

Managing Tasks Across the Work-Life Boundary: Opportunities, Challenges, and Directions

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Task management tools allow people to record, track, and manage task-related information across their work and personal contexts. As work contexts have shifted amid the COVID-19 pandemic, it has become important to understand how these tools are continuing or failing to support peoples' work-related and personal needs. In this paper, we examine and probe practices for managing task-related information across the work-life boundary. We report findings from an online survey deployed to 150 information workers during Summer 2019 (i.e., pre-pandemic) and 70 information workers at the same organization during Summer 2020 (i.e., mid-pandemic). Across both survey cohorts, we characterize these cross-boundary task management practices, exploring the central role that physical and digital tools play in managing task-related information that arises at inopportune times. We conclude with a discussion of the opportunities and challenges for future productivity tools that aid people in managing task-related information across their personal and work contexts.

CCS Concepts: • **Human-centered computing** → **Human computer interaction (HCI)**; *Empirical studies in HCI*.

Additional Key Words and Phrases: Task management, work-life boundary, online survey, COVID-19, pandemic.

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1 INTRODUCTION

Task management tools are a family of physical or digital artifacts that facilitate the collection, tracking, and management of task-related information. Task management software for the individual, such as Google Tasks [2], Todoist [5], and Microsoft ToDo [4], have become ubiquitous aids for managing task-related information both in people's work and personal contexts. A broad array of task management software options exist for managing task-related information at the team or organizational levels, such as Asana [1], Trello [6], and Jira [3]. Across individual and team-level contexts, these tools generally share the goal of supporting people as memory aids that capture task objectives, often alongside

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their relevant context. Recent estimates predict that the task management software industry will exceed 4-billion dollars in value by 2023 [7], signifying the area as both active and fruitful for research, innovation, and exploration.

As memory aids, task management tools are often used to record fleeting task-related thoughts as they arise. A person may, for example, temporarily stop cooking dinner to capture new information about a work-related task. Similarly, a person may temporarily suspend a work activity to record new information about a task unrelated to work. Ethnographic studies of task management tools use suggest that such scenarios are common in practice with new task-related information arising either from one's self (e.g., a new idea) or from a third-party (e.g., an e-mail from a colleague) [14, 17]. Regardless of the longevity of these moments, studies of task switching behavior suggest that the process of interleaving of work and personal contexts can be significantly taxing on individuals [70, 75]. As the majority of information organizations were subjected to a Work-From-Home mandate during the pandemic, it remains important to understand how users' task management needs have changed as a new hybrid future of work is realized.

In this paper, we introduce and study *Cross-Boundary Task Management*, a form of task management in which information related to an individual's work-related tasks is managed beyond their work context or information related to an individual's personal tasks is managed within their work context. The goal of our inquiry is to understand how people have utilized task management tools to manage tasks across the work-life boundary and use that understanding to contextualize how these tools should evolve to support new individual and organizational needs that stem from working from home. We report findings from an online survey deployed to 150 information workers during Summer 2019 (i.e., pre-pandemic) and 70 information workers during Summer 2020 (i.e., mid-pandemic) at the same organization. We are particularly interested in understanding how the increased interleaving of work and personal activities due to working from home during the COVID-19 pandemic may have impacted the mid-pandemic cohort's task management strategies [27, 57]. Through our study, we contribute a comprehensive characterization of information workers' cross-boundary management practices and how they have changed during the COVID-19 pandemic. Specifically, we find that:

- Workers in both cohorts use task management tools that in ways that align to their goals and preferences in integrating or separating their work and personal spheres.
- Workers in the mid-pandemic cohort use a larger number of tools to manage work-related tasks than the workers in the pre-pandemic cohort as a result of team practices.
- Workers in the mid-pandemic cohort manage work-related tasks beyond work hours less often than the workers in the pre-pandemic cohort by a 24% decrease in proportion.
- Workers in the mid-pandemic cohort manage work-related tasks during 8PM-12AM more often than the workers in the pre-pandemic cohort by a 20% increase in proportion.
- Workers in the mid-pandemic cohort experience less cognitive difficulty in interleaving cross-boundary task management within personal and work-related activities than workers in the pre-pandemic cohort.
- Workers in both the pre-pandemic and mid-pandemic cohorts exhibit significant overlap in their feature requests for supporting cross-boundary task management.

From our findings, we extrapolate key questions directed at motivating next-generation task management tool design in settings where people's way of working has fundamentally changed, acknowledging that the future of work in the very near term will increasingly challenge work-life boundaries. We discuss our findings in the scope of the emergent landscape of distributed and remote work that exists today. We conclude with a discussion on the opportunities, challenges, and directions for studying task management practices and designing future task management tools as information work continues to evolve both at the individual and organizational level.

2 RELATED WORK

Our work makes strides in understanding how people utilize task management tools to manage tasks across the work-life boundary. Here, we describe related literature from occupational health psychology, cognitive science, human-computer interaction, and other areas of study that have examined the impact of the COVID-19 pandemic on information work.

2.1 The Work-Life Boundary

2.1.1 Theory. The “Work-Life” boundary has been described through two complementary theoretical lenses: Boundary Theory [11] and Border Theory [32]. Boundary theory posits that people “create, maintain, or change boundaries in an effort to simplify and classify the world around them” [11]. When applied to the work-life context, the theory postulates that people’s established boundaries are molded by the personal meanings that people assign to work, to home, and the transition between the two – each of which affects the ‘role’ (i.e., work or nonwork) that an individual assumes at a particular moment in space and time. [83]. For example, an individual may be more likely to assume the “work” role when working physically in their organizational workplace during normal work hours. In contrast, the “nonwork” role may be more likely to be assumed while at home on a weekend. Importantly, the role that people assume can also be affected by environment artifacts that blur the boundary (e.g., a family photo on an office desk) [104].

In contrast, Border Theory is a theory “about work-life balance” [32]. The theory postulates that boundaries are dividers that take three primary forms: physical, temporal, and psychological – each of which may have varying degrees of flexibility, strength, and permeability [50]. Border Theory also distinguishes itself from Boundary Theory with a categorization of people entitled “border keepers” who manage boundaries between work and nonwork [9]. For example, a manager may act as a border keeper for the work context while a spouse may act as a border keeper for the nonwork context. However, in practice, research has shown that people may be unable to realize such a preference as a result of “role blurring” in which they experience difficulty in separating their work and nonwork roles [36]. Boundary management preferences can be shaped by a range of factors, such as job role, workplace attitudes, and family situation [60], and several instruments have been developed for measuring these preferences reliably [36, 65].

Beyond these concepts, research generally reinforces the notion the importance of maintaining a boundary (or border) between work and nonwork. Theories of psychological recovery [52, 78] suggest that boundaries allow people to recover the “resources” expended from engaging in work activities. Studies have repeatedly shown that adequate recovery facilitates long-term benefits for well-being, such as work performance [20] and higher satisfaction with life [91]. The lack of a boundary has been shown to contribute to an inability to psychologically detach from work, particularly with unfinished tasks [20, 24].

2.1.2 Supporting the Work-Life Boundary. Understanding pathways for supporting people’s work-life boundaries has been of growing interest for recent HCI research [48, 85]. A significant series of studies has, for example, focused specifically on understanding how mobile devices and constant connectivity affect the work-life boundary with varying results [28, 30, 31, 33, 42, 88]. Other studies have provided empirical accounts for a range of techniques for supporting the work-life boundary including volunteering [81], mindfulness or cognitive-behavioral therapy programs [53, 54], and interactive systems that operationalize these concepts by design (e.g., SwitchBot [101]).

2.2 Task Management Practice

Task management tools allow people to record, track, and organize task-related information. As memory aids, task management tools are frequently used as the every-day tool for reminders [84]. The concept of task management has

been utilized in designing new systems that intelligently serve reminders (e.g., based on context [38, 59, 67]). More recent realizations of such technologies take the form of intelligent personal assistants, such as Siri, Google Assistant, or Cortana, which people have also used to support their work and personal contexts [47]. More broadly, task management tools have been used to support the recovery of interrupted or suspended work by automatically capturing and later resurfacing a task’s relevant context [15, 39].

2.2.1 Defining Task Management Practice. The study of task management tools has been a focal point of Personal Information Management (PIM) research for decades, motivating early examinations of task management and its overarching role in people’s work practices [58]. Ethnographic examinations of task management practice have shown that people have personalized strategies for managing their tasks and that task management itself is highly contextual [14]. Studies of task management practice in more niche contexts have similarly found individual differences can play a substantial role in how people choose to manage and prioritize their tasks [51, 63].

Alongside these prior studies, more recent research in HCI has focused on defining, characterizing, and understanding productivity through the lens of the individual. In a two-week, mixed-methods diary study with 24 knowledge workers, Kim et al. identified six themes that individuals apply in assessing their productivity through a personal lens [64]. Guillou et al. conducted a “holistic” examination of productivity with 40 knowledge workers to rate how they spend their time and personally define “time well spent” [49]. From their one-week experience sampling study, Guillou et al. found that reflecting on how their time was spent allowed some, but not all workers to improve their awareness and perception of their work. Most recently, in a repeated interview study with 15 academics and early-career researchers during the first COVID-19 lockdown in the United Kingdom, Ahmetoglu et al. found that the majority of participants disengaged from their pre-pandemic planning routines, and that two planning techniques – breaking down tasks and manual time-tracking – were effective at aiding productivity [8]. Collectively, these studies highlight new opportunities for exploring task management tools that align to users’ personal characterizations of productivity as the nature of information work continues to change.

2.2.2 Studies of Task Management Tools. Today, a range of commercial tools exist for aiding people in managing their tasks (see Table 1). Studies of task management tool use generally focus on providing a thorough examinations of a particular type of tool with the exception of several more qualitative studies. For example, Bellotti et al. [14] conducted a comprehensive examination of task management tool use and practice with the goal of designing personalized to-do list software. Bernstein et al. [17] examined the use of “information scraps” (i.e., loose-leaf paper artifacts) in task management practices and provided a set of design goals for personal information management tools. While many tool types are limited in study due to commercial ownership, e-mail has been the focus of much task management research within the HCI literature with findings highlighting its potential for serving as an independent task management tool [73], overloading people with information [100], automatically extracting tasks as to-do items [15]. Other examinations of e-mail have also explored its use within the context of boundaries between work, such as Cecchinato et al. [29] who introduced the notion of “micro-boundaries”. More broadly, surveys of task management practice have shown that task management can occur across multiple tools, leading to challenges of interoperability and re-finding [21, 22]. More recent research has explored opportunities for embedding intelligence into task management interfaces. Toxtli et al. [95] explored the feasibility of managing tasks through a chatbot named TaskBot. Other studies, such as ShareDo [61], have explored how mixed-initiative intelligence techniques can augment traditional task management interfaces via collaboration. While additional systems have been introduced in several unique task management contexts, they have yet to make their way into consumer markets [16, 44, 82].

