

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

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ABSTRACT

With the global shift towards remote work, understanding how people maintain their desired boundary has become critically relevant to HCI research at large. In this paper, we examine how people employed task management tools across the work-life boundary before the emergence of COVID-19. We report findings from a survey deployed to 150 information workers during Summer 2019 that inquired about task management tool usage, contextual task management practice, and preferences for separating work and nonwork. We first characterize and identify trends across tool use, job role, and task management practice. We find that the majority of task management activity occurs during work hours, and that information workers regularly managing work tasks beyond work hours and vice versa. 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.

CCS CONCEPTS

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

KEYWORDS

Task management practices, Work-life boundary, Online survey.

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1 INTRODUCTION

Task management tools are ubiquitous aids for managing task-related information in people's work and personal contexts. From simple to-do applications to intelligent assistants, a variety of task management infrastructures have emerged that empower people in managing task-related information at any time or place. Recent estimates predict that the task management software industry will exceed 4-billion dollars in value by 2023 [1], signifying the area as both active and fruitful for research, innovation, and exploration.

Task management tools, like many memory aids, are often used as new task-related information arises. 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 tool 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) [4, 7]. Theoretical and practical examinations of interruptions generally conclude that, in either circumstance, people experience a cognitive challenge in reorienting themselves and resuming their suspended task [36, 39].

In this paper, we seek 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 needs that have emerged as people adapt to new forms of work as a result of the pandemic. We report findings from an online survey deployed to 150 information workers during Summer 2019. In our analysis, we observe and report on trends in tool use across peoples' work and personal contexts. We also find that the majority of task management activity for work and nonwork alike occur during normal work hours, and that information workers regularly manage work-related tasks beyond work hours and vice versa. Finally, we observe 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.

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 the work-life boundaries. We discuss our

findings in the scope of to 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.

2 RELATED 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 [3] and Border Theory [12]. Boundary theory posits that people “create, maintain, or change boundaries in an effort to simplify and classify the world around them” [3]. 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. [45]. 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) [57].

In contrast, Border Theory is a theory “about work-life balance” [12]. 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 [21]. Border Theory also distinguishes itself from Boundary Theory with a categorization of people entitled “border keepers” who manage boundaries between work and nonwork [2]. 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 [14]. Boundary management preferences can be shaped by a range of factors, such as job role, workplace attitudes, and family situation [28], and several instruments have been developed for measuring these preferences reliably [14, 32].

Beyond these concepts, the importance of maintaining a boundary (or border) is well understood. Theories of psychological recovery [23, 42] 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 [8] and higher satisfaction with life [50]. In contrast, the lack of a boundary has been shown to contribute to an inability to psychologically detach from work, particularly in the context of unfinished tasks [8, 9].

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 [20, 47]. A significant series of studies has, for example, focused specifically on understanding how mobile devices affect the work-life boundary with varying results [13, 17, 48]. Other studies have provided empirical

accounts for a range of techniques for supporting the work-life boundary including volunteering [43], mindfulness or cognitive-behavioral therapy programs [24, 25], and interactive systems that operationalize these concepts by design (e.g., SwitchBot [55]).

2.2 Task Management Practice

Task management tools allow people to record, track, and organize task-related information. The study of task management tools and systems 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 [26]. 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 [4]. 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 [22, 31].

As memory aids, task management tools are frequently used the every-day tool for reminders [46]. The concept of task management has been utilized in designing new systems that intelligently serve reminders (e.g., based on context [15, 27, 33]). 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 [19]. 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 [5, 16].

2.2.1 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 [4, 7]. 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 [37], overloading people with information [54], automatically extracting tasks as to-do items [5]. More recent research has explored the feasibility of agent-oriented task management by which tasks are managed via conversation [51] or via collaboration [29]. While the design of these systems has been introduced in several unique task management contexts, they have yet to make their way to consumer markets [6, 18, 44].

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, Wunderlist.
<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.

Table 2: Outline of the retrospective rehearsal for contextualizing participants’ task management practices.

Think of the last time you created a [...] task while you were [...].	Data Type	Reference
1. What information did you record in your task management tool?	Free-form Text	[4]
2. Did you categorize this information when you recorded it in your tool?	Free-form Text	[4]
Yes → 2.1. What was the name of the category you added it to?	Free-form Text	NA
2.2. Briefly describe your rationale for categorizing the information.	Free-form Text	NA
No → 2.1. Briefly describe your rationale for not categorizing the information.	Free-form Text	
3. Briefly describe what you were doing before you recorded the information.	Free-form Text	[4, 56]
Please indicate the weekday and time of day in which the task was created.		
4. This task was created in my tool on a _____.	Day (Categorical)	[4, 19]
5. This task was created in my tool between ____ and ____.	Time (Categorical)	[4, 19]
When creating this task, ...		
6. Did this task involve other people?	Yes / No (Binary)	[4]
7. Did this task have a deadline?	Yes / No (Binary)	[4]
Yes → 6.1. Indicate the time range in which the task needed to be completed by.	Time (Categorical)	NA
8. I felt this task was important.	Likert (Ordinal)	[4]
9. I felt this task was urgent.	Likert (Ordinal)	[4]
10. I felt this task had a clear goal.	Likert (Ordinal)	[36]
11. I felt this task had a clear solution.	Likert (Ordinal)	[36]
After creating the task, ...		
12. I had difficulty returning to what I was doing beforehand.	Likert (Ordinal)	[36]
13. I kept thinking about this task after recording the information in my tool.	Likert (Ordinal)	[36]
14. Briefly describe what you did after you recording the information.	Free-form Text	[4, 56]
When it came time to start doing the task, ...*		
15. I was satisfied with how I had recorded the task.	Likert (Ordinal)	NA
16. I was satisfied with how I had organized the task.	Likert (Ordinal)	NA
Please indicate the weekday and time of day in which the task was completed.*		
17. This task was completed on a _____.	Day (Categorical)	[4, 19]
18. This task was completed between ____ and ____.	Time (Categorical)	[4, 19]
19. This task was marked as complete in my tool on a _____.	Day (Categorical)	[4, 19]
20. This task was marked as complete in my tool between ____ and ____.	Time (Categorical)	[4, 19]

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

3 ONLINE SURVEY

To understand how task management tools are utilized across the work-life boundary, we deployed an online survey during Summer 2019. Here, we describe the survey’s design alongside its motivation.

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 [49]. As a proxy for identifying the work-life boundary, we also asked participants to report the hour of the day closest to which 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 take no longer than 30 minutes to complete.

3.1.1 Section 1: General Task Management Practices. The survey first 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 [4, 7] and newer [53] studies of task management tools. An “Other” option was also provided to allow participants to specify unnamed tools. Alongside primary task management tool use, the survey asked participants to indicate how frequently they utilize each tool in Table 1 for both work and nonwork using a five-point Likert scale that ranged from Never to Very Frequently. Following inquiries of tool use, the survey continued by asking participants how often they use their task management tools to (1) manage work-related tasks during work hours, (2) manage work-related tasks during nonwork hours, (3) manage nonwork-related tasks during nonwork hours, and (4) nonwork-related tasks during work hours using a five-point Likert scale that ranged from Never to Every Day. The survey also inquired about the number of active tasks they keep in each tool and how they organize their tasks (e.g., alphabetically, by time, etc.)

3.1.2 Sections 2 & 3: 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 [52] in which were participants asked to think about two different events: (1) “the last time you created a new nonwork task 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 new work task with their task management tool while they were away from work (e.g., at home, running errands, etc.)”.

Table 2 outlines the retrospective questions used to capture information about participants’ cross-boundary task management experiences across these two scenarios. Prior studies that have recognized lingering thoughts that ultimately trigger distractions or interruptions in an individual’s activity [36]. We therefore modelled the design of this section around prior studies qualitative and quantitative of interruptions from the HCI literature [38, 40, 41, 56]. The overarching goal of this section was to identify the opportunities and challenges that exist in supporting people in managing tasks across the work-life boundary. 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. [10] 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.

3.1.3 Stage 4: Work-Life Indicator. The final section of the survey administered the Work-Life Indicator (WLI) [32], 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 classifications: (1) Work Warrior, (2) Overwhelmed Reactors, (3) Fusion Lovers, (4) Dividers, (5) Nonwork Eclectics, and (6) Family Guardians. Each classification describes how an individual’s preferences for integrating or separating their work and nonwork spheres. 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 [11, 17, 34, 56].

3.2 Participant Recruitment

We recruited a total of 150 individuals (104 men / 44 woman / two non-binary) by randomly sampling an internal company-wide employee list. 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%) or more years of experience in their job role. Participation was voluntary. Use of “physical or digital tools for recording, tracking, or managing tasks” was the only requirement for participation.

3.2.1 Work-Life Indicator Profiles. We employed the standard practice for calculating participants’ WLI profiles by taking the mean of each of the instrument’s five dimensions [32]. The profiles observed across our pool of survey participants spanned all five profile types: 43 Nonwork Eclectics (28.7%), 29 Family Guardians (19.3%), and 9 Work Warriors (6%), 30 Fusion Lovers (20%), and 15 Dividers (10%). 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.

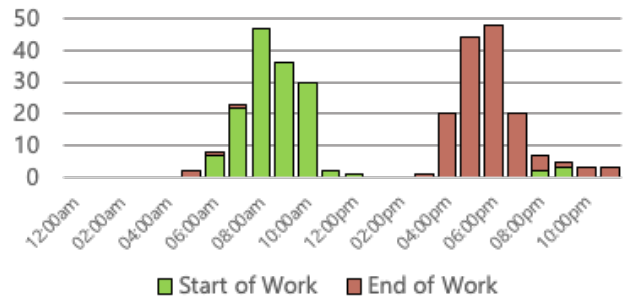


Figure 1: Histogram of participants’ work hours.

4 FINDINGS

In this section, we describe the findings from our online survey. Our primary methods of analysis include non-parametric statistical tests for examining differences in our Likert-type data due to their ordinal nature. We also employed open coding and affinity diagramming to identify trends in participants’ open-ended responses [35]

4.1 General Observations

Participants’ reported work hours reflect what one would expect for a standard job in information work. 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. Seven participants (4.7%) reported inverse time periods for beginning and ending their workday as they work overnight schedules. The time between the start and end of participants’ workdays was, on average, 9.32 hours ($\sigma=1.32$). Significant differences in work hours were neither observed across participants’ job roles nor WLI profiles.

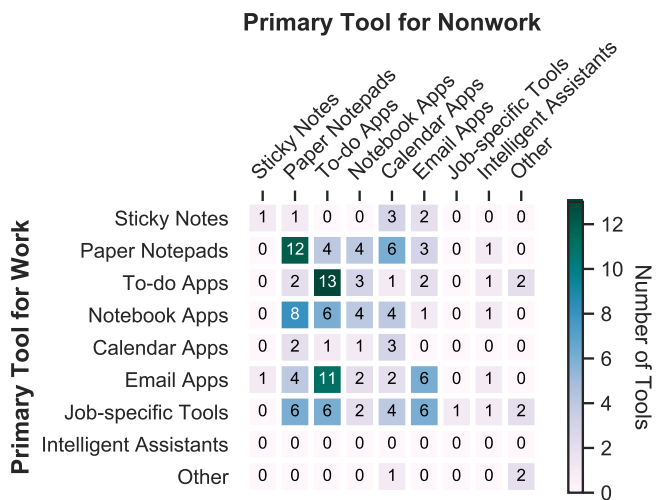


Figure 2: Heatmap of primary tool use for work & nonwork.

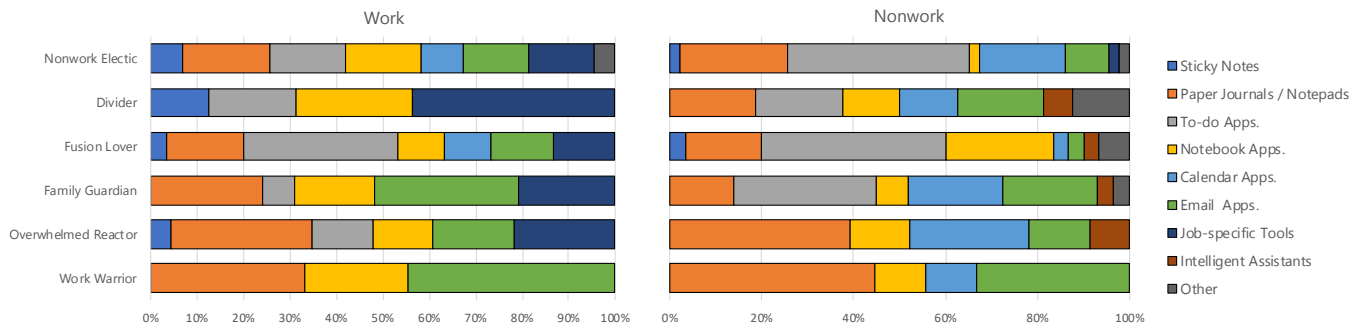


Figure 3: Primary tool use across work and nonwork separated by WLI profile.

4.2 Tool Use in Work and Nonwork

Figure 2 shows the distribution of participants’ primary tool use across work and nonwork. Participants’ reported paper lists and journals (30) as the most commonly used primary tool used for work-related task management, shortly followed by job-specific tools (29) and e-mail applications (28). In contrast, To-Do applications (41) were the most commonly reported primary tool used to manage tasks unrelated to work with paper lists and journals (34) being slightly less common. 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.

We find that three combinations of primary tool use across work and nonwork to be generally more common than others. As shown in Figure 2, To-Do applications were the most common combination for primary tool use across work and nonwork as reported by 13 participants. The use of paper journals and notepads as the primary tool both for work and for nonwork was reported by 12 participants. The third most common combination of primary tool use across work and nonwork contexts centered on e-mail and To-Do applications respectively as reported by 11 participants.

Figure 3 shows the distribution of primary tool usage across work and nonwork for each WLI profile. To examine differences in primary tool usage across WLI profiles, we used Fischer’s exact tests as our sample size is relatively small for several categories of tools. We find that primary tool use significantly differed across WLI profiles both for managing tasks in work contexts ($p = 0.04$) and for managing tasks in nonwork contexts ($p = 0.002$). Specifically, participants classified as Work Warriors, Overwhelmed Reactors, and Family Guardians tend to use e-mail applications for managing their work-related tasks while Nonwork Electrics, Dividers, and Fusion Lovers tend to use To-Do applications more frequently. Alongside differences in WLI profiles, we use Fischer’s exact tests to find that primary tool use for work significantly differed across job roles ($p = 0.001$), but a similar observation was not made for the nonwork context ($p = 0.94$).

Finally, we find that task management practices are often supported by multiple tools across work and nonwork contexts. 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 ($\sigma=1.1$). We did not find statistically significant differences between job role nor WLI profile.

4.3 Task Management Across Boundaries

4.3.1 Practices for Managing Tasks Across Boundaries. In general, we find that managing tasks across the work-life boundary is near-entirely fueled by emergent and often serendipitous task-related information. In their retrospective rehearsals, participants noted the need to capture and record such information can occur at any time or place, whether it be while “cooking” (P47), “driving” (P15), “sleeping” (P35), or even while “sitting on the toilet” (P72). As P32 says, sometimes “[tasks] just come to mind and have to be noted down quickly”.

Alongside the rationale for engaging with their tools, we find that our participants maintain distinct organizational practices when managing new task information. 46 participants (30.6%) reported organizing the task-related information at the time of capture as it “belonged to category/project scope” (P9). The remaining 104 participants (69.4%) described the organization of information itself as a secondary priority to simply capturing the fleeting information:

“I don’t even open my main tool. I just email it to myself so I won’t forget. Opening the tool outside of work is too heavyweight.” (P82)

These participants noted that the overarching goal of their task management tools in these scenarios was 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).

Finally, we find that participants’ practices for managing tasks within and beyond work are molded by the belief that work and nonwork are inherently interleaved. As one participant says, *“Life isn’t siloed these days”* (P67). 52 participants (34.7%) reported using only one particular list or group for their task management needs. When asked to provide rationale, participants highlighted that work and nonwork activities are often constrained in their scheduling:

“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)

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).

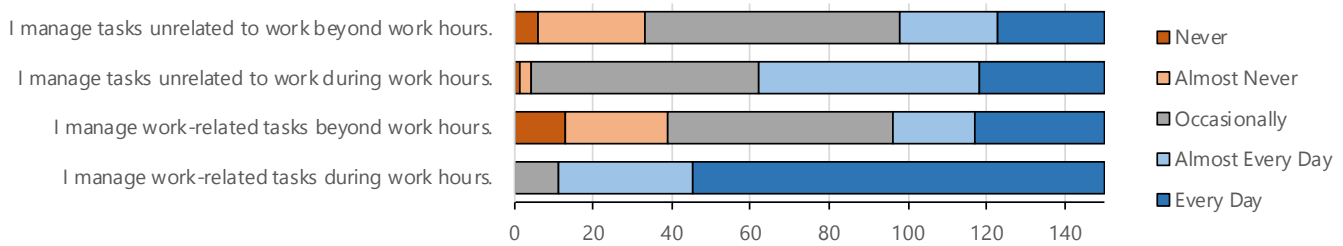


Figure 4: Frequencies for managing tasks within and between work and nonwork.

4.3.2 Frequency of Managing Tasks Across Boundaries. Figure 4 shows the distribution of participants' frequencies for managing tasks within and beyond their work hours. In general, we find that task management occurs most often during work hours. All 150 participants reported that they manage work-related tasks during work hours "Occasionally", "Almost Everyday", or "Every Day". Similarly, 149 participants (99.9%) reported managing tasks unrelated to work during work hours. In contrast to work hour activity, 105 participants (70%) reported managing work-related tasks beyond their work hours "Occasionally", "Almost Everyday" or "Every Day" with 117 participants (78%) reporting similar behavior for managing tasks unrelated to work outside of work.

We conducted a one-way multivariate analysis of variance (MANOVA) using each participant's four self-reported frequencies for managing work within and between work and nonwork as dependent variables. As independent variables, we used participants' age, gender, job role, WLI profile, and primary tool for both work and nonwork. We found that a statistically significant difference exists in participants' reported frequencies based on gender ($F(2,122)=2.80$; $p=.006$). A follow-up univariate analysis of variance (ANOVA) again yielded a significant difference on gender ($F(2,112)=5.66$, $p=0.005$). Using a post hoc Tukey test, we find that womens' mean frequency for managing tasks unrelated to work while outside of work hours ($\mu=3.93$; $\sigma=0.73$) was significantly higher ($p=0.01$) than mens' mean frequency ($\mu=3.69$; $\sigma=0.86$). Significant differences in frequencies were not observed in any other contexts.

4.3.3 Opportunities for Managing Tasks Across Boundaries. Our survey asked participants to evaluate the difficulty they experience in reorienting themselves both between work and nonwork and vice-versa. Using standard Likert agreement scales (i.e., 1=Strong Disagree; 5=Strong Agree), participants, on average, expressed they experience little difficulty in reorienting themselves to 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. Similarly, participants, on average, have 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 ($\mu=2.01$; $\sigma=1.10$). Further, participants 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 ($\mu=3.99$; $\sigma=0.86$) and nonwork ($\mu=4.18$; $\sigma=0.79$).

Despite self-reporting very little issue in managing tasks across the work-life boundary, 87 participants (58%) offered a myriad of suggestions for new task management features for supporting them

in managing tasks across the work-life boundary. In iteratively analyzing and coding participants' suggestions for new features, we arrived at four distinct themes for future task management tools:

- 1. Accelerated Capture (46 Participants):** Capabilities for quickly and easily capturing fleeting information. Voice creation, delegation, and interaction was mentioned explicitly by 32 participants.
- 2. Application Design & Integration (33 Participants):** A digital shift toward lightweight, integrated task management across all software applications, emphasizing desktop accessibility via phone.
- 3. Management Automation (22 Participants):** Automated methods for generating tasks (e.g., from e-mail) and partially automating their management (e.g., scheduling time for management triage).
- 4. Explicit Boundary Support (11 Participants):** Explicit system support for reducing work-life perforation (e.g., transition support) and deferring management tasks (e.g., capture now, organize later).

In addition to these four primary themes, several suggestions touched on less thematic elements for improvement, namely "the ability to share tasks with colleagues" (P29). Unlike the frontier of software opportunities, participants expressed little interest in using any device that was neither their desktop computer or their smartphone.

5 DISCUSSION

Our work makes strides in understanding how people's task management practices intersect with their preferences on separating or integrating their work and nonwork spheres. We first identified several trends in task management tool use across work and nonwork contexts, noting that certain tools are commonly used toward managing tasks related to work while others are more commonly used toward managing tasks unrelated to work, both as independent tools and in combinations. Complementing our analysis of tool use, we found that an individual's use of a primary task management tool is related to their preferences for separating or integrating their work and nonwork spheres.

Alongside our findings regarding tool use, our research introduces empirical evidence for measuring how frequently people manage tasks across the work-life boundary in information work. We first found that the vast majority of task management activities for both work and nonwork contexts take place during work hours. Despite being lower in their reported frequency, we also observed

that tasks belonging to work and nonwork are managed by a majority of people. Within these frequencies, we discovered that women are more likely to manage tasks unrelated to work beyond work hours in comparison to men.

Finally, our work provides insight into information workers' perceptions of the challenges and opportunities that stem from managing tasks across the work-life boundary. Unlike prior studies of interruptions and distractions, we find that information workers experience little challenge or difficulty in reorienting themselves to their work or nonwork sphere after briefly using their task management tool. We also find that information workers are generally satisfied with the quality of their recording information when the time to use the information later arrives. Our conclusive findings center on a brief, but significant list of future directions for task management tool features aimed at supporting people in managing tasks across the work-life boundary.

5.1 Contextualizing to the Current Situation

Information work has undergone a global shift toward remote work over the past several months. One particularly important characteristic about this shift is that the vast majority of information workers are now working from their home, ultimately minimizing the psychological distinction between work and nonwork places. Our work highlights that a significant percentage of people already interleaved task management within and between these two spheres well-before the current work situation. In our research, we noted that the challenges of working across these spheres was minimal. However, as the world is operating within a pandemic, we believe there are a wealth of societal, economical, medical, and personal factors that may amplify the challenge and difficulty in moving between these two spheres today. A significant question for today's working context is simply: Does a boundary exist at all, or are have people adopted the perspective that "life isn't siloed"? If not, what role do task management tools play in upholding such a boundary?

Work practice itself has been subjected to change with the shift toward remote work. Virtual meetings, for example, now account for a substantial percentage of many people's workday, replacing time originally spent in physical meeting spaces with the growing popularity of team-based task management tools (e.g., Microsoft Teams, Slack). Our findings that describe information workers' tool use and management practices are firmly rooted in practices that existed before the current work situation. A significant question of interest for contextualizing our own research is: How frequently are people managing tasks across the work-life boundary today? What magnitude does an individual's primary task management tool itself play in supporting people's separation of work and nonwork? To what extent are task management tools still used when boundaries are so substantially blurred? Most importantly, what new challenges and opportunities does the additional of these team-based tools bring to people's broader task management practices?

A significant consideration for our study is that it relies heavily on characterizing people based on their preferences for separating work and nonwork (i.e., using the Work Life Indicator [32]). How has the pandemic altered people's preferences for separating their work and personal spheres? We are unaware of any research, within and beyond the HCI literature, that addresses this question at depth.

6 A FRONTIER FOR RESEARCH

People's work and personal spheres are currently more intertwined than ever before, yet the tools that support these spheres have yet to reflect the world we live in. The two central facets of our lives – work and nonwork – rarely know about one another, and people carry the burden of managing the scheduling of their work, while rapidly undergoing transitions in and out of context.

We described several directions for future task management features lead by analyses of participant responses in Section 4.3.3. Extrapolating these suggestions into more recent work contexts, one potentially fruitful direction of system research could explore the scheduling of tasks with the penultimate goal of finding an arrangement sufficient for work and nonwork alike. As well-being has become a significant point of interest in the current work situation, an appropriate form of evaluation may study users' changes in productivity, but also their emotional state (e.g., happiness) [30]. Other topics rich for exploration include task management tools that improve interruption resilience, help us prepare for resumption, facilitate engagement and disengagement, support us in divided attention settings where multitasking is necessary. Each of these directions introduces new research questions regarding how, when, and where future task management tools can be leveraged.

6.1 Future Research

We are currently planning a redeployment of our online survey with the goal of conducting a comparative repeated cross-sectional study aimed at understanding how task management across the work-life boundary has changed in the current work situation. Alongside our own continued inquiry, our work advocates for further examination of task management across the work-life boundary through the lens of mixed-method approaches, such as interviews, experience sampling, and log analyses – each of which provide a unique and alternative perspectives complementary to the one presented here.

7 CONCLUSION

We reported findings from a survey deployed to 150 information workers during Summer 2019 that inquired about task management tool usage, contextual task management practice, and preferences for separating work and nonwork. We first characterize and identify trends across tool use, job role, and task management practice. We find that the majority of task management activity occurs during work hours, and that information workers regularly manage work tasks beyond work hours and vice versa, despite maintaining practices and preferences toward not 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.

REFERENCES

- [1] 2020. *Task Management Software Market - Global Forecast to 2023*. Technical Report. 155 pages. https://www.researchandmarkets.com/research/ss834x/task_management?w=4
- [2] Tammy D Allen, Eunae Cho, and Laurenz L Meier. 2014. Work–family boundary dynamics. *Annu. Rev. Organ. Psychol. Organ. Behav.* 1, 1 (2014), 99–121.
- [3] Blake E. Ashforth, Glen E. Kreiner, and Mel Fugate. 2000. All in a day's work: Boundaries and micro role transitions. *Academy of Management Review* 25, 3 (7 2000), 472–491. <https://doi.org/10.5465/AMR.2000.3363315>

- [4] Victoria Bellotti, Brinda Dalal, Nathaniel Good, Peter Flynn, Daniel G. Bobrow, and Nicolas Ducheneaut. 2004. What a To-Do: Studies of Task Management towards the Design of a Personal Task List Manager. In *Proceedings of the 2004 conference on Human factors in computing systems - CHI '04*. ACM Press, 735–742. <https://doi.org/10.1145/985692.985785>
- [5] Victoria Bellotti, Nicolas Ducheneaut, Mark Howard, and Ian Smith. 2003. Taking email to task: the design and evaluation of a task management centered email tool. In *Proceedings of the conference on Human factors in computing systems - CHI '03*. ACM Press, New York, New York, USA, 345. <https://doi.org/10.1145/642611.642672>
- [6] Victoria Bellotti and J D Thornton. 2006. Managing Activities with TVACTA: TaskVista and Activity-Centered Task Assistant. In *Proc. SIGIR Workshop on PIM*. 8–11.
- [7] Michael Bernstein, Max Van Kleek, David Karger, and M. C. Schraefel. 2008. Information scraps: How and why information eludes our personal information management tools. *ACM Transactions on Information Systems* 26, 4 (9 2008), 1–46. <https://doi.org/10.1145/1402256.1402263>
- [8] Carmen Binnewies, Sabine Sonnentag, and Eva J. Mojza. 2010. Recovery during the weekend and fluctuations in weekly job performance: A week-level study examining intra-individual relationships. *Journal of Occupational and Organizational Psychology* 83, 2 (6 2010), 419–441. <https://doi.org/10.1348/096317909X418049>
- [9] Jos F. Brosschot, Suzanne Pieper, and Julian F. Thayer. 2005. Expanding stress theory: Prolonged activation and perseverative cognition. *Psychoneuroendocrinology* 30, 10 (11 2005), 1043–1049. <https://doi.org/10.1016/j.psyneuen.2005.04.008>
- [10] Frederik Brudy, Christian Holz, Roman Radle, Chi-Jui Wu, Steven Houben, Clemens Klokose, and Nicolai Marquardt. 2019. Cross-Device Taxonomy: Survey, Opportunities and Challenges of Interactions Spanning Across Multiple Devices. In *CHI Conference on Human Factors in Computing Systems Proceedings (CHI 2019)*. ACM Press, New York, New York, USA. <https://doi.org/10.1145/3290605.3300792>
- [11] Marta E. Cecchinato, Anna L. Cox, and Jon Bird. 2015. Working 9-5?: Professional Differences in Email and Boundary Management Practices. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems - CHI '15*. ACM Press, New York, New York, USA, 3989–3998. <https://doi.org/10.1145/2702123.2702537>
- [12] Sue Campbell Clark. 2000. Work/Family Border Theory: A New Theory of Work/Family Balance. *Human Relations* 53, 6 (6 2000), 747–770. <https://doi.org/10.1177/0018726700536001>
- [13] Karlene Cousins and Daniel Robey. 2015. Managing work-life boundaries with mobile technologies. *Information Technology & People* 28, 1 (3 2015), 34–71. <https://doi.org/10.1108/ITP-08-2013-0155>
- [14] Stephan Desrochers, Jeanne M. Hilton, and Laurie Larwood. 2005. Preliminary Validation of the Work-Family Integration-Blurring Scale. *Journal of Family Issues* 26, 4 (5 2005), 442–466. <https://doi.org/10.1177/0192513X04272438>
- [15] Anind K. Dey and Gregory D. Abowd. 2000. CybreMinder: A Context-Aware System for Supporting Reminders. 172–186. https://doi.org/10.1007/3-540-39959-3_13
- [16] Anton N. Dragunov, Thomas G. Dietterich, Kevin Johnsrude, Matthew McLaughlin, Lida Li, and Jonathan L. Herlocker. 2005. TaskTracer: A Desktop Environment to Support Multi-Tasking Knowledge Workers. In *Proceedings of the 10th international conference on Intelligent user interfaces - IUI '05*. ACM Press, 75. <https://doi.org/10.1145/1040830.1040855>
- [17] Rowanne Fleck, Anna L. Cox, and Rosalyn A.V. Robison. 2015. Balancing Boundaries: Using Multiple Devices to Manage Work-Life Balance. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems - CHI '15*. ACM Press, New York, New York, USA, 3985–3988. <https://doi.org/10.1145/2702123.2702386>
- [18] Michael Freed, Jaime G Carbonell, Geoffrey J Gordon, Jordan Hayes, Brad A Myers, Daniel P Siewiorek, Stephen F Smith, Aaron Steinfeld, and Anthony Tomic. 2008. RADAR: A Personal Assistant that Learns to Reduce Email Overload. In *AAAI*, Vol. 8. 1287–1293.
- [19] David Graus, Paul N. Bennett, Ryen W. White, and Eric Horvitz. 2016. Analyzing and Predicting Task Reminders. In *Proceedings of the 2016 Conference on User Modeling Adaptation and Personalization - UMAP '16*. ACM Press, New York, New York, USA, 7–15. <https://doi.org/10.1145/2930238.2930239>
- [20] Erik Grönvall, Luigina Cioffi, Gabriela Avram, Chiara Rossitto, and Louise Barkhuus. 2016. HCI at the boundary of work and life. *Personal and Ubiquitous Computing* 20, 4 (2016), 481–485. <https://doi.org/10.1007/s00779-016-0937-5>
- [21] Douglas T. Hall and Judith Richter. 1988. Balancing Work Life and Home Life: What Can Organizations Do to Help? *Academy of Management Perspectives* 2, 3 (8 1988), 213–223. <https://doi.org/10.5465/ame.1988.4277258>
- [22] Mona Haraty, Joanna McGrenere, and Charlotte Tang. 2016. How personal task management differs across individuals. *International Journal of Human-Computer Studies* 88 (4 2016), 13–37. <https://doi.org/10.1016/j.ijhcs.2015.11.006>
- [23] Stevan E Hobