negotiating priorities and goals.

Taken together, these works indicate that engaging in TMP produces meaningful, positive effects for individuals, both in the workplace and in their personal life. Indeed, other work from Claessens et al. and Cotte & Ratneshwar additionally shows planning behaviors may interact with factors such as job characteristics and aspects of one's personality to be predictive of how one chooses to spend their leisure time, overall perceived control of time, and even web browsing habits [14, 16, 17]. However, it remains unclear *how* people engage in all of the steps of TMP (determining tasks, prioritizing, scheduling, estimating completion time).

For how important planning is, a review of the time management literature found a glaring gap in the literature around detailed aspects of the mechanics of planning [15]. Even in some of the above survey-based works which depend on identifying planning behaviors, the survey questions included are abstract and reveal little about the process itself: "I set myself short-term goals", "I plan my daily work activities", "I make lists of things to do each day" [14, 16]. While there is one study that reports on a single participant think-aloud in a planning task [24], the situation is contrived and the participant is not planning his own schedule. This existing work identifies that TMP is important and confirms that people are engaging in some form of it, but the process by which individuals do it and their reasons for it are still unclear.

Understanding the specific, contextualized mechanics of what people do is a critical step toward designing and developing software that effectively supports TMP [25]. This leads us to two research questions:

RQ1: How do people currently engage in TMP?

RQ2: How do participants respond when asked to plan employing all of the TMP behaviors?

2.3 Time Management Tools

Many people rely on paper tools for various time management tasks, including planning [33]. Paper-based time management tools are convenient and easy to use, making them an obvious go-to. However, paper-based tools also lack the ability to directly support overcoming common barriers to successful time management, including procrastination [47, 55] and prospective memory, which "refers to a collection of behaviors and mental processes concerning a formed intention to remember something later (most often a task) and remembering that intention at the appropriate time or place" [34]. In contrast to paper-based tools, software has the potential to offer new opportunities to support overcoming these barriers.

There is also a variety of software intended to directly support time management behavior, most commonly calendars and to-do lists. The majority of calendar and to-do list software is mostly a simple digitization of their paper counterparts, with some additional features such as the ability to set reminders.

While calendars support some kinds of planning, past work has shown that their use is overloaded, and not in line with the definition of TMP given above [41, 44, 51]. One consistent observation across this work is that calendars are used for many things that are not plans to complete tasks, including: time-based reminders (e.g., deadlines), travel plans, and the whereabouts of others [11] and that people tend not to follow what is on their calendars, skipping things that are on their calendars and doing things that are not on their calendars [51]. Other work has found that families do not depend on calendars to support their planning because their behaviors end up being a complicated mix of routine and deviation from routine, and in practice, there is so much last-minute deviation from routine that those tools are not currently helpful [18].

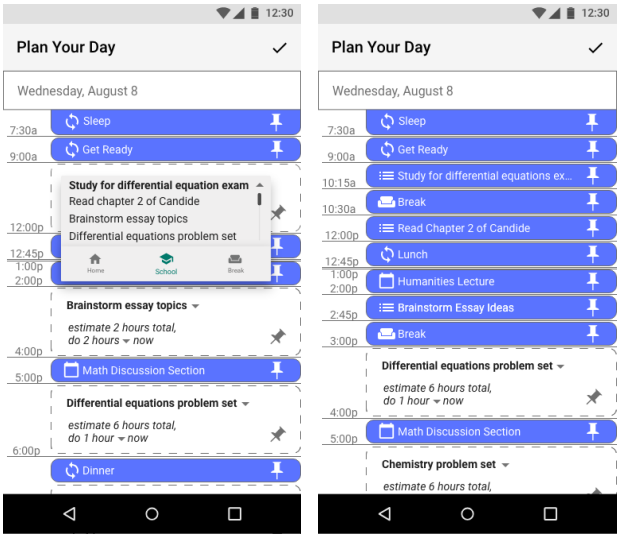
Research has sought to develop new tools for to-do lists and task management, calling for a more holistic, user-centered approach that leverages the benefits of different tools and offers stronger support for integrating them together [11]. One such user-centered effort resulted in TaskVista, a tool that supports task management driven by a series of data-driven insights identified from two studies with seven participants in a professional context [8]. Similarly, Haraty et al. explored individual differences in approaches and tools used by academics when managing their tasks [23] and developed ScriPer - a scripting mechanism for personalizing features of task managers [22]. Other tools attempt to automatically parse to-do lists to infer meaning [19] or automate task and appointment scheduling [10, 39, 40]. However, it is unlikely that just being given an automatically generated schedule for individual tasks will work for most people. Being an active participant in forming a specific short-term plan is likely to be an important step, especially for people who struggle with procrastination.

While many of these time management tools described above support or are related to some of the aspects of TMP, none of them integrates the aspects of TMP (determining tasks to be performed on a particular day, prioritizing and scheduling the order of such tasks, and sketching out the approximate amount of time to be spent on each task) into a cohesive tool or process. Additionally, as referenced earlier, we have a limited understanding of how individuals use these tools specifically when creating plans. This leads to our final research question:

RQ3: How do participants use software and paper-based tools to engage in TMP?

3 INITIAL DESIGN PLANS

We drew our initial framing for this design problem from the literature: there is value in engaging in TMP, especially for people who have flexibility in when they choose to do things. We hypothesized that a main reason that people do not engage in TMP is because they perceive it as too burdensome. Thus, a primary objective for us was to reduce the burden of engaging in TMP. Furthermore, we expected that it was easy for individuals to forget or leave out important aspects of TMP, such as having complete plans for their days, assigning times to tasks, and estimating how long they would take.



(a) Selecting an item to go in a time slot (b) A mostly complete plan

Figure 1: Screens from an early vision for software to support planning

In other words, we approached this design as a way of **combining TMP behaviors into a unified process, then supporting and streamlining that process so it could occur each day**. The components of TMP provided in the definition are:

(C1) determining tasks to be performed on a particular day
(C2) prioritizing and scheduling the order of such tasks
(C3) sketching out the approximate amount of time to be spent on each task

We further drew on guidance from the italicized principles in subsection 2.1 for direction on how to accomplish this goal and how to support people in following these plans, which we consolidate below.

(P1) assigning specific contexts to tasks
(P2) being reminded that one has a plan for their actions
(P3) providing scaffolding for plan structure and components
(P4) identifying or anticipating opportunities to take action
(P5) accounting for and communicating contextual information
(P6) determining specific tasks to engage in

As a result of this framing and guidance from the literature, our early design ideas in thinking about software solutions to this problem were focused on structured approaches—scaffolding structure on users' plans and the planning process (P3)—as a way of addressing these problems. We thought that this approach would lead to the best combination of *ease-of-use* and *including the important aspects of plans*. Figure 1 shows mockups that we had made of this vision during the summer of 2018, the same time we conducted the interviews described below.

These mockups illustrate our ideas and understanding at the time, including some assumptions we made about what users would be willing to do in the context of the app. Specifically, identifying tasks to be done on a day (C1), assigning specific times to every item ((P1) and (C2)), estimating duration for a task (C3), making implicit tasks (like sleep and meals) explicit (P5), prompting prospective memory (P2), identifying opportunities to plan a specific item (P4), and only having one thing scheduled in a time slot (P6).

We include this design because it captures a snapshot of our original thinking based on the literature and our interpretation and application of that literature. In our analysis, it also aided us in thinking about how what we learned from participants compared with our original framing. Knowing what we now know after conducting the study described in section 5, it can be difficult to see our own past perspective where we imagined this design would be adopted and appreciated. However, we note that we were not alone. There are now a variety of apps[1], published in the app store around that same time, which follow a similar approach to the one portrayed in Figure 1.

Noting that the gap in the literature regarding the processes and motivations of individuals engaging in TMP meant we did not have enough direction to proceed with our design, we conducted the interviews described below with a goal of developing deeper insights on the mechanics of *how* people plan their days, and if they would be receptive to following a highly structured process like the one we were envisioning.

4 METHODS

We conducted semi-structured interviews, a diary study, and an end-of-study survey to explore the research questions outlined above.

4.1 Interviews

In the 30-60 minute semi-structured interview, we asked participants about their general approach to managing their time, how they use the specific tools they indicated using in the screening survey, and their experiences with TMP. We had prepared questions, but allowed for follow-up questions or deviations to go into topics in greater depth when appropriate. The script used can be found as part of supplemental materials. We also asked them to demonstrate how they currently make plans for the coming day. Following discussion and demonstration about participants' current planning practices, we asked them to make a plan according to instructions based on the TMP behaviors described earlier.

Provided instructions:

(1) *Make a list of to-dos or tasks that should be done tomorrow*
(2) *Make an estimate of how long each task will take and put it next to the task*
(3) *Mark any tasks that are especially critical or non-essential as such*
(4) *Put any structured events on the calendar*
(5) *Fill in when to complete tasks you wrote down earlier*

One of the authors conducted and transcribed all of the interviews. One author coded 2 transcripts following inductive coding, then the other author coded the remaining ones after discussing and agreeing upon the coding of the first 2. Following the coding, both authors discussed each code together and followed iterative thematic analysis to develop common themes.

[1]Futurenda, Sectograph, TimePlanner, Planner Pro, Accomplish, and others

ID	Gender	Department	Status	Interview	Diary Activity	Final Survey
P01	F	English	PhD	Yes	Yes	Yes
P02	F	Communication	PhD	Yes	Yes	Yes
P03	F	English	Masters + PhD	Yes	Yes	Yes
P04	F	Communication	PhD	Yes	Yes	Yes
P05	F	Communication	PhD	Yes	Yes	Yes
P06	F	English	PhD	Yes	Yes	Yes
P07	F	Education/Business	PhD	Yes	Yes	Yes
P08	F	Educational Psychology	PhD	Yes	Yes	Yes
P09	M	English	PhD	Yes	Yes	No
P10	F	Educational Psychology	PhD	Yes	Yes	Yes
P11	M	ECE	PhD	Yes	Yes	Yes
P12	M	ECE	PhD	Yes	Yes	No
P13	M	Biological Sciences	PhD	Yes	No	Yes
P14	M	Atmospheric Sciences	PhD	Yes	Yes	Yes
P15	M	ECE	PhD	Yes	Yes	Yes
P16	F	Audiology	PhD	Yes	Yes	Yes
P17	M	ECE	PhD	Yes	No	No
P18	F	Biological Sciences	PhD	Yes	Yes	Yes
P19	F	Dance	PhD	Yes	Yes	Yes

Figure 2: Participant data. 19 participants participated in the interview portion, 17 in the diary activity, and 16 in the end-of-study survey. ECE stands for Electrical and Computer Engineering.

4.2 Diary Activity

Following completion of the interview, we gave each participant instructions for how to complete the planning diary activity and asked them to do so for five days. We requested they follow the given instructions for planning for the duration of the diary study regardless of their usual behaviors. Participants had the choice of five consecutive weekdays or five consecutive days including the weekend if they felt that fit their time management practices better. This seemed appropriate as the purpose of the diary activity was to discover what happens when they integrate TMP practices into their existing behavior.

Each of the 5 days, participants used an online form to submit a picture of their plan (or another appropriate format) and answer a series of questions about their experience creating and executing their plan for the day. Specifically, participants were asked to indicate which tools they used when making their plan, what was easy or challenging about making their plan, how they felt about what they accomplished during the day, how often they referred to their plan, and how much of their plan they accomplished and why.

The instructions for planning were included in the form so participants could review them if they could not remember them.

After completing the five day diary activity, we sent a brief end-of-study survey asking about the participant's overall experience with the study, if they found it useful, if planning affected their time management, how likely they were to continue with TMP, and if they felt making the plan each day was worth the time it took.

4.3 Participants and Recruitment

We recruited 19 participants from a large research university through a mass email sent by their department or college academic advisor. All procedures were approved by our institution's IRB. The email used to explain the study can be found in the supplemental materials for this work. Volunteers completed an online screening survey asking about the paper and digital tools they use currently or used in the past to manage their time. The survey also asked how often the participant plans for the upcoming day, how they do so, and how productive they felt they were compared to their peers. We considered using Macan's Time Management Behaviour Scale (TMBS) [36], but during pilot work we found that many of the questions were confusing and led to responses that did not accurately represent respondents' opinions. We selected participants with the goal of an even spread of tools used, gender, and field of study. Of the 19 who were selected and completed the interview, 12 were female, and no more than 4 were from any given department. None of the participants had any prior relationship with any author. Participants were contacted via email, text message, or phone call to arrange a time to interview. We conducted interviews in person on the university campus. We paid participants $10.00 following the interview and upon completion of the final survey, participants collected the remaining $15.00 of compensation.

We refer to interview data with I-# (with # being participant number), diary activity data with D-#, and end-of-study survey data with E-#. Participants participated in each portion of the study such that I-9 and E-9 will refer to the same person.

We worked with a graduate student population for this study, which satisfied two criteria we identified for doing this work. Most importantly, we wanted to be sure that a majority (preferably all) of our participants would be in situations that would likely require regular planning and time management to be successful in their work life. A key aspect of this is having a significant part of the workday being unstructured time where they get to decide how they spend that time. We asked participants to plan their whole day, rather than only their work day. Additionally, we wanted to focus on a population that would have some overall similarity in the structure of their work so that we could be more confident that differences we saw were not simply because their work contexts were dramatically different.

To aid in assessing the translation of these results to other populations, we provide a general description of the type of work and tasks typical for this group (referred to simply as graduate students). The graduate students we worked with complete coursework and conduct research under the direction of an advisor or principal investigator (analogous to a supervisor), but generally have high autonomy regarding their schedule and short-term tasks. Their primary tasks typically include writing and reading research publications, completing coursework, teaching or grading coursework, and conducting and recording their research and related experiments. Tasks related to research — such as writing and conducting experiments or studies — may be more abstract with long-term deadlines, while tasks related to coursework are more likely to be concrete with short-term deadlines.

These characteristics bear most similarity to knowledge workers, especially those in an academic context, and undergraduate students. Though the specific tasks may differ, the interleaving of long- and short-term deadlines and varied levels of autonomy may suggest broader applicability of these findings to other types of knowledge workers. However, the experiences of this population (graduate students) may differ greatly from other groups, particularly those which work a predefined schedule, work exclusively towards short-term deadlines or on repetitive, well-defined tasks,

or generally have significantly less autonomy regarding what to work on and when during the day.

4.4 Limitations

Participants in our study were from our own university and self-selected. These methods likely attracted participants who have more developed time management skills. No participants indicated they felt they were less productive than their peers in the screening surveys. When collecting demographic information, we believed age would not be a notable factor in participants' time management relative to each other and thus did not collect it in the interest of minimizing the collection of personal data. However, in interviews, two participants referenced their age because they felt perhaps they were less inclined to use technology than their peers because of a difference in age. While we wish we had foreseen this and done things differently, we did not collect age, thus we cannot report it for our participants. As such, generalizing these results should be done with care.

5 RESULTS

The combined results of our interviews and diary study reveal insights into how our participants currently engage in TMP, how their processes compare to those suggested by the literature, how do participants respond when asked to plan employing all of the TMP behaviors, and how they use software and paper-based tools to engage in TMP. We also discuss the experience of participants when creating and executing these plans and identify obstacles to the process as well as the benefits and drawbacks they observed when doing so regularly. We hypothesized, based on prior literature, that that participants would react positively to a more concrete and detailed method of TMP when prompted to do it. While not completely incorrect, we found some participants intentionally avoid aspects of TMP that seem critical to its success.

5.1 RQ1: How do people currently engage in TMP?

In interviews, participants described and demonstrated how they would plan for the next day using a variety of digital and paper tools. Some, such as determining tasks, were common, but others, like explicitly estimating completion time or prioritizing were rare. We observed both *methods* and *mechanics* in our participants' experiences. Mechanics are the specific actions participants took, or the way they interacted with their data and tools when planning. Methods are the ways participants used these mechanics together to create their plans.

5.1.1 Observed mechanics. We observed a set of common, specific *mechanics* that our participants took when engaging in TMP. These mechanics provide deeper insight into the more abstract behaviors identified by the literature as involved in TMP we discussed earlier. Each mechanic is associated with one of the components of the TMP definition:

Determining tasks (C1):

- **Review current tasks**: Collect and review various sources of information likely to provide reminders of tasks to complete. This could include prior to-do lists, calendars, text messages, meeting notes, sticky notes, flyers, pictures, and one's own memory.
- **Create a task list**: Write or type out a representation of each task intended to be done during the day in a single, concrete list separate from events.
- **Review scheduled events - to remember tasks**: Open and review scheduled events on a calendar as a reminder of tasks that still need to be completed.

Scheduling the order of tasks (C2):

- **Scan for large deviations**: Reviewing sources of information for obvious deviations from one's routines that will require more careful planning.
- **Schedule tasks relatively**: Associate a task with a block of time (e.g., morning, before 2pm, after work, etc.).

Sketching out time for tasks (C3):

- **Review scheduled events - to gauge time constraints**: Open and review scheduled events on a calendar to see how much time is available around pre-existing commitments.
- **Review scheduled events - to gauge contextual constraints**: Open and review scheduled events on a calendar to identify when one will be in certain contexts during the day, which limits or enhances one's ability to work on a task.
- **Schedule tasks concretely**: Assign a specific time of day to work on a task (both start and end time).

5.1.2 Observed methods. We observed 3 different ways that participants used the mechanics above to engage in TMP. These *methods* are best distinguished by the format of the plans they produced: creating a schedule, creating a to-do list, and pause and resume. We describe each in more detail below and provide an example below. The examples are descriptions based on an individual participant's planning process that was generally representative of the others. The names used are not participants' actual names.

Creating a schedule. 6 of our 19 participants created a schedule when planning. This method incorporates most of the behaviors defined as part of TMP earlier. 4 of these participants created concrete schedules with specific times (I-3,4,6,8), while 2 created more abstract, "soft" schedules (I-13,19). Those that developed a concrete schedule utilized these mechanics: review current tasks, review scheduled events - to gauge time constraints, context constraints, and remember tasks, and schedule tasks concretely. The final plan format is a combined list of tasks and events for the day in chronological order with specific start and end times.

Example: *Rachel creates her schedule using her paper planner and a piece of scrap paper. She writes tomorrow's date at the top of the paper and records a routine item (going on a run) and then a meeting she copies over from her paper planner with start and end times. She continues chronologically through the day, adding tasks from previous day's schedules, other task lists, or from memory when there are breaks in between scheduled events. She doesn't make any plans after 5 pm to leave that time more flexible.* (I-8)

Participants who created soft schedules (I-13,19) planned in their heads and did not write the plans down (even if the involved tasks and events exist separately in calendars and to-do lists). These plans did not involve concrete assignments of when the specified

tasks were to be worked on, and they used fewer mechanics: review current tasks, review scheduled events - to gauge time and context constraints, schedule tasks relatively. The final plan format is a mental reconciliation of the events and tasks for the day in chronological order.

Example: *David thinks through how the day will go. He refers to a Google Calendar he shares with his wife to see what events are happening and where he'll be during the day. He scrolls through the Microsoft To-Do app on his phone to remember what tasks he's currently working on. He takes a minute to think about how much time he has available in between each event for the coming day. He doesn't see any conflicts between what he needs to get done and how much time he has and goes on with his day.* (I-13)

Creating a to-do list. The most common (10 of 19) method of planning took the form of creating a daily to-do list (I-1,2,5,7,9,10,11, 14,16,17). Participants practicing this method used the following mechanics: review current tasks, review scheduled events - to remember tasks, schedule some tasks, and create a task list. This task list is distinct from more general lists or other sources of information and explicitly captured in some tool, whether paper or digital. Some participants did schedule a task or two and transfer it to their calendars. The final plan format is a list of tasks to be completed during the day, potentially in tandem with some tasks added to the current day on a calendar.

Example: *Amanda uses Google Calendar and the Samsung Notes app on her phone when creating a daily to-do list. She reviews her calendar and notices a meeting later in the week she needs to prepare an agenda for. She schedules a lunch workout on the calendar, and makes a separate to-do list for the day in the notes app based on prior task lists and what her calendar reminded her of.* (I-7)

Pause and resume. Finally, 3 of our participants had no form of conscious planning (I-12,15,18). They instead used the following mechanic: scan for large deviations. While this mechanic involves checking a calendar, it is distinct from reviewing scheduled events because its purpose is to identify major disruptions to a routine rather than systematically review potential related tasks, available time, or context. These participants also reported intentionally leaving materials related to their tasks as a reminder of what to do next. The final plan format is a mental sense of the day's flow, with a note of unusual disruptions if necessary.

Example: *Crystal scrolls through her calendar after she wakes up to see if she has any meetings that might change her regular work schedule. There aren't any, so she continues with her normal routine. Later, she sits down to work and unlocks her computer. She glances through her most recent emails, the tabs she left open in her web browser, and her last entries in a lab notebook. After reviewing these for a few minutes, she begins work where she sees that she left off. When she finishes up work for the day, she makes sure to leave things as she had them for the next day.* (I-18)

5.2 Planning methods change with demands

Although our participants described the above methods as what they currently do each day, many participants mentioned that how they plan and manage their time is not static. Sometimes these changes happen depending on the semester or time of year (I-1,10,18,19), but also simply as needed when their workload increases or decreases on a daily or weekly basis (I-2,3,4,5,6,12,18). Generally, as one's workload increases, the concreteness and regularity of their plans increases. I-3, for example, regularly switches between making daily to-do lists and planning specific times to complete tasks depending on how stressed they feel about upcoming tasks. I-10 does not usually create specific plans, but will use a sticky note to draft out the exact tasks that need to happen in an upcoming time block if they are particularly busy. I-18 normally does no form of planning, but if they notice they have fallen behind on a particular project, they will begin scheduling blocks of time to work on it. Similarly, they reduce the concreteness or regularity of their planning when they have less pressing commitments. Those who schedule their tasks may reduce to simply making daily to-do lists, and others may shift from making lists to relying on memory. In short, the process and product of our participants' planning fluctuates as they adapt to their current needs.

If the earlier methods of planning were placed on a spectrum from utilizing no TMP behaviors and specifying nothing about one's plans to explicitly engaging in all TMP behaviors and specifying everything about one's plans, our participants could be imagined as maintaining a baseline at the position they described in the interviews, but drifting forward and back along it in coordination with their workload or feelings of overwhelm.

Our participants' experiences revealed that they do engage in TMP behaviors, but only some occur regularly, and some seemingly not at all. Additionally, they utilize different methods - combinations of these behaviors and associated mechanics. Their descriptions of how they adjusted their strategies with demands suggested this may not be due to a lack of awareness or ability to apply all the TMP behaviors, but more insight was needed. The following results investigate how these same participants responded when asked to regularly engage in all of the TMP behaviors when planning.

5.3 RQ2: How do participants respond when asked to plan employing all of the TMP behaviors?

During the diary study, our participants acknowledged benefits to engaging in more TMP behaviors than they usually did. These benefits were very similar to those identified by the literature: feeling more committed to tasks, recognizing and resolving conflicts in advance, and recognizing opportunities to use their time more effectively. However, we also found that very few participants consistently, if ever, fully engaged in all the TMP behaviors during the diary study. They either only partially engaged behaviors, left out behaviors, or did not engage in planning at all on certain days.

During interviews, participants both described and demonstrated how they currently enact planning in their personal time management systems. Later in the interview and for the duration of the diary activity, participants planned according to the specific guidelines we identified that engage each of the TMP behaviors. As a result, this section includes findings from the interviews, diary activity, and final comments made in the end-of-study survey.

Participants found a wide variety of benefits to following our TMP guidelines. Ten participants expressed that they felt increased commitment to completing planned tasks due to simply having tasks and times listed out and decided upon. D-14 found, "*it helped*

because I didn't have to waste time deciding what to do", and D-3 commented "*I may not have felt particularly motivated to do certain tasks (like go to the gym) but since I'd already written the task out, the decision had already been made, so I just went.*" Five participants realized they had conflicts when attempting to reconcile their plans. For example, I-16 realized, "*I might have a conflict...Just like writing out the specific times like that and thinking through it more. If I have an appointment from 8 to 9 am, but I also need to be to the clinic with my clipboards at 9am, that's not factoring in drive time. So, one of these might be cut from my to-do list. Probably the appointment.*"

The process of planning helped participants think of their tasks as less abstract (D-6,8), more achievable (D-9), and more clearly prioritized (D-18). For example, D-18 explained, "*Planning helped me visualize and be realistic about my goals. I accomplished the items that I had set as a priority. That made me not dwell on the items I did not accomplish.*" By consciously determining, prioritizing, and deciding times to complete tasks, participants were better able to approach completing them and gained greater insight into their priorities.

Further, some participants noted that planning helped them accomplish more tasks than they would otherwise because they made use of typically unproductive time. D-19 noted, "*it helps remind me of the need for getting homework done between other tasks*", and D-4 observed, "*I think I did more this morning than I would have otherwise despite the environment preventing me from being as productive as I would have liked. For example, I read some stuff online on my phone while I was getting ready that I otherwise would have pushed off.*" D-3,9, and 10 made similar observations. Reconciling tasks to complete with the constraints in the day prompted participants to look for additional time to complete tasks and decide to use that time more effectively to accomplish what they intended to do.

Participants D-4,6,9,16, and 18 also found they felt more motivated to continue following their plans due to the satisfaction of seeing their progress. D-6 described how they, "*feel accomplished checking things off of my lists, and that feeling is motivating for continuing my scheduled work.*" Similarly, 11 of 19 participants specifically mentioned in interviews that they found marking tasks as completed to be motivating even in just the context of their to-do lists (I-1,4,5,7,8,9,10,12,13,16,19). TMP provides a concrete view of the day for individuals to refer to, giving their efforts context and order even beyond that of a to-do list because their other obligations such as appointments and daily routines are also included. Seeing progress through these various commitments generates additional motivation and helps the plan's creator better acknowledge what they accomplish.

5.3.1 Limited engagement with TMP behaviors. Although participants were asked to engage in each of the TMP behaviors, provided easy access to the planning "instructions," and did an example with an interviewer, only 2 participants fully and explicitly engaged in each TMP behavior for all 5 days and only 4 others (6 in total) even partially engaged in every behavior for each day.

On days when participants did not fully engage in TMP behaviors, they either 1) only partially engaged in behaviors, 2) left out behaviors, or 3) did not plan at all. Responses accompanying their plans and comments from the interviews provide some context for the reasons why these occurred.

When participants partially engaged in TMP behaviors, they showed some evidence of engaging in it, but only did so with some parts of their plans or in a way that didn't fully accomplish its aim. For example, D-3 developed a full schedule for the day, but used generic descriptions such as "Work" for long stretches of time rather than determining what to do at/for work - partially engaging in determining tasks. D-11 partially engaged in scheduling tasks and sketching out time for them by making estimates of how long they would spend on groups of tasks, but only specifying that they would happen "in the morning" or "before 3pm". Prioritization was also partially engaged by a few participants who assigned every task the same priority level (D-1,4,14).

When participants left out TMP behaviors, there was no evidence of engaging in a certain behavior. One example is D-1. After initially fully engaging with all the TMP behaviors as directed for the first day, they stopped scheduling tasks at specific times or prioritizing them for the remainder of the diary activity. Sometimes, only one behavior was absent, typically prioritization (D-2,6,7,8), but other times several were absent such as when D-10 only determined tasks for a given day and didn't engage in any other TMP behaviors. Most participants did not provide reasoning for why they left out certain behaviors. We suspect they simply did not feel them necessary or helpful as other participants noted they felt prioritization or assigning specific times to tasks to be tedious on certain days, even though they did do it (E-3,4,5,19).

Finally, participants sometimes did not engage in planning at all. 2 participants (D-13,17) ultimately did not participate in the diary activity. Of the remaining, 6 had at least one day where they consciously did not engage in any form of planning. D-11 also missed a day of planning, but this was due to a misunderstanding of the instructions.

Although the fact that most participants did not engage with the TMP behaviors as they were asked might initially appear to be due to misunderstanding or even laziness, the experiences our participants' shared surrounding planning with these behaviors revealed they often had valid personal and contextual reasons for doing so. For example, some participants did not fully engage in scheduling or sketching out time for tasks because they found it "*...made me feel guilty when I missed the targets*" (E-14) or "*...can increase the anxiety and stress in response to tasks that don't go according to plan*" (E-15).

Others left out sketching out time for tasks completely in response to tasks that were difficult or even impossible to concretely plan. A difficult task to plan might be one like D-2's, cold calls to recruit study participants. "*I may end up leaving a bunch of voicemails for participants (2 mins each) or every person might answer and agree to participate (30 mins each).*" The struggle to give an accurate time estimate discouraged engaging in this behavior at all. On the other hand, some tasks that emerge from meetings during the day are truly impossible to concretely plan because they are expected, but unknown (D-1,2,12).

Still other participants sometimes consciously did not engage in planning for an entire day when it felt useless to them. For most, this was due to feeling unwell or a family/personal commitment (D-6,7,12,16). In these cases, they reported feeling that their plans would ultimately be upended by these unpredictable factors, making the time spent planning unhelpful overall. D-7 "cancelled all plans

due to illness," and D-16 "didn't end up making a plan...My dog had to be taken to the emergency vet, which threw a wrench in my planning and all the things I thought I was going to do!" While these participants did not plan due to the unpredictable nature of the entire day, D-2 decided not to plan when the day felt completely predictable: "My days without plans are due to the repetitive nature of my current tasks...they all just fit into the natural flow of my day at some point." Because their day would follow a predictable routine and all their current tasks were incorporated into that routine, creating a plan felt unnecessary to D-2 and they chose not to do it. In short, participants sometimes regarded planning as useless if they had a major event, task, or factor (e.g., illness) that would override any other efforts that could be planned for the day, or if all their required tasks were fully integrated into a regular routine.

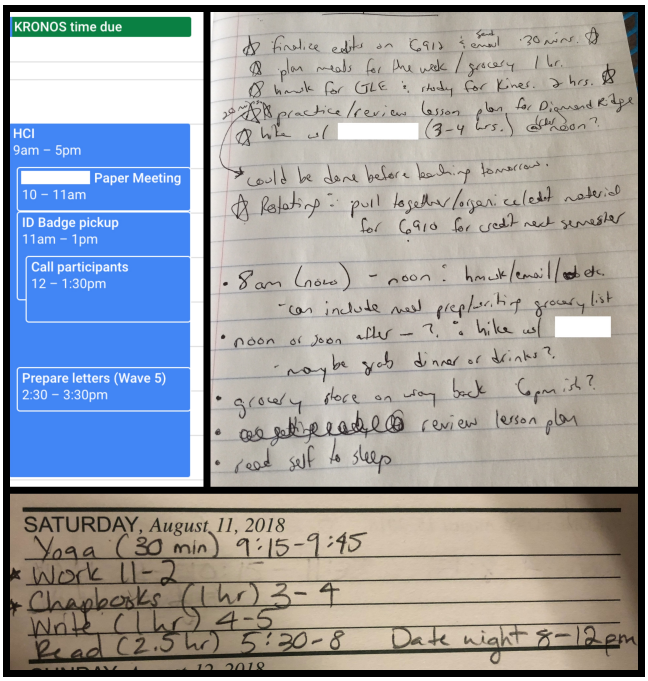


Figure 3: 3 examples of distinct formats participants used when creating plans. D-2 (top left) created a plan by adding calendar events for each task. The tasks were placed on top of an extended event showing what location (e.g., work) they would be done at. D-19 (top right) used a paper list. All the steps of planning can be seen: brainstorming tasks, making notes on them, prioritizing, and placing in the plan below. The schedule of when they would happen is much more fluid than other participants. A time such as "on way back" demonstrates the flexibility of paper or plain text vs. the rigidity of a calendar event. D-3 (bottom) composed their plan in a paper planner, but did not show any drafting or process. Only the final plan with strict times was copied from another source where the plan was originally made.

5.4 RQ3: How do they use software and paper-based tools to engage in TMP?

5.4.1 TMP happens in unstructured tools. When planning according to their prior methods and when asked to use all the TMP behaviors, participants used a variety of tools. Some were used to record the plan they would refer to throughout the day, while others were used to help them remember tasks they needed to complete and events that were already scheduled for the next day. Participants recorded their plans in or on paper planners, plain paper, digital sticky notes, the provided text box in the daily report survey, Samsung Notes, a plain text editor, email drafts, Google Docs, events in Google Calendar, and digital handwriting in Microsoft OneNote. The most common tools referred to when making plans were digital calendars, email, and paper lists respectively. In 4, we collapsed some of these into more general categories (e.g., digital sticky notes, OneNote, and Samsung Notes are each a "Notes Application").

There was a notable absence of specialized or "dedicated" time management tools. This mirrors findings from prior work investigating individuals' time management tool use [8, 23, 33], but was still somewhat surprising considering the vast amount of commercial software developed specifically to support task and time management since even the most recent of these works (2012).

There were no clear differences in tool usages between the different methods of planning participants described in interviews other than that we observed that those who use paper planners in their planning were more likely to create concrete schedules (4 of 5). In the diary activity, most participants (all but 3) created their plans on the same tool for the entire activity. Digital tools were slightly more common, but most interesting is that participants clearly preferred unstructured tools (such as paper lists or text editors) whether they were paper or digital. Of the tools used for recording plans, only two (paper planners and digital calendars) impose any sort of organizational structure. See Figure 4 for more details about which tools participants used when planning prior to the study and during the diary activity.

5.4.2 Planning requires flexibility and imprecision. From observing participants plan live in interviews and the plans they created during the diary activity, we identified common interactions between an individual and their planning tools of choice when engaging in TMP.

Transferring from other sources: locating a task or event in another source (even one's memory) and then copying it down into a concrete plan. Sometimes this was a verbatim copy, but other times the task or event was abstracted ("WRIT 1400" becomes "class") or annotated ("WRIT 1400" becomes "WRIT 1400: make sure to take attendance!!").

Rearranging items: changing the order of tasks and events as one's plan evolves. This is related to the presence of different plan structures mentioned in 3. Some participants made separate task lists which they edited and annotated, then copied them into a different section of the plan in order and with times assigned. Others simply created their plan chronologically, but still needed to draw arrows or copy and paste items to their correct placement as needed.

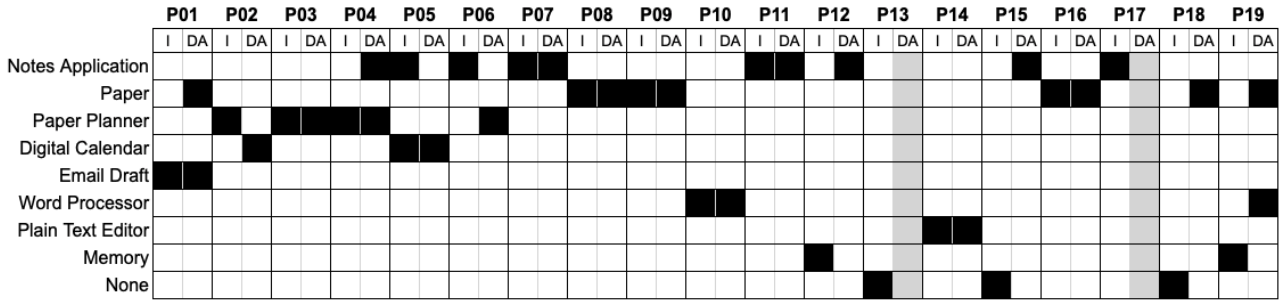


Figure 4: The tools each participant used when engaging in TMP. "I" or the left column for each refers to the tool(s) they described currently using in the interview. "DA" or the right column refers to the tool(s) they used during the diary activity. P13 and P17 did not participate in the diary activity.

Using imprecise times: assigning a time to a task or event that is more abstract or *not* assigning a time. For example, tasks might be included without times in between scheduled events in a plan and others might have a relative time-frame such as "before 2 pm." While not an interaction with a tool per se, it is interesting here because this type of time assignment is straightforward in an unstructured tool, but hard to reproduce in a specialized one like a calendar [11].

Setting reminders: setting an alert to occur at a specific time to prompt beginning a task or preparing for an event. This most often happened through supporting tools such as smartphone alarms or digital calendar notifications. Some participants used this as a way of increasing their focus because they knew they didn't need to worry about their next obligation until a notification went off.

Checking off tasks: marking a task as complete. While it may seem trivial, over half (11 of 19) of our participants specifically mentioned that marking tasks as complete helped motivate them in following their plans. In some cases there was a literal checkbox to tick, other times participants would cross items or, delete typed items, or even throw the plan away to signify completion.

Moving tasks to the next day: copying a task from one day's plan to the next. This happened regularly for participants and also seems trivial, but is in fact an interaction that does not occur in some specialized time management tools where a task simply persists in the same location until it is checked off. Having to intentionally move a task over to another day reminded participants it was there, motivated them to get it done, or even gave them an opportunity to update/revise it if they made some progress on it, but hadn't finished it yet.

Overall, none of these interactions were groundbreaking, but they demonstrated that our participants were leveraging and, in some cases, depending on the flexible structure of the tools they used to facilitate how they engaged in planning.

5.4.3 Comparing with existing tools. As noted above, none of the identified interactions we observed are groundbreaking. Yet, many cannot easily be accomplished in today's most popular productivity applications. We reviewed the 200 most downloaded productivity applications on the Google Play Store [52], and found that dedicated calendar and task management applications (Google Calendar, Microsoft To Do, Any.do, etc.) rely on heavily structured approaches to entering and manipulating one's time management data. A task or event must explicitly be given attributes in predefined fields to allow for basic interactions such as rearranging items (by sorting on metadata) or adding notes. These tools support checking off tasks and setting reminders well due to this structured approach, although it also makes using imprecise times virtually impossible. Transferring from other sources is possible in some applications, but typically the imported items are kept separate from one's other tasks/events or copying items between them is non-trivial (requires multiple menus, recategorization of items, etc.). Ironically, manually copy-pasting even text-based items between applications is rarely supported.

On the other hand, general purpose notes applications in this same group of 200 applications — like Google Keep and Samsung Notes — take a more flexible approach. They allow free-text editing and enforce little to no structure. This means rearranging items, manually copy-pasting items from other lists or days, and using imprecise times are low-effort, but also that setting reminders requires a supporting application. For example, Google Keep allows a reminder to be set for an entire note, but not for a specific item or line within a note. Some notes applications support adding checkboxes inline, although this sometimes requires using a separate editing mode with less flexibility or repeatedly digging through formatting menus.

While neither approach supports all of the interactions we observed our participants engage in well, we note that most opted to use the more flexible, general purpose applications, even if it required using multiple tools or extra steps to achieve the functionality they desired.

6 DISCUSSION

These results show that participants approached planning in different ways, with some of the TMP behaviors happening regularly, such as determining tasks, while others were irregular or absent, such as allocating time for tasks and reconciling tasks with constraints. Our participants broadly found the guidelines we asked them to follow in the diary study provided value as they engaged in TMP, particularly in that it lowered barriers to carrying out their intentions and helped them view their time and tasks more constructively. Despite these positive responses, participants still

varied considerably in how they enacted these behaviors, both between each other and within themselves. These findings offer new insights into TMP that made us change our initial design framing, leading us to design a more flexible tool. This new design in turn yielded insights that can be useful when considering other contexts where there is a tension in how much structure a tool should enforce.

6.1 There is a lot of variation in planning behaviors

Despite the demonstrated value of TMP behaviors, simply knowing that a behavior is valuable is not sufficient for it to become a regular occurrence. Even among a population with likely more advanced time management practices (self-selected graduate students) than more general populations, few of our participants regularly incorporated all the TMP behaviors identified by the literature. Despite their acknowledgement that they found value in the planning they completed in the diary study portion of the project, participants also expressed emotional and logistical drawbacks that suggest that adhering to the TMP behaviors is not always desirable or worth the effort. Further, while we saw people engaging in many of the high-level TMP practices, the *mechanics* they employed to accomplish those practices differed. These variations were not simply due to ignorance or laziness, but real, individual differences that evolve with time and context. In short, while each of the behaviors identified by the literature or observed in the current practices of participants has been demonstrated to provide value, how those practices are combined into a specific process varies from person to person and within each person from day to day.

The design of common time management tools has often focused on (and continues to focus on) trying to create a one-stop shop where all a user's tasks, events, data related to these tasks and events, etc. are captured in one place as structured data. In our initial design, our idea was that this simplifies the user experience and allows richer analysis of the data in context of each other. In practice, this does not seem to be aligned with user needs. Indeed, in addition to our results above, prior studies find that people actually use a variety of tools to manage their time management data and frequently transfer data between them [8, 9, 23, 33]. Our participants, similar to DIYers in Haraty et al.'s work [23], also did not use specialized tools to manage their time generally, so incorporating planning functionality into existing forms of task managers seems unlikely to be successful. Additionally, a primary reason people didn't use specialized tools was because there were too many features, so adding yet another feature-heavy tool is unlikely to help.

6.1.1 Rethinking our initial design. In the context of these findings, it was clear we could not simply continue with the initial design ideas in Figure 1. Instead, we began to revise our plans for the application we thought we should implement. Over seven iterations of app mockups, we worked through multiple approaches to accommodate the results we had collected. Supplemental materials contains all seven iterations. While we tried to maintain some of the elements of our initial design, by the end of this process we produced a very different artifact.

What we ultimately realized, through the process of these iterations, is that our initial problem framing was problematic. Many people in our study were already planning, and it seemed to be working well enough for many of them. People planned differently from each other when left to their own devices, and when we provided them guidance on how we wanted them to plan during the diary studies, we saw that they still engaged in different combinations of TMP behaviors, utilized different formats, and interacted with tools in ways that made the level of structure imposed on the planning process and format unlikely to be useful. These participants would be more likely to abandon our tool than to change their behavior. If we wanted to make a tool that people would use to plan, we had to accommodate their existing practices first. In retrospect, we wish we had seen this all all along, but it was obscured from us by our framing.

Earlier we framed the problem as people finding TMP too cumbersome and being unaware of, or unable to recall TMP behaviors and engage in them regularly. However, we realized that in fact our participants were aware of and capable of employing these behaviors, but adjusted their planning based on individual and contextual factors. Thus, our focus became, given that the tools that people choose to support TMP are general purpose tools that do not have any explicit support for TMP, can we develop a tool that supports their current practices *better* than the existing general purpose tools they are using?

The tools our participants used to make plans were highly flexible and unstructured: pen and paper, notes applications, and other text editors. This suggested to us a possible new form to pursue. Designing for a system with minimal structure and a focus on allowing software-agnostic transfer seemed appropriate.

6.2 Design Reframing: Leveraging a familiar, flexible interface

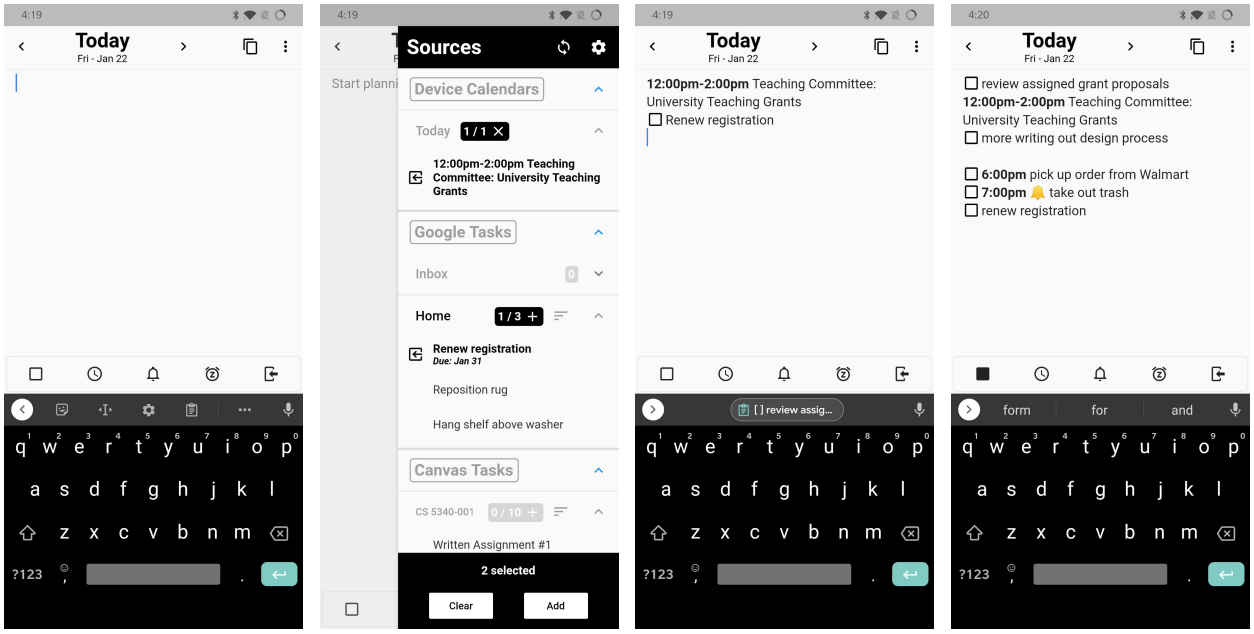
In this section, we describe our revised design. This design is not meant to be seen as the only or "correct" way of integrating the insights drawn from our above work, but it provides a concrete way of contrasting our framing, assumptions, and reasoning before and after conducting the study. It also demonstrates how all the functions/implications we have raised could be implemented together in a form that we believe remains flexible and does not introduce significant burden to the user.

The interface of our new design emulates that of a notes application or basic text editor. As such, it is familiar and easy to understand the possible interactions. The toolbar, instead of supporting formatting options like bold or italics, facilitates some of the additional interactions we observed our participants using when planning that a basic notes application would not, which are identified here:

Transferring from other sources: calendar events and tasks can be copied in from other structured data sources (e.g., Google Calendar, to-do list apps, etc.). A drawer can be revealed where these items can be reviewed and then copied into the plan as text.

Rearranging items: rearranging lines of text can be done by dragging individual lines to the desired location.

Using imprecise times: while specific, formatted times are supported, it is just as easy to type "before 2pm" or "on way back" as an assigned time for a task as our participants did when creating their plans.



(a) Blank when starting (b) Pasting from sources (c) After pasting calendar (d) Additional tasks and events

Figure 5: Screens from current implementation of the app, showing one example process for planning a day

Setting reminders: setting an alert for any line in a plan is done with one tap that sets a specific time for the reminder that can be changed by editing the text on the line or using the time picker.

Checking off tasks: checkboxes can be added to or removed from the beginning of any line with one tap.

Moving tasks to the next day: a "snooze" button copies the current line the user is editing to the next day's plan with one tap.

It is important to keep in mind, and easy to forget given all of the functionality described above, that our design works as a text editor. A user can type, edit, delete, copy, and paste just as they would in the standard notes app or any other text field on their phone. The features supported are flexible and unobtrusive: a user can easily use some, all, or none of the features described above. The value of this design lies in the fact that it makes the activities of planning easier, like adding items from the calendar or to-do list to the plan or assigning times to items. Lowering this barrier even a little can make planning more likely and effective.

6.3 Domain-specific flexible tools

Beyond this specific context of TMP, we see a broader opportunity to explore implementing purpose-built text editing tools in other domains where more structured tools are not working, including some of the types of data identified in Bernstein, *et al's* information scraps work [9], for example: recipes, how-tos, expense tracking and reporting, shopping lists, and inventories. In all of these cases, while a free-text representation might be preferred, we can still imagine a design analogous to the one we describe that could be targeted at supporting each of these contexts. The researchers behind OmniTrack [30] identified a similar need in the context of self-tracking as well:

> They switched to general-purpose apps when (1) tracking apps imposed heavy tracking burden by asking to fill in too many mandatory fields for each entry or (2) existing tracking apps did not support their tracking needs…Simplicity of the input interface was one of the main criteria for choosing a tracking tool to use. [30]

In the deployment of OmniTrack, they also found that some people used long text fields to capture lists of information separated by newlines, which was not a way they had anticipated or intended the tool to be used.

Similarly, other individuals seek additional flexibility in self-tracking by engaging in *bullet journaling* - "a freeform, analog logging system for organizing tasks, events, and notes" [2]. The flexible nature of paper and other physical media offers deep personalization in the format and granularity of self-tracking. This allows the experience to be more fulfilling, intimate, and adaptable to an individual's needs than technology with similar goals [2, 6, 49].

These behaviors further underscore users' desires for flexible and open-ended tools, even when they do not offer any explicit support for that activity.

However, it is worth also pointing out some of what we give up when leaving a structured tool for an unstructured one; namely, some of the features we had initially hoped to implement to offer support for people to improve their TMP behaviors become difficult or impossible when the data is all free-text. Here, we would point

out that all hope is not lost for inferring meaning from these plans. In fact, having a purpose-built text editor offers interesting opportunities for inferring meaning from unstructured data, because there are still some commonalities between plans. Once a tool like this is implemented and actually being used, there is potential to use that data to address some of the goal of our additional prototype, such as support for making time estimates, tracking time spent on different tasks or activities, or providing in-app guidance for people who want to improve their TMP behaviors. This offers an interesting opportunity to combat the chicken and egg problem in personal data [54]. While the unstructured data model can make some of these more challenging, we think it is more important to have a less capable tool that supports real uses, than an interesting research artifact that provides little real-world applicability.

7 CONCLUSION

TMP is an understudied process and the ways that people apply TMP in real life vary both between and within individuals. While many the mechanics we identified in our participants were shared across participants, the ways they combined and instantiated those mechanics in practice were unique. This work offers some opportunities to advance the ways that technology might better support people in managing their time the way they want to. Though many time management tools tend towards a rigid and structured approach — as we originally did — our problem reframing and final design reflect an awareness of the many ways people already engage in TMP today. More generally, the one insight that seems to apply broadly to time management is that people seem to prefer coming up with their own bespoke strategies. Tools that support this rather than fight it are the ones that are most likely to be useful.

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