2.3 Working-from-Home and the Impact of the COVID-19 Pandemic

It is generally well-understood that the COVID-19 pandemic has fundamentally changed the nature of work. In a repeated survey deployed to working Americans during April 2020 and May 2020, Brynjolfsson et al. reported that 34% of the workforce, specifically younger people, had switched to a **Work-from-Home (WFH)** work practice [26]. In an online survey deployed monthly between May 2020 and March 2021 to more than 30,000 Americans, Barrero et al. found that WFH is the predominant preferred working arrangement and that a 5% productivity boost could arise if employers re-optimize for these work arrangements [13]. While these studies suggest that information work will continue to shift toward more remote contexts, the long-term future of work practices is perceived as significantly uncertain for employers and employees alike [79]. This uncertainty is driven partially by analyses that suggest upward of 71.7% of the entire US workforce could work remotely if necessary [18].

2.3.1 COVID-19 and Individual and Organizational Productivity. Understanding COVID-19's effect on individual productivity has been a key interest for HCI research [23]. In a two-part survey with 200 developers in April 2020 and May 2020, Russo et al. observed no differences in how developers spend their time at home and in the office and concluded that working remotely is “not per se a challenge for organizations or developers” [86]. In April 2020, Miller et al. conducted a survey with developers at Microsoft and observed that 74% of respondents missed social interaction with colleagues with 51% of respondents reporting a decrease in communication ease with colleagues [80]. From data collected from a 14-month longitudinal survey study with developers that began in April 2020, Russo et al. found that developers' well-being and social contracts had improved in quality while emotional loneliness had decreased [87].

Research has given significant attention to understand the pandemic's effect on management in information organizations. In August 2019 and August 2020, Teodorovicz et al. deployed an online survey to 1,192 managers in knowledge work settings to better understand how the pandemic has changed their time allocation practices [94]. From their study, the authors found that managers reallocate their pre-pandemic commute time with virtual meetings in order to “recoup some of the extemporaneous interactions that typically happen in the office”. The authors also observed that managers were disproportionately affected by the pandemic if they were employed by larger organizations with a broader number and variety of people. Similarly, in a study with 1,700 managers in Germany's information and industrial sector, Erdsiek et al. found that larger organizations are more likely to expect a “persistent shift” toward an adopted WFH practice [41].

Beyond the level of the individual, a wealth of HCI research has aimed to better understand how WFH practices have changed organizational productivity. In a large-scale analysis of e-mail and meeting data collected from Microsoft workers in the early stages of the pandemic, Yang et al. [103] observed a decrease in time devoted to focused work and a decrease in inter-organizational communication and collaboration. The latter was also observed by Zuzul et al.'s analysis of 362 billion email receipts from 4,361 organizations in Germany from 2019 and 2020 [105]. Both Yang et al. and Zuzul et al. reported that the magnitude of the observed effects was significantly less if workers were already engaged in a pre-pandemic WFH practice.

2.3.2 The Nonuniform Impact of COVID-19. Prior studies report a collective consensus that suggest individuals are non-uniformly impacted by the COVID-19 pandemic. In a two-part study with repository mining and an online survey, Silveira et al. identified 12 themes related to productivity, code, and developer wellbeing to conclude that the COVID-19 pandemic has nonuniformly impact “is not binary, but rather a spectrum” [90]. Through an online survey repeatedly administered to employees at Microsoft, Ford et al. observed a dichotomy exists among workers that primarily experience new benefits in the shift to WFH while another group of workers experience new challenges [43]. Ford et al. notes that

the presence of these benefits and challenges can hinge both on personal factors (e.g., family needs) and on work-related factors (e.g., reliance on teammates). A similar dichotomy was observed by Bao et al. in their study of developers’ daily activities working at Baidu [12]. Both Ford et al. and Bao et al. provide generalizations of nonuniform impact with significant opportunity for further examination related to individual constraints. For example, Deole et al. found that individuals with higher autonomy in their work are more inclined to not only have their work hours change, but also have them increase more generally [35].

Research has shown that the shift to WFH has nonuniformly affected men and women during the COVID-19 pandemic. In a study with 233 Brazilian software developers during April 2020, Machado et al. reported that, when working from home, women are more likely to experience interruptions (e.g., caretaking or home-schooling) and are more likely to engage in more meetings due to team-related decisions or information needs [72]. From an online survey with 94 women at Sony Ericsson, Trinkenreich et al. reported that many of the facets challenges identified by Machado et al. continue to serve as barriers to entering and remaining in the software development profession [97].

2.4 Contribution

Our work builds upon this prior literature by examining how common task management tools are used to manage task-related information across the work-life boundary. While prior work has studied general task management practice [14] and the broad effect of COVID-19 on information work patterns [94], we provide a comprehensive assessment of task management tool use and how it relates to the boundaries that people seek to maintain between work and nonwork. We specifically show how cross-boundary task management is common practice and contribute an understanding of how this practice has changed during the COVID-19 pandemic. To our knowledge, our research is the first to broadly examine the role that physical and digital tools play within the specific scope of managing task-related information across the work-life boundary at a large technology corporation. More generally, our work provides a pre-pandemic baseline for understanding how people use task management tools to manage work-related and personal information.

3 ONLINE SURVEY: SUMMER 2019 & SUMMER 2020

Our overarching research question is: *How have practices for managing tasks across the work-life boundary changed during 2019 and 2020?* Specifically, we seek to address the following four questions derived from this primary question:

[RQ1] *“How has the context in which tasks are managed across the work-life boundary changed during the COVID-19 pandemic?”*

[RQ2] *“How have the perceptions, frequencies, and challenges of managing tasks across the work-life boundary changed during the COVID-19 pandemic?”*

Table 1. Types and examples of task management tools.

Tool Type	Tool Examples
<i>Loose-leaf Paper Artifacts</i>	Sticky notes, paper scraps.
<i>Bound or Collated Paper Artifacts</i>	Paper lists, notepads, notebooks.
<i>To-Do Software Applications</i>	Google Keep, Microsoft ToDo.
<i>Notebook Software Applications</i>	EverNote, OneNote, Notability.
<i>Email Software Applications</i>	Outlook Inbox, Gmail.
<i>Calendar Software Applications</i>	Outlook Calendar, OS X’s Calendar.
<i>Job-Specific Software Applications</i>	Taskboard for Visual Studio Online.
<i>Intelligent Assistants</i>	Siri, Google Assistant, Cortana.

[RQ3] “How has the role of task management tools changed for people in managing tasks across the work-life boundary changed during the COVID-19 pandemic?”

[RQ4] “How have design opportunities for task management tools as systems for supporting people in managing tasks across the work-life boundary changed during the COVID-19 pandemic?”

Based on prior work on task management practice and interruption theory, we designed and deployed an online survey to answer each of these questions through the lens of retrospection and introspection [21, 96].

3.1 Survey Design

The survey began by inquiring about participants’ demographics (i.e., age, gender, job role, years of experience) following the appropriate guidelines for collecting such information [89]. As a proxy for the temporal dimension of the work-life boundary, we also asked participants to report the hour of the day closest to when they usually start and stop working. The remainder of the survey was split into four sections, each of which emphasizes a focal point for understanding how people manage work-related and nonwork-related tasks: (1) General Task Management Practices, (2) Managing a Work Task Beyond Work Hours, (3) Managing a Nonwork Task during Work Hours, and (4) Preferences for Separating Work and Nonwork. The survey was designed to require fewer than 30 minutes and is available as supplementary material.

Table 2. Statements administered in the survey’s *General Task Management Practices* section.

I. Work Schedule	Data Type
1. I normally start my workday at _____.	Hour of Day (Categorical)
2. I normally stop my workday at _____.	Hour of Day (Categorical)
II. Primary Task Management Tool Use	
3. Indicate the primary tool that you use to manage tasks RELATED to work (i.e. “work tasks”).	Tool (Categorical)
4. Indicate the primary tool that you use to manage tasks UNRELATED to work (i.e. “nonwork tasks”).	Tool (Categorical)
III. Frequency of Cross-Boundary Task Management	
5. I use my tools to create and manage my work-related tasks during my work hours.	Likert (Ordinal)
6. I use my tools to create and manage my work-related tasks outside of my work hours.	Likert (Ordinal)
7. I use my tools to create and manage my nonwork tasks outside of my work hours.	Likert (Ordinal)
8. I use my tools to create and manage my nonwork tasks during my work hours.	Likert (Ordinal)
IV. Frequency of Cross-Boundary Task Management Across Tools	
9. How frequently do you use each tool in Table 1 to manage my work-related tasks during work hours?	Likert (Ordinal)
10. How frequently do you use each tool in Table 1 to manage my work-related tasks outside of work hours?	Likert (Ordinal)
11. How frequently do you use each tool in Table 1 to manage my nonwork tasks during work hours?	Likert (Ordinal)
12. How frequently do you use each tool in Table 1 to manage my nonwork tasks beyond work hours?	Likert (Ordinal)
V. Organization of Cross-Boundary Task Information	
13. How many active tasks do you currently have for work and nonwork in your primary tool(s)?	Number of Tasks (Categorical)
14. How many groups (or lists) do you use for organizing nonwork and work in your primary tool(s)?	Number of Groups (Categorical)
15. Do you have any lists / groups that include both work tasks and nonwork tasks?	Yes/No (Binary)
Yes → 15.1 Briefly explain why you mix tasks that are work-related and nonwork-related within the same list.	Free-form Text
No → 15.2 Briefly explain how you prioritize work in your shared work-nonwork list.	Free-form Text

3.1.1 *General Task Management Practices.* As shown in Table 2, the survey section began by asking participants to indicate the hour of day closest to which they typically start and stop their workday. The survey then asked participants to indicate (1) the primary tool they currently use for managing work-related tasks and (2) the primary tool they currently use for managing nonwork-related tasks. In answering these questions, we provided respondents with a list of tools, shown in Table 1, that was populated based on older [14, 17] and newer [98] studies of task management tools. An “Other” option was also provided to allow participants to specify unnamed tools. After reporting their primary task management tool used for work and nonwork, the section asked participants to indicate how frequently they engage in creating and managing task information related to work and nonwork in both during and beyond work hours.

Participants were then asked to report the frequency at which each tool in Table 1 is used in these same settings. The section concluded by inquiring about the number of active tasks they keep in each tool, how they organize their tasks, and whether they organized tasks related to work and nonwork in individual lists.

Table 3. Abbreviated outline of the retrospective rehearsal for contextualizing participants' task management practices.

	Data Type	Reference
I. Think of the last time you created a [...] task while you were [...]		
16. What information did you record in your task management tool?	Free-form Text	[14]
17. Did you categorize this information when you recorded it in your tool?	Yes/No (Binary)	[14]
Yes → 17.1. What was the name of the category you added it to?	Free-form Text	NA
17.2. Briefly describe your rationale for categorizing the information.	Free-form Text	NA
No → 17.3. Briefly describe your rationale for not categorizing the information.	Free-form Text	NA
II. Time of Task Information Recording		
18. This task was created in my tool on a _____.	Day (Categorical)	[14, 47]
19. This task was created in my tool between _____ and _____.	Time (Categorical)	[14, 47]
III. Returning to the Primary Task		
20. Briefly describe what you were doing before you recorded the information.	Free-form Text	[14, 102]
21. Briefly describe what you did after you recorded the information.	Free-form Text	[14, 102]
22. After creating the task, I had difficulty returning to what I was doing beforehand.	Likert (Ordinal)	[70]
23. After creating the task, I continued to think about this task after recording information in my tool.	Likert (Ordinal)	[70]
IV. Using the Recorded Task Information *		
24. When I started the task later, I was satisfied with how I had recorded the task.	Likert (Ordinal)	NA
25. When I started the task later, I was satisfied with how I had organized the task.	Likert (Ordinal)	NA
V. Desired Features for Supporting Cross-Boundary Task Management		
26. What features would you like to see in future tools for [...] tasks that arise [...]?	Free-form Text	[14]

*If the task was not completed, participants were told to select "N/A".

3.1.2 *Managing Tasks Across the Work-Life Boundary.* To contextualize how participants utilize their task management tools across the work-life boundary, we adopted a retrospective rehearsal protocol [96] in which participants were asked to think about two events: (1) “the last time you created a task unrelated to work with their task management tool while they were at the workplace (e.g., in their office, in a meeting, etc.)” and (2) “the last time you created a task related to work with their task management tool while they were away from work (e.g., at home, doing errands, etc.)”.

Table 3 outlines the retrospective questions used to capture information about participants' cross-boundary task management experiences across these two scenarios. Prior studies have recognized lingering thoughts that ultimately trigger distractions or interruptions in an individual's activity [70]. We therefore modelled the design of this section around prior studies qualitative and quantitative of interruptions from the HCI literature [74, 76, 77, 102] to specifically inquire about the side effects that stem from temporarily shifting your attention to toward managing task-related information.

Complementary to the goal of understanding the perceptions of side effects surrounding the management of tasks across the work-life boundary, we sought to identify the opportunities and challenges that exist in supporting people in managing tasks across the work-life boundary (e.g., new interactive systems). Each retrospective rehearsal concluded by asking participants to indicate the devices they either currently use or have a desire to use to “record or manage” their tasks across each scenario. The list of devices was inspired by the recent cross-device taxonomy described in Brudy et al. [25] and included five types of devices: (1) Desktop / Laptop, (2) Mobile, e.g., smartphone, (3) Wearables, e.g., Apple Watch, (4) Smart Speakers, e.g., Amazon Echo, and (5) Smart Headphones, e.g., Apple AirPods. In addition, participants were asked about any features they would like to see included in their task management tools.

3.1.3 *Work-Life Indicator.* The final section of the survey administered the Work-Life Indicator (WLI) [65], a 17-item (5-point Likert) questionnaire to measure respondents' boundary management strategies for separating work and nonwork. Using an individual's responses, the WLI categorizes people into one of six profiles: (1) Work Warrior, (2)

Table 4. Four additional questions related to the work-life boundary and tool support included in the mid-pandemic (2020) deployment.

State your agreement with the following statements related to the current WFH situation:	Data Type
27. <i>The worklife boundary was blurred before the current situation.</i>	Likert (Ordinal)
28. <i>The worklife boundary has become more blurred in the current situation.</i>	Likert (Ordinal)
29. <i>How are your current task management tools correctly supporting your needs during the work-from-home mandate?</i>	Free-form Text
30. <i>How are your current task management tools failing to support your needs during the work-from-home mandate?</i>	Free-form Text

Overwhelmed Reactors, (3) Fusion Lovers, (4) Dividers, (5) Nonwork Eclectics, and (6) Family Guardians, each of which uniquely describes how an individual prefers to integrate or separate their work and nonwork spheres. As profile types, Nonwork Eclectics, Family Guardians, and Work Warriors tend to shape their boundary preferences around one particular factor (e.g. a hobby, family, or work) while Fusion Lovers and Dividers tend to adjust their preference contextually. The primary distinction between Fusion Lovers and Dividers is the prior prefers integrate their work and nonwork while the latter prefers separating the two spheres to the fullest extent possible.

Prior studies have used the WLI to better understand the role that technology can play in supporting people’s practices for managing the boundary between work and nonwork [30, 42, 68, 102]. For our study, we employed the standard practice for calculating participants’ WLI profiles by taking the mean of each of the instrument’s five dimensions [65].

3.1.4 Survey Additions for the 2020 Deployment. To better contextualize the second survey deployment’s data, a fifth stage was added in which participants were asked about their perceptions of the work-life boundary both before and after the emergence of COVID-19. Table 4 lists the four questions that ask participants to state their agreement with two questions concerning the perception of the work-life boundary alongside two additional open-ended questions about how tools are correctly or incorrectly supporting their needs.

3.2 Participant Recruitment

We deployed our survey in two iterations: once during July 2019 and again during July 2020. Across the two deployments, a total of 220 participants were recruited by randomly sampling an internal company-wide employee list at Microsoft Corporation, a large, US-based technology corporation that instituted a company-wide ‘work-from-home’ mandate on March 5, 2020. The sampling methodology did not allow July 2019 respondents to complete the July 2020 survey. Participation was voluntary, and the use of “physical or digital tools for recording, tracking, or managing tasks” was the only requirement for participation.

3.2.1 Pre-Pandemic Cohort (P1-P150). 150 individuals (104 men / 44 woman / two non-binary) participated in the first deployment of our survey. 25-34 years old (27) was participants’ most commonly reported age range with 25-34 (27), 35-45 (17), 45-54 (15), 55-64 (7), and 18-24 (4) being less frequently reported. Participants’ job roles included project manager (53), software engineer (53), business manager (17), designer (9), service engineer (4), hardware engineer (3), security engineer (2), operations manager (2), data scientist (2), HR administrator (2), finance manager (2), and community manager (1). 135 participants (90%) held at least a college degree, and 87 participants (58%) had five or more years of experience in their job role. Observed WLI profiles across our pool of the Summer 2019 respondents included all six profile types: 43 Nonwork Eclectics (28.7%), 30 Fusion Lovers (20%), 29 Family Guardians (19.3%), 16 Overwhelmed Reactors (10.7%), 15 Dividers (10%), and 9 Work Warriors (6%).

3.2.2 Mid-Pandemic Cohort (P151-P220). 70 individuals (47 men / 19 woman / one non-binary) responded to our survey. 25-34 years old (27) was participants’ most commonly reported age range with 35-44 (16) and 45-54 (16) being reported

nearly half as often. The age ranges of 18-24 (4) and 55-64 (7) were less present. Participants' job roles included software engineer (29), program manager (26), business manager (4), service engineer (4), technical writer (4), designer (2), security engineer (2), and hardware engineer (1). 63 participants (90%) held at least a college degree, and 43 participants (61%) had 5 or more years of experience in their job role. WLI profiles spanned all six profiles: 19 Nonwork Eclectics (27.1%), 14 Overwhelmed Reactors (20%), 12 Fusion Lovers (17.1%), 10 Family Guardians (14.2%), 8 Dividers (11.4%), and 7 Work Warriors (10%).

3.3 Analysis Methods

Our survey design resembles a repeated cross-sectional survey design in which the same survey has been administered multiple times to different samples of individuals in a given population. Cross-sectional survey designs have become a common utility for identifying trends over time and comparing these trends across groups. Prior studies have found that task management is a highly individualized practice [14], and we therefore chose to drive our inquiry with open coding and affinity diagramming to identify themes in participants' open-ended responses, but also better contextualize their broader survey responses [69]. We complement qualitative discoveries with various descriptive statistics and statistical significance tests, such as Mann-Whitney U-tests and Fisher exact tests, based on the number of compared groups. To account for scenarios involving multiple testing, we further examine statistical significance using Bonferroni post-hoc tests. We describe the details of our qualitative and quantitative methods in each of the following sections.

4 FINDINGS

In this section, we describe the findings from the analysis of our survey deployed during Summer 2019 and 2020. We organize this section into subsections in which each research question outlined in Section 3 is independently discussed alongside a supporting table of the relevant survey data used to address the question at hand.

Table 5. Research questions and survey data points used in Section 4.1 to address RQ1.

RQ1.1: How has the timing of the transition between work and home changed?		
- The closest hour at which work normally begins for the respondent.	Categorical	Table 2: Q1
- The closest hour at which work normally ends for the respondent.	Categorical	Table 2: Q2
RQ1.2: How have the settings in which cross-boundary management occur changed?		
- Free-form responses regarding the task that was being done before using a tool to manage a task.	Text	Table 3: Q21
- Free-form responses regarding the task that was being done after using a tool to manage a task.	Text	Table 3: Q22
RQ1.3: How have the times in which cross-boundary management occur changed?		
- The closest hour at which the respondent recorded their task information in their tool.	Categorical	Table 3: Q19

4.1 Understanding the Context of Cross-Boundary Task Management

We now present findings related to understanding how the context of cross-boundary task management has changed during the COVID-19 pandemic. To address RQ1, we define "context" through lens of three attributes that prior research has identified as being central to understanding tool-use in-the-wild: *activity*, *place*, and *time* [37]. Table 5 shows the three questions derived through this notion of context alongside the survey data we used to address them. To analyze responses to Q21 and 22, we developed a top-down coding process in which each response was coded with a unique label for *place* (i.e., the physical location in which information was recorded) and a unique label for *activity* (i.e., the activity being performed before recording task information). All disagreements were resolved via discussion. Responses were categorized *only* if it was unambiguous. All ambiguous responses were coded as "Other". After resolving disagreements via discussion, we observe high agreement between annotators ($\kappa=0.74$).

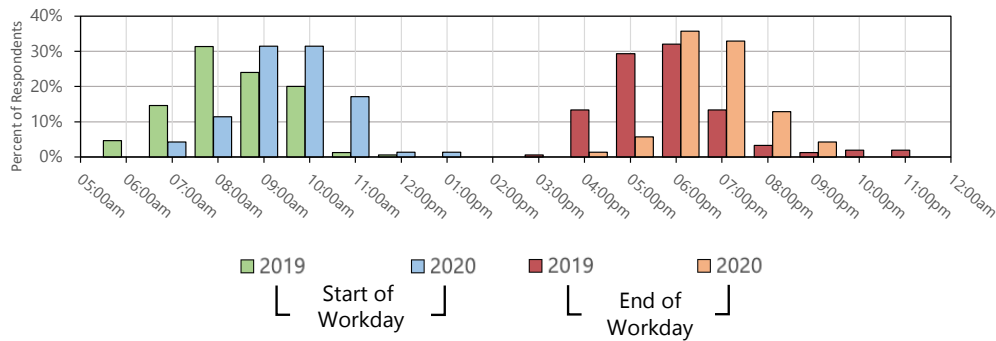


Fig. 1. Histogram of participants' start times and end times for work during 2019 and 2020.

4.1.1 *Understanding Changes in the Work-Life Schedule.* We find that the scheduling of the key transitions between work and nonwork have changed. Using a Fisher's Exact Test, we found that a statistically significant difference in the time at which work begins between the pre-pandemic cohort and the mid-pandemic cohort ($p < 0.001$) as well as the time at which work ends ($p < 0.001$). As shown in Figure 1, 8:00am was most frequently reported by 41 participants (31.3%) as the closest time at which the workday begins. In contrast, 6:00pm was most frequently reported by 48 participants (32.0%) as the time at which the workday ends. Alongside start and end times of participants' workdays, we observe that the length of participants' workdays for Summer 2019 ($\mu = 9.11$ hours, $\sigma = 1.32$) averaged slightly less than the length of participants' workdays for Summer 2020 ($\mu = 9.35$ hours, $\sigma = 1.06$). Despite statistically significant differences being present between the start and end time of participants' workdays, we did not find that differences in the length of workday to be significant between Summer 2019 and Summer 2020 ($p = 0.29$). These findings collectively suggest that the length of workday has not changed between the two years, despite the primary temporal transitions between work and nonwork taking place, on average, 1-2 hours later for the mid-pandemic survey cohort.

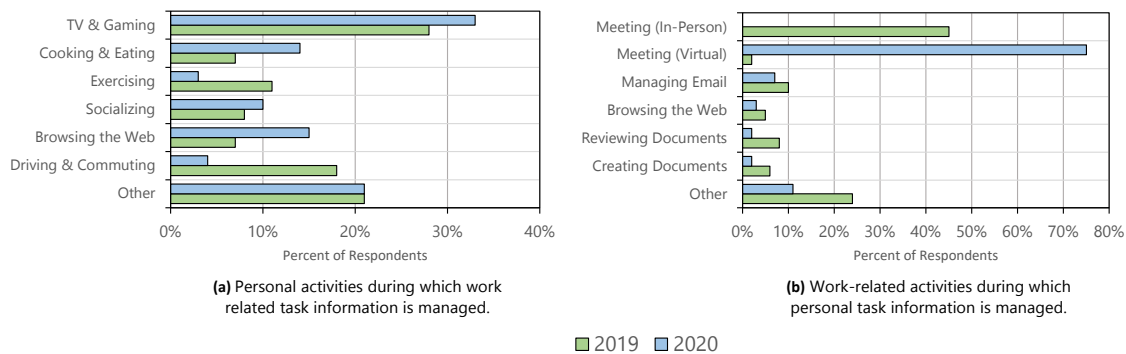


Fig. 2. Histograms showing the proportion of personal and work-related activities during which cross-boundary task management was interleaved between the 2019 (pre-pandemic) and 2020 (mid-pandemic) survey deployments.

4.1.2 *Understanding Peripheral Activities in Cross-Boundary Task Management.* The coding process yielded a total of seven work-related activities and seven personal activities representing all 220 participant responses. As shown in Figure

2a, watching television and playing video games was the most commonly described personal activity during which participants’ manage work-related tasks. Notably, the proportion of responses that related to Driving and Commuting was 14% smaller for the mid-pandemic cohort while the proportion of other activities, such as Browsing the Web, Cooking and Eating, Socializing, was marginally larger. A Fisher’s exact test showed a statistically significant difference in the proportion of personal activities between the survey cohorts ($p=0.01$).

Alongside the change in proportion of personal activities interleaved with cross-boundary task management, we observe a significant shift in the proportion of work-related activities during which personal task information is managed. As shown in Figure 2b, we observe a 73% increase in the proportion of responses related to managing personal information during virtual meetings for the mid-pandemic cohort. We similarly see a decrease for every other work-related activity experienced in 2019, specifically noting the 45% decrease in the proportion of in-person meetings. A Fisher’s exact test showed a statistically significant difference in the proportion of work-related activities between the pre-pandemic and mid-pandemic cohorts ($p<0.001$).

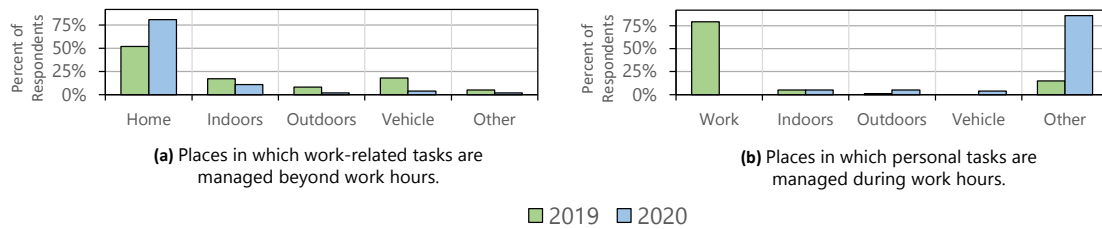


Fig. 3. Histograms showing the proportion of places at which participants’ instances of cross-boundary task management took place between the 2019 (pre-pandemic) and 2020 (mid-pandemic) survey deployments.

4.1.3 Understanding Where Cross-Boundary Task Management Takes Place. Alongside the 14 activity labels, our coding process produced a total of five high-level labels for places in which participants’ moments of cross-boundary task management took place: (1) Home/Work, (2) Indoors, (3) Outdoors, (4) Vehicle and (5) Other. As the specific goal of this process was to provide a general characterization of where moments of cross-boundary task management take place, these five labels are designed to characterize “place” relative to the notion of “home” and “the workplace”. For example, the notion of “Indoors” in the context “home” indicates an indoor building that it not the home. Similarly, “Indoors” in the context of ”work” indicates an indoor building that is not the workplace. This is specifically motivated by Gajendran et al. who applied labels to physical locations in the same relative fashion [46]

As shown in Figure 3a, the most commonly associated place in which cross-boundary task management took place was in the home for both survey cohorts. We observe that the proportion of responses associated with home is 29% larger for participants in the mid-pandemic cohort while the proportion of other identified places diminishing significantly, namely the “Vehicle” place which decreased by a proportion of 14% between the pre-pandemic and mid-pandemic cohorts. Using a Fisher’s exact test, we find a statistically significant difference in the proportion of places for managing work-related tasks between the survey cohorts ($p<0.001$).

As seen in Figure 3b, the proportion of identified places in which personal tasks are managed during work hours exhibits a bimodal distribution between cohorts. As made evident by the 86% of responses labeled as “Other”, we

experienced significant challenge in determining where a particular activity was taking place. For example, consider the P29’s response when describing what they were doing before recording their task’s information:

*“I was working on work tasks. I finished a group meeting.
I was syncing my calendar around meetings.” (P29, Nonwork Electric)*

Similar challenges for categorizing *place* were observed with responses that referenced “sitting on the toilet” (P72), being “in a meeting with boss or team” (P142), and “working and remembered that I need to re-park the car” (P194). Each of these activities can occur in the home or in the workplace, and without sufficient explicit reference to either, we were unable to label these instances in a more fine-grained fashion. We discuss this further in Section 5.

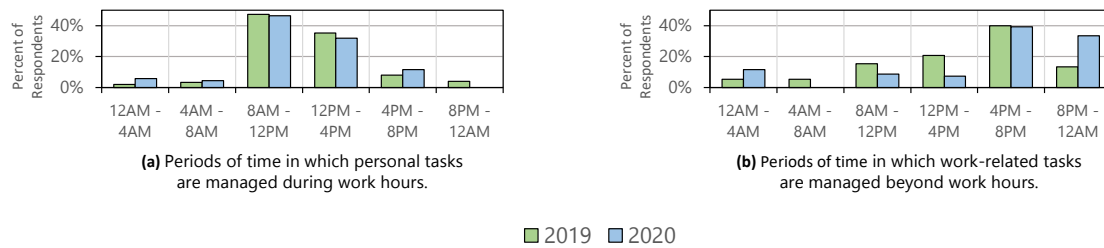


Fig. 4. Histograms showing the proportion of reported times at which participants’ instances of cross-boundary task management took place between the 2019 (pre-pandemic) and 2020 (mid-pandemic) survey deployments.

4.1.4 Understanding the Timing of Cross-Boundary Task Management. Figure 4 shows the periods of time in which participants reported using their tools in their described instances of cross-boundary task management. As shown in Figure 4a, 47% of participants in the pre-pandemic cohort and 46% of participants in the mid-pandemic cohort collectively identified 8AM-12PM as the time period associated with their instance of cross-boundary task management. In comparison, the 12PM-4PM time period was reported less often by 35% and 32% of participants in the pre-pandemic and mid-pandemic cohorts respectively. The remaining time periods accounted for smaller proportions ranging from 1% to 12%. A Fisher’s exact test did not show a statistically significant difference in these proportions ($p=0.78$), suggesting that the time at which personal activities are managed during work hours has not changed during the pandemic.

In contrast to the timing associated with managing information associated with personal tasks, we observe a significant distinction in the proportion of time periods associated with managing work-related tasks beyond work hours. As shown in Figure 4b, 40% of participants in the pre-pandemic cohort and 39% of participants in the mid-pandemic cohort collectively identified 4PM-8PM as the time period in which they manage work-related task information is managing beyond work hours. While this time period is identified as the most prominent across both survey cohorts, we specifically observe a 20% increase in the proportion of responses associated with the 8PM-12AM time period for the mid-pandemic cohort while simultaneously observing a decrease in the remaining four time periods before 4PM. Using a Fisher’s exact, we observe that a statistically significant difference exists in the proportions of time periods associated with managing work-related task information beyond work hours ($p<0.001$).

4.1.5 Summary of Findings for RQ1. In general, we observe that the context in which cross-boundary task management occurs has changed significantly when managing task information related to work or nonwork. Our findings suggest that the duration of work hours for information workers has not changed, but the time at which transitions between

work and home occur have. We observe that the personal activities in which instances of cross-boundary management arise has significantly changed with the proportion with activities outside of the home (i.e., Driving and Commuting) being significantly smaller in comparison to the activities within the home (i.e., Cookies & Eating). Moreover, we see a larger shift in work-related activities during which personal task information is managed, observing a 73% increase in these instances occurring in virtual meetings. Finally, we find that the periods of time in which personal tasks are managed during work hours has not changed while observing the opposite for periods of time in which work-related tasks are managed beyond work hours. We specifically observe a 20% increase in instances of cross-boundary task management during the hours of 8PM-12AM during the pandemic. These findings collectively address RQ1.

Table 6. Research questions and survey data points used in Section 4.2 to address RQ2.

RQ2.1: How have perceptions of the work-life boundary changed?		
- Perceived “blurriness” of work-life boundary before the WFH mandate.	Likert	Table 4: Q27
- Perceived “blurriness” of work-life boundary during the WFH mandate.	Likert	Table 4: Q28
- Binary response indicating if the respondent uses lists / groups that include both work tasks and nonwork tasks.	Binary	Table 2: Q15
- Rationales for organizing work tasks and nonwork tasks in distinct or shared lists.	Text	Table 2: Q15.1+2
RQ2.2: How has the frequency of cross-boundary task management changed?		
- Self-reported frequency for managing “work” and “nonwork” tasks both during and beyond work hours.	Likert	Table 2: Q5-Q8
RQ2.3: How have the challenges associated with cross-boundary task management changed?		
- Perceived difficulty in returning to the activity being done prior to using the tool to record task information.	Likert	Table 3: Q22
- Perceived continuation of thoughts related to the task after recording its related information in their tool.	Likert	Table 3: Q23
- Perceived satisfaction with the information recorded in the tool at time of use.	Likert	Table 3: Q24

4.2 Understanding Perceptions, Frequencies, and Challenges of Cross-Boundary Task Management

Table 6 shows the research questions and survey data points used to address our inquiry related to the perception, frequencies and challenges of cross-boundary task management. We analyze all Likert and binary data using appropriate significance tests alongside supporting descriptive statistics. We analyze rationales for organizing work tasks and nonwork tasks with top-down open-coding to categorize each participant’s response into supporting themes. After resolving disagreements via discussion, we observe high agreement between annotators ($\kappa=0.7$).

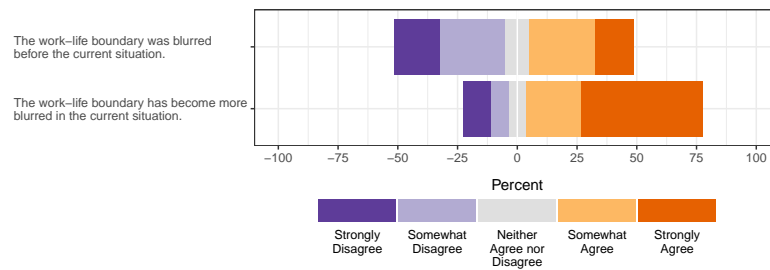


Fig. 5. Responses for two statements aimed at understanding perceptions related to the “blurriness” of the work-life boundary.

4.2.1 Understanding Perceptions of the Work-Life Boundary. As shown in Figure 5, we observe that participants’ attitudes about the work-life boundary being blurred before the current situation is generally neutral ($\mu=2.94$, $\sigma=1.4$). In contrast, participants’ attitudes about the work-life boundary having become more blurred in the current situation leans significantly positive ($\mu=3.94$, $\sigma=1.39$) with 51 respondents in the mid-pandemic cohort (72.8%) reporting “Somewhat

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Agree” or “Strongly Agree”. Using Fisher’s exact tests, we did not observe significant differences in attitudes about the work-life boundary before the WFH mandate across gender ($p=0.08$), age ($p=0.11$), job role ($p=0.61$), or WLI profile ($p=0.56$). Again, using Fisher’s exact tests, we did not observe statistically significant differences in attitudes about the work-life boundary’s blurriness after the WFH mandate across gender ($p=0.08$), age ($p=0.11$), job role ($p=0.61$), or WLI profile ($p=0.94$), collectively suggesting that the observed attitudes are not distinct across any particular group.

Through our analysis of responses to Q15.1 and Q15.2, we find that practices for organizing task-related information often mirrors the perception of the work-life boundary. By analyzing responses to Q17, we find that 51 participants in the pre-pandemic cohort (33.7%) reported using shared lists or groups for simultaneously storing a mix tasks related to both work and nonwork. In contrast, only 20 participants in the mid-pandemic cohort (28.6%) reported maintaining the same practice, indicating the proportion of respondents has decreased during the pandemic. Across both cohorts, we observe that the rationale for storing task information for work tasks and nonworks tasks in a single list hinges on the fundamental belief that work and life are, for better or worse, inherently interleaved. As one participant says, “*Life isn’t siloed these days*” (P67).

“I have a fixed amount of time in the day and need to balance work and personal. My calendar and tasks are completely mixed between work and personal, so I can properly schedule my day.” - (P122, Fusion Lover)

These participants hold the specific belief that “both work and nonwork have to get done in a given day” (P117) and their organizational practice needs to facilitate “work/life in one place” (P85). Participants cited several examples of events beyond their scheduling autonomy that demand interleaving, such as “doctor appointments” (P32), “car maintenance” (P117), and “lunch with my sister” (P60). Beyond supporting the interleaving nature of work and nonwork, alternative motivations for using a singular list for organizing captured tasks generally supported participants ability to off-load information quickly as it was “easier to see everything in one place” (P78) or “may be the tool that happens to already be open” (P42).

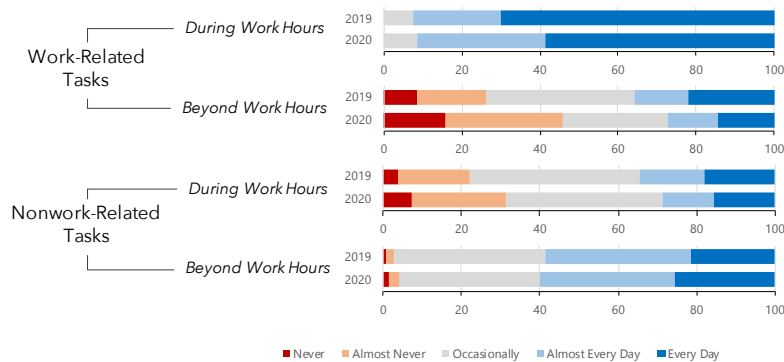


Fig. 6. Frequencies for managing tasks within and between work and nonwork across survey cohorts.

4.2.2 *Understanding the Frequency of Cross-Boundary Task Management.* As seen in Figure 6, we observe across both pre-pandemic and mid-pandemic cohorts that the majority of tool use occurs in managing work-related tasks during work hours and nonwork-related tasks beyond work hours. Between cohorts, the proportion of responses associated with managing work-related tasks beyond work hours “Occasionally”, “Almost Every Day”, or “Every Day” dropped

from 78% to 54%. Using a Mann-Whitney U test, we find that a significant difference in the proportion of frequencies for managing work-related tasks beyond work between the pre-pandemic and mid-pandemic cohorts ($p=0.01$). Differences between age, gender, WLI profile, and job role were not observed. Similarly, we did not observe a statistically significant difference in the proportion of responses related to managing nonwork-related tasks during work hours ($p=0.17$). Despite the lack of significant difference for this particular context, we still observe that managing nonwork-related tasks during work hours is a practice that upward of 70% of participants in both cohorts regularly engage in.

4.2.3 Understanding Challenges in Cross-Boundary Task Management. Theoretical and empirical perspectives of interruptions suggest that temporarily suspending work to manage emergent task-related information may be cognitively challenging [55, 56]. Our survey asked participants to evaluate the difficulty they experience in reorienting themselves to their work or nonwork spheres after managing task-related information. Using standard Likert agreement scales (i.e., 1=Strong Disagree; 5=Strong Agree), participants in the pre-pandemic cohort, on average, reported experiencing little difficulty in returning to their nonwork spheres ($\mu=1.85$; $\sigma=0.96$) and to their work spheres ($\mu=1.92$; $\sigma=1.05$) after engaging in task management activities. In contrast, participants in the mid-pandemic cohort responses suggest they experience even less difficulty in reorienting than the pre-pandemic cohort both in the work context ($\mu=1.35$; $\sigma=0.9$) and the nonwork context ($\mu=1.38$; $\sigma=0.99$). Mann-Whitney U tests confirmed significant differences in difficulty in returning to work contexts ($p<0.001$) and nonwork contexts ($p<0.001$).

As observed with difficulty in reorienting, participants in the pre-pandemic cohort, on average, reported having little issue with terminating task-related thoughts after relevant information has been recorded both for the work context ($\mu=2.21$; $\sigma=1.11$) and the nonwork context ($\mu=2.01$; $\sigma=1.10$). Again, participants in the mid-pandemic cohort, on average, reported even smaller responses both for the work context ($\mu=1.64$; $\sigma=1.2$) and the nonwork context ($\mu=1.5$; $\sigma=1.10$). As was seen with reorientation difficulty, Mann-Whitney U tests confirmed significant differences between cohort for both work contexts ($p<0.001$) and nonwork contexts ($p<0.001$).

Finally, participants in the pre-pandemic cohort were, on average, in strong agreement that they were satisfied with the information they had recorded when it came time to reference or use the information between both work ($\mu=4.0$; $\sigma=0.82$) and nonwork ($\mu=4.2$; $\sigma=0.75$). Participants in the mid-pandemic cohort reported being less satisfied with their recorded information, again, in both work ($\mu=3.29$; $\sigma=1.8$) and nonwork ($\mu=3.80$; $\sigma=1.76$). Unlike prior tests, a Mann-Whitney U test failed to suggest these differences were significantly different either for work ($p=0.12$) or for nonwork ($p=0.09$).

4.2.4 Summary of Findings for RQ2. Our findings suggest that perceptions of the work-life boundary were molded by the notion that “life isn’t siloed” (P67) across both survey cohorts. Further, we find that information workers perceive the boundary as being more blurred than it was before the WFH situation that existed at the time. Alongside these perceptions, we find that respondents in the mid-pandemic cohort report managing work-related tasks beyond work hours less frequently than those in the pre-pandemic cohort. Moreover, our findings suggest that information workers, during the pandemic, are experiencing less challenge in managing the cognitive aspects that stem from temporarily suspending work and capturing emergent and inopportune-timed task-related information. In addition, our findings suggest that information workers have remained generally satisfied with the information captured during these inopportune moments. Taken as a collective, these findings address RQ2.

Table 7. Research questions and survey data points used in Section 4.3 to address RQ3.

RQ3: How has the role of tools changed for cross-boundary task management?		
- Free-form responses regarding how tools are correctly supporting users' needs in the current WFH situation.	Text	Table 4: Q29
- Free-form responses regarding how tools are failing to support users' needs in the current WFH situation.	Text	Table 4: Q30
- Primary task management tool used to create and manage information for work tasks and nonwork tasks.	Categorical	Table 2: Q3-Q4
- Number of task management tools used for managing task information for work tasks and nonwork tasks.	Number	Table 2: Q9-Q12
- Number of respondents who organize work tasks and nonwork tasks in a single list.	Number	Table 2: Q15

4.3 Understanding the Role of Tools in Cross-Boundary Task Management

Table 7 shows the research questions and data aimed at understanding the role of tools in cross-boundary task management. Unlike the previous sections, we drive our answer to RQ3 through qualitative data. We applied a top-down coding process that sought to categorize participants' responses related to the ways in which tools are currently supporting or failing to support users' needs (Table 4: Q3 and Q4). Through this process, we observed four high-level themes related to tool use in the context of cross-boundary task management. We now describe each of these four themes with supporting quantitative data from other questions in Table 7 where relevant.

4.3.1 Bespoke Practices for Cross-Boundary Task Management. The most prominent theme in our data was the individualization of practices for managing tasks across work and personal contexts. Specifically, we find that people craft task management experiences that are tailored to their personal and work-related needs and desires for managing information. Across both survey cohorts, participants often characterized the individual nature of their task management practice both implicitly and explicitly in their responses:

"I make a new OneNote page in a 'to-do' section for most days, and I copy/paste the previous day's list as a starting point. My system is very consistent, yet customizable to how I want to manage tasks."
 - (P158, Nonwork Eclectic)

Thematic elements of individualization included "integrating a process" (P152), "flexibility" (P182), and having a general "habit of documenting work" (P203). Further, the same theme of individualization emerged in analyzing the mid-pandemic cohort's responses to being asked how their tools were sufficiently or insufficiently supporting their task management practices in the current situation. 56 participants (80%) provided explicit examples for describing how their tools were failing to support their current needs in working remotely:

Table 8. Counts and proportions of primary tool use for work and nonwork across the 2019 and 2020 cohorts.

Tool Type	2019 Cohort				2020 Cohort			
	Work		Nonwork		Work		Nonwork	
	Count	%	Count	%	Count	%	Count	%
Sticky Notes	7	4.7	2	1.3	2	2.9	1	1.4
Paper Notepads	30	20.0	34	22.7	12	17.1	21	30.1
To-Do Applications	24	16.0	41	27.3	10	14.2	22	31.4
Notebook Applications	24	16.0	16	10.7	18	25.6	7	10.0
Email Applications	28	18.7	20	13.3	15	21.4	4	5.7
Calendar Applications	7	4.7	23	15.3	0	0.0	8	11.4
Job-Specific Tools	29	19.3	1	0.7	12	17.1	0	0.0
Intelligent Assistants	0	0.0	5	3.3	0	0.0	2	2.9
Other	3	2.0	6	4.0	2	2.9	4	5.7

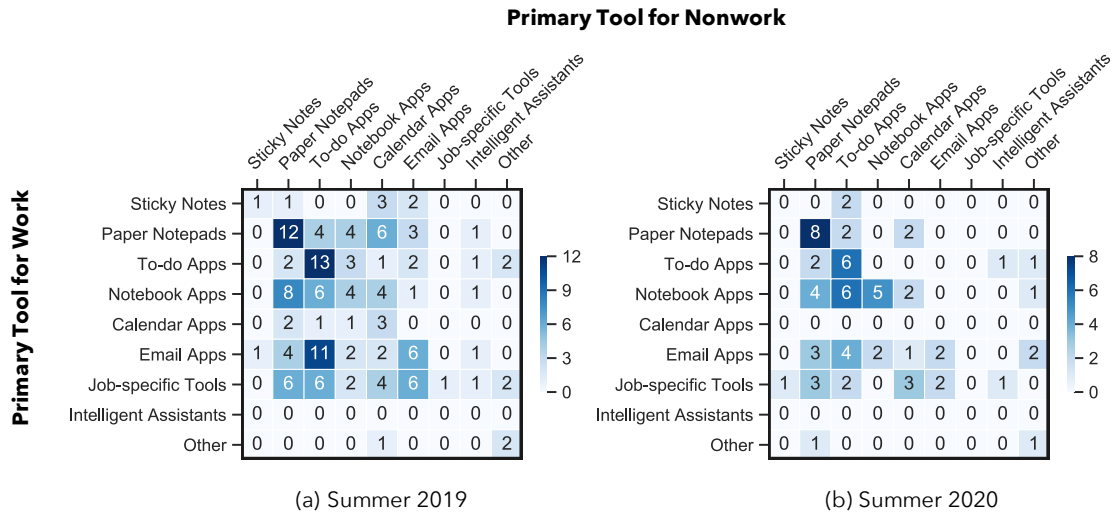


Fig. 7. Heatmap of primary tool pairs for work & nonwork contexts across the pre-pandemic (2019) and mid-pandemic (2020) survey cohorts.

“I miss my whiteboards. Not a good setup at home for that. Also, I feel like none of the online tools really support the way I want to manage action items on a daily basis.” - (P178, Nonwork Eclectic)

The remaining 14 participants (20%) reported that their tools were generally supporting them “the same as before, which is perfectly fine” (P152), suggesting they see little need for additional support in their practice. Despite the bespoke nature of participants’ practices, we remained capable of observing both qualitative and quantitative themes in general task management practice as it relates to managing tasks that are both unrelated to and related to work.

4.3.2 Characterizing Task Management Tool Use. Table 8 shows the counts and proportions of primary tool use for work and nonwork across the two survey cohorts. 30 participants (20%) in the pre-pandemic cohort reported paper notepad as their primary tool used for work-related task management, shortly followed by 29 job-specific tools and e-mail applications as reported by 29 participants (19.3%) and 28 participants (18.7%) respectively. In contrast to the work context, 41 participants (27.3%) reported To-Do applications as their primary tool for managing tasks unrelated to work, trailed by 34 participants (22.7%) for paper notepads and 23 participants (15.3%) for calendar apps. Sticky notes, intelligent assistants, and “Other” tools (e.g., self-engineered task management tools or extensions) were much less frequently reported as a primary tools for both work and nonwork contexts.

In contrast to the 2019 cohort, notebook applications were the most commonly reported primary task management tool for the mid-pandemic cohort as reported by 18 participants (25.6%). Email applications followed in popularity with 15 participants reporting its use, followed by paper notepads and job-specific tools which were each reported by 12 distinct participants (17.1%; 17.1%). The remaining tools were each reported by less than 15% of participants distinctly. Using Fisher exact tests, we did not observe statistically significant differences in primary tool use counts between the pre-pandemic and mid-pandemic cohorts either in supporting participants’ work contexts ($p=0.47$) or their nonwork contexts ($p=0.73$).

Following our examination of tool use, we sought to better understand participants' practices from the lens of tool collectives for work and nonwork. Figure 7 shows a heatmap of participants' primary tool pairs for their work and nonwork contexts across the pre-pandemic and mid-pandemic survey cohorts. Specifically, we observe that paper journals and to-do applications are most frequently used as a primary tool for work contexts when they are also used for nonwork contexts, while the same pattern was not observable for other tools.

4.3.3 Characterizing Tool Use and Boundary Preferences. One sub-theme that emerged within the broader theme of individualization was the interplay between tools and their potential for matching participants' preferences for separating or integrating their work and nonwork spheres. Among the nine types of tools we examined, we find that paper serves, for many of our participants, as a tool designed for separation. Using paper notebooks to manage their work and nonwork contexts, P200 states:

"Paper allows me to keep work and nonwork tasks cleanly separated. I use separate notes/notebooks and separate computing devices. So, even though I use the same desk for both (and even the same monitor/mouse/keyboard), I'm able to draw a clean line between them, and really be not working when I'm not working." - (P200, Fusion Lover)

Paper-users were generally consistent in describing the tool's strengths in reinforcing separation between work and nonwork, noting that the tool makes "accessing [information] is easy" (P181), facilitates the ability to "get things off my brain as quickly as possible" (P188), and generally "reminds me of tasks without the need to specifically pull up an app to get reminded" (P167). More broadly, these participants described aversions to using technical alternatives for task management, citing that they introduce personal challenges for achieving desired levels of separation. As P205 states:

"I aim to keep myself from doing any work tasks in non-work time. Having additional tools to make this easier just means it will be easier for me to not keep that separation" - (P205, Family Guardian)

Unlike participants who primarily utilize paper, the remaining participants neither implicitly or explicitly expressed similar aversions to using technical tools to manage their work and nonwork contexts.

Inspired by these qualitative findings, we explored the connection between primary tool use and boundary preferences. Using Fisher exact tests, we found that primary tool use significantly differed across the pre-pandemic cohort's WLI profiles for tool use in both work contexts ($p = 0.04$) and in nonwork contexts ($p = 0.002$). Using the same tests on the mid-pandemic cohort, we, again, found that primary tool use also significantly differed across WLI profiles both in nonwork contexts ($p = 0.01$), but not in their work context ($p = 0.55$), suggesting that work-life separation preferences tend to shape tool use for nonwork contexts more consistently than for work contexts. One possible explanation for the observed differences between cohorts is that participants in the mid-pandemic cohort are, in fact, adapting their practice to a new work environment:

"I have moved away from using a paper journal at work to using OneNote. This was partly because of lack of a stationery cupboard at home, and partly because moving everything online meant it was more portable. I can work from different parts of the house without carrying my desk." - (P177, Fusion Lover)

4.3.4 Managing Task-Related Information Across An Ecology of Tools. An additional theme that emerged in our qualitative analysis is that the act of managing tasks across boundaries is a practice not only driven by the an individual, but also by those that work with them. Specifically, we find that most people utilize not one, but many tools in managing their work contexts as a direct result of working across teams with varying task management styles:

“Everyone is using so many different tools. So, when you need to look at all your tasks across all other people and teams, you have too many places to look. ICM, Visual Studio, OneNote, Excel, Email, Teams, Word – it’s all depending on what PM or Manager is running it.” - (P204, Divider)

Participants noted that most tools “were not well integrated” (P212) and “allows my manager to have too much control over how I organize my work” (P187). The problem was particularly significant for paper-reliant participants as they “can’t view all tasks on their computer or notebooks” without significant effort. 31 participants (44.2%) across various managerial and non-managerial job roles in the mid-pandemic cohort highlighted the challenge of managing information across multiple tools as a key scenario that their tools are failing to support in their current working situation.

Complementary to these qualitative findings, we explored differences in the participants’ number of tool types used in their practice between the two cohorts. In Section 3.1.1, we asked participants to report the frequency in which they use each tool type listed in Table 1. We computed participants’ total number of tools by tallying the number of tool types in which participants’ reported using “Occasionally”, “Frequently”, or “Very Frequently”. Following this procedure for the pre-pandemic cohort, the mean number of tools used for managing work-related tasks was 3.56 ($\sigma=1.3$) while the average number of tools used for managing tasks unrelated to work was 3.2 ($\sigma=1.1$). In contrast for the mid-pandemic cohort, the mean number of tools used for managing work-related tasks was 4.0 ($\sigma=1.49$) while the average number of tools used for managing tasks unrelated to work was 3.3 ($\sigma=1.4$). A two-tailed t-test showed a statistically significance in the number of tools used in work context between the pre-pandemic and mid-pandemic cohorts ($t = -2.00$, $df = 122.3$, $p = 0.05$), but the same difference was not observed for the number of tools used in nonwork contexts ($t = -0.69$, $df = 117.5$, $p = 0.49$).

4.3.5 Summary of Findings for RQ3. Our findings suggest that the choice of task management tool has remained generally consistent individually, but changed organizationally. At the individual level, we observe that paper has retained its commonality as a tool for managing work-related and personal tasks used during the pandemic while other types of tools (i.e., email) have become less frequently. We specifically not only find that paper as a task management tool maintains a unique quality for separating work-related and personal spheres, but also that a person’s preferences are related to their choice of task management tool. Finally, we find that information workers report using a larger number of task management tools to manage their work-related tasks with the same trend not being reported for managing personal tasks. Our findings suggest that such a change may be motivated by an elevated need to work across teams that maintain their own task management practice at the team-level. These findings collectively address RQ3.

Table 9. Research questions and survey data points used in Section 4.4 to address RQ4.

RQ4: How have design opportunities for tools for cross-boundary task management?
Free-form responses suggesting desired features for cross-boundary task management. Text Table 3: Q26

4.4 Understanding Design Opportunities for Cross-Boundary Task Management

Table 9 shows the sole research question and survey data point used to understand design opportunities for cross-boundary task management. Despite self-reporting very little issue in managing tasks across the work-life boundary, participants across both survey cohorts offered a myriad of suggestions for new task management features for supporting them in managing tasks across the work-life boundary. We employing a top-down coding approach to iteratively analyze and code participants’ suggestions for future opportunities from the pre-pandemic cohort. Through a labeling process with two annotators, agreement was determined to be reliable ($kappa=0.87$), and any disagreements were

resolved through discussion. We arrived at four distinct themes for future tools relevant to supporting task management both within work and beyond it. Using these themes as codes, we then employed a qualitative top-down approach to coding participants' suggestions and allow us to assess how users' recommendations have changed. Responses that did not align with any of the four themes that arose from the initial bottom-up approach were coded as "Other".

4.4.1 Opportunity #1: Supporting Accelerated Capture. Within the scope of capturing fleeting information *quickly*, we find that technical tool users generally believe that "most task tracking application fail at making this fundamentally easy to create in fewer than 15 seconds" (P153). As P209 states, tool design affects their ability to step away from work:

*"Make it easy to get in, write the task, leave, and get back to my non-work life.
I don't want to work outside of work hours."* - (P209, Nonwork Eclectic)

The problem of slow information capture was voiced by 46 participants (31%) in the pre-pandemic cohort and 23 participants (33%) in the mid-pandemic cohort. Key barriers in capturing task-related information quickly, as observed across all 220 participants, centered around two points. The first was the requirement to authenticate to capture information, which was problematic due to using multiple accounts to create "micro-boundaries" between work and nonwork as found in other contexts [29]. The second was the fundamental requirement to enter information by hand. To that end, desire for creating, delegating, and engaging with task-related information via voice was mentioned explicitly by 68 participants (30.8%) across cohorts. In general, the overarching goal of task management tools in these scenarios served to "just get it out of my brain so I don't forget now" (P41), which they can "categorize later, when I'm at work" (P41).

4.4.2 Opportunity #2: An Interoperable, Unified, and Standardized Tool Infrastructure. Alongside capturing information quickly, an emergent theme of opportunity centered around the need for task management tools that are interoperable, unified, and standardized. Once information was captured, participants noted they may actually "forget where I captured it and serendipitously find it several days later" (P189). Aligned with our earlier finding that suggests that the mid-pandemic cohort uses more tools in their practice, we observe that a significant desire hinges on how these communicate with one another and reduce the overhead of summarizing information from multiple sources:

"The problem is we have too many freaking tools with no standards. You have to have all of these tools running and continually juggling priorities between teams and projects with no connection between them other than the individual." - (P204, Divider)

The challenge of managing task-related information across a family of tools was voiced by 22 participants (15%) in the pre-pandemic cohort and 23 participants (33%) in the mid-pandemic cohort. Extending the context of our findings in Section 4.2.3, one particular sub-theme that surfaced from the mid-pandemic cohort was the social side of task management by which tasks arise within work-related social circles:

"Many tasks come are sent in Teams chats. There is no easy way to mark an item for future attention other than keeping it marked as unread or transferring it manually to something else, but then lose context of the ask (unless one copies more or creates links which is tedious)." - (P196, Overwhelmed Reactor)

Specifically, the underlying failure of current families of task management tools is that they "all fail in that they don't talk to each other to provide a consolidated list" (P192).

4.4.3 Opportunity #3. Management Automation and Intelligence: Across all 220 participants, a total of 51 (23%) thematically voiced a desire for integrated computational automation and intelligence in managing their task-related

information entered into their task management tools. The most commonly reported suggestion centered around assisted task management after having captured information:

“Give me a notification to do the task when I’m most likely to want to take action on it (e.g. after work hours, but use my previous task history/profile to nudge me in the right way at the right time).”

- (P182, Overwhelmed Reactor)

Contextual dependencies aside, additional suggestions included “Friday afternoon summary of things on the docket for the weekend” (P161), “morning reminders for upcoming work” (P173), and various features where automation takes action on behalf of the user, e.g. “automatically categorizing task information” (P151).

4.4.4 Opportunity #4. Explicit Boundary Support: The fourth and final theme observed in our analysis centered around the design and deployment of explicit system support for preventing work-life perforation (e.g., motivating separation) and providing structured workflows for deferring post-capture tasks (e.g., capture now, organize later).

“We shouldn’t be managing non-work tasks while working. Because we are at work. Do not make it easier for people to blend work and non-work. People are complaining about it already, why enable it?”

- (P152, Overwhelmed Reactor)

Elements of desired boundary support were voiced by 11 participants (7%) in the pre-pandemic cohort and 29 participants (41%) in the mid-pandemic cohort. The drastic difference in sample percentages reinforces the notion that the boundary has, in fact, become more blurred as described in Section 4.2.

Alongside these themes, several suggestions touched on less thematic elements for improvement, namely “helping me be more accountable” (P182) in the mid-pandemic cohort’s data. Unlike the frontier of software opportunities, participants across both cohorts expressed little interest in using any device that was neither their desktop computer or their smartphone.

4.4.5 Summary of Findings for RQ4. Our findings related to design opportunities for supporting cross-boundary task management suggest that information workers value features that enable them to more clearly separate their work and personal spheres. While the themes of responses remained unchanged between survey cohorts, we observe a significant increase in demand for task management tools that provide explicit boundary support and amplified interoperability. Specifically, we find that the proportion of responses related to interoperability doubled from 2019 to 2020 while the proportion of responses related to explicit boundary support quintupled from 2019 to 2020. In contrast, the need for accelerated capture and intelligent support remained relatively the same. Thus, these findings address RQ4.

5 DISCUSSION

We present a comprehensive exploration of cross-boundary task management and how they’ve changed during COVID-19 pandemic. We find that the proportion of both personal activities and work-related activities interleaved with cross-boundary task management have changed significantly during the pandemic. We also observe that task information related to work tasks is managed far more often in the evening by participants in the mid-pandemic cohort than those in the pre-pandemic cohort. We find that primary tool use is intertwined with an individual’s preferences for separating or integrating these spheres. We also find that information workers utilize multiple tools to support their practice, and that the mid-pandemic cohort of participants uses significantly more tools than the pre-pandemic cohort. In addition, we observe that participants in the mid-pandemic cohort are managing work-related tasks beyond work hours less frequently than participants in the pre-pandemic cohort. Contrary to our expectations, we observe

that participants in the mid-pandemic cohort report significantly less cognitive difficulty in managing tasks during inopportune times. Finally, we outlined four key directions for technical innovation in the area. We now highlight the implications of our findings toward designing task management tools for managing tasks across the work-life boundary.

5.1 Designing Task Management Tools for the Individual and the Organization

Through our examination of task management practice, we capture the various perspectives that people hold about their personal boundary between work and nonwork. For some, the boundary serves as a concrete, firm separator between spheres while, for others, the boundary is a more fluid concept that involves permissibly interleaving spheres to meet their arising needs. Our study specifically highlights the bespoke nature of task management practices for work and nonwork contexts that is unquestionably intertwined with the nature of managing group work.

Despite the bespoke nature of task management practice, our research introduces new directions for supporting the individual by identifying the frictions that people experience in their tools. A significant percentage of participants reported a desire for capturing such information in an rapidly accelerated fashion. Recent studies of quick-capture tools reinforce the notion that new task management systems and tools (e.g., Scraps [93]) that support such functionality may be substantially beneficial. These systems, however, continue to require authentication, which introduces an additional layer of friction particularly if an individual is using their tools to build “micro-boundaries” between work and nonwork [29, 30]. Our findings suggest that new system designs should facilitate accelerated capture of task-related information without requiring that the user know precisely how to organize it or that the user be authenticated to facilitate its capture. The efficacy of these systems as tools for supporting people in achieving their desired work-life boundary remains unclear, motivating the need for studies of current and new systems alike.

Alongside innovating at the level of system design, our research suggests there exists new opportunities in augmenting the task management workflows that people may employ with these new system designs. As reported by 51 participants, task managements with integrated automation and intelligence can support people in extracting tasks [99], creating timely notifications [47], and even determining which task a user should complete first [62]. While each of these directions has been evaluated within their own silos, they have yet to be evaluated within the context of a comprehensive task management tool suite. More broadly, there exist significant challenges in studying such systems due to the technical nature of task management infrastructures and intelligent systems – both of which can be substantially complex even as standalone systems.

Finally, a key opportunity for future research is engineering new tools that align to users’ personal characterizations of productivity as the nature of information work continues to change. In our study, we observe the significance of “individualization” as one of the key themes representing how information workers depict the role of their task management tool in managing tasks across the work-life boundary. Alongside qualitative studies of task management practice [14], the role of individualization in work patterns has been previously described by Kim et al. [64] who studied “personal productivity” and Guillou et al. [49] who studied the notion of “time well spent”. However, as observed by Ahmetoglu et al. [8], people may be aware of the “right” productivity practice for themselves, but disengage from practicing it as the nature of work continues to change. This is particularly relevant to the notion of understanding peoples’ motivations to work, which have also been impacted by the COVID-19 pandemic [23].

Beyond the individual, we find that modern task management tools generally ignore the organizational aspects that are core to information management practice. Through our research, we observe that information workers often manage tasks across teams, each of which may have their own tools, standards, and culture for managing information. While the underlying necessity for *interoperable* task management tools is certainly not new [21, 22], the problem continues

to introduce challenges for information management that create unnecessary challenges for managing information. We find that information workers desire *a unification of tools*, relying on a common standard of capture, representation, and access that reduces the cognitive burden of managing information across tools that rely on a bespoke practice specific to a particular part of an organization. One possible pathway for resolution centers on the use of a centralized storage location in digital space that task management tools can read from and write to in-situ. Such a system introduces new opportunities for designing task representation standards for cross-tool management and enabling new experiences driven by automation that automatically complete facets of the task management workflow (e.g., task categorization) after new information has been captured. However, the centrality of same system design introduces a series of new challenges related to the security, privacy, and access of the information that teams manage both within and beyond themselves.

5.2 Considerations for Adaptation and the Work-Life Boundary

The COVID-19 pandemic has had an unquestionable effect on peoples' work and personal spheres [92]. Our research details a number of similarities and distinctions between the pre-pandemic and mid-pandemic survey cohorts ranging from simple changes in personal information management to extended tool infrastructures. One particular question amid these observations is whether there are signals that suggest information workers are adapting to their new work environment amid the pandemic. Complementary to Boundary Theory [11], our findings suggest that adaptation has been demanded for some while others' practices remained relatively unchanged in working from home.

5.2.1 The Impact of the Evolving Workday. Recent research has aimed to understand how the COVID-19 pandemic has allowed information workers to spend their time differently while working from home. For example, in a survey with 1,300 knowledge workers during Summer 2019 and Summer 2020, Kun et al. found that respondents saved an average of 41 minutes per by not commuting day during the WFH mandate [66]. Kun et al. also observed that the workday-span lasted, on average, an additional 56 minutes, which we do not observe in Figure 1. In an extended analysis of Kun et al. [66]'s data, Teodorovicz et al. [94] found that managers at larger firms tend to spend recovered commute time in virtual meetings. While our study does not focus explicitly on understanding where gained time is spent, we do observe a proportional decrease in commuting activity and a proportional rise in numerous other home-based activities being interwoven with cross-boundary task management as shown in Figures 2a and 2b. Despite having observed noticeable changes in work-life schedules as shown in Figure 1, the limitation's of our study's scope and data do not allow us to draw conclusions about the ways in which individuals have reallocated their time away from one activity (e.g., the commute) to another. However, we recognize this space as one of significant value for further study and exploration.

Our analysis suggests that information workers are managing work-related tasks beyond work hours less frequently than they were before the work-from-home mandate. One possible explanation that the similar differences were not observed in managing nonwork-related tasks during work hours is that peoples' personal responsibilities have fundamentally changed in the shift to working from home. As noted by Ford et al. [43] and Bao et al. [12] alike, the ways in which time is spent cannot be assumed to uniformly benefit or challenge every person equally. For example, Machado et al. [72] reported that women are more likely to experience interruptions when working from home, which we observe for men and women alike in Section 4.2.1. During work hours, parents, for example, may be required to assist their children in various caregiving responsibilities (e.g., "herding the kids to dinner", P199). As our study was focused on the timeframe between July 2019 and July 2020, a rich opportunity exists for future research in understanding how particular caregiving responsibilities (e.g., helping children manage remote education) continue to shape how people

choose to manage their spheres across one another. These responsibilities undoubtedly vary between people and should be explored with methods well-suited to this highly context-dependent research goal (e.g., diary studies [34]).

5.2.2 Cross-Boundary Task Management as an Cognitive Distraction. Prior studies of interruptions and task switching reinforce the notion that switching between contexts (i.e., work and nonwork) is a cognitively taxing activity [70, 75, 101]. Research often suggests, for example, that people undergo “prospective memory failure” when returning to an interrupted context, forgetting exactly where the context was suspended [10, 40]. Our findings suggest that information workers undergo these experiences with significantly less cognitive difficulty after working under the work-from-home mandate. Additional research is needed to understand the context and extent to which individuals’ cognition has adapted, if at all, to the changing work environment and what such changes may suggest for individualized task management practice. To that end, it remains unclear how these practices may, again, change as individuals are required to re-adapt now that WFH mandate has concluded.

5.3 Rethinking a Paper-Centric Practice for People and Organizations

We motivated our research with the goal of designing next-generation task management tools. More than a decade ago, Bernstein et al. [17] conducted an examination of “*information scraps*”, broadly defined as loose-leaf scraps of paper by which people use for the purposes of temporary storage, archival needs, reminding, and the general management of unusual data. Through their study, Bernstein et al. identified numerous design directions for future PIM applications, including lightweight entry, unconstrained content, flexible use and adaptability, visibility, and mobility. Our study finds that these suggestions, albeit under different aliases, remain key areas of opportunity for technical innovation today.

Across both survey cohorts, we found that paper accounted for 20-30% in managing tasks for both work and nonwork. Our analysis suggests that paper, as a task management tool, is an exemplar tool for establishing rigid boundaries between work and nonwork in ways that technology seems to challenge. Prior research has shown that people are less likely to recall information that’s presented in a computer-based interfaces in comparison to paper-based alternatives [71]. Electronic interfaces also fail to provide “global perspectives” of information, which prevent people from forming mental representations about the information’s “big picture” [45]. This prior research resonates with our participants’ fears about capturing task-related information, but later being unable to identify *where* it was captured – a problem that an organized paper notepad is generally resilient to.

Our research motivates an important question: *Should we continue to introduce technology into paper-centric practices?* Survey participants who utilize paper as their primary task management tool identified a plethora of challenges that stem from using a non-technical tool, namely syncing task information between paper and digital space. One technical solution to this problem could, for example, be a crowd-powered system (e.g., like VizWiz [19]) that automatically extracts tasks from photos of the users’ paper notepad. Despite introducing a clear benefit in managing information across tools, such a system takes a central part of the user’s task management workflow, which can influence how they choose to manage information. The intersection of paper and technology remains a fruitful areas of both exploration and discussion in task management research as their harmony has yet to be understood for supporting work and nonwork alike.

5.4 Limitations

Our study has several limitations. First, both iterations of our survey were deployed to information workers at Microsoft Corporation, a large, US-based technology corporation. Our study can neither make claims about individuals who,

for example, work at smaller or non-technical organizations. Second, the second deployment of our survey recruited individuals who were under a work-from-home mandate per the instruction of their organization. Our study cannot make claims about individuals who were not under a work-from-home mandate from February 2020 to August 2020. Finally, the study’s survey deployments make use of two different samples of participants from the same population of participants (i.e. the same organization). Before conducting our analysis, we confirmed demographic identity between our participant samples to ensure that this methodology would allow us to reliably draw comparisons between them. Finally, our methodology – an online survey – allows us to make observations about information workers only as a collective and fail to provide the necessary context to provide explanations for our findings. Our findings provide the necessary motivation and grounding for future contextual inquiries aimed at characterizing task management tool use at the work-life boundary.

6 CONCLUSION

We reported findings from an online survey deployed to 150 information workers during Summer 2019 (i.e., pre-pandemic) and 70 information workers during Summer 2020 (i.e., mid-pandemic) at the same organization. Across these survey cohorts, we contribute a characterization of practices for managing tasks across the work-life boundary, which we find to be common practice. In comparison to the pre-pandemic cohort, we find that information workers in the mid-pandemic cohort are using more tools to manage their task-related information, are managing work-related tasks less frequently beyond work hours, and are experiencing less difficulty in managing tasks across the boundary. Finally, we find that information workers generally see the task management tools as a rich space for furthering supporting them in managing tasks across the work-life boundary, despite reporting minimal issue in doing so. We use the findings to inform new research questions that are pertinent to managing work-life boundaries in the context of the pandemic, its resulting stay-at-home orders, and more broadly, in the new future of work.

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7 AUTHORS' STATEMENT

The research described in this manuscript is being submitted for publication as entirely original research; no research included in this manuscript has been published either in a journal or a conference proceeding. The work builds on research presented at the 2020 Symposium on the New Future of Work that was held virtually at Microsoft Research. The Symposium is not a publication venue, and the paper was therefore not published. The Symposium paper can be found at the following link:

<http://web.eecs.utk.edu/~acw/pubs/nfw2020-task-management-boundaries.pdf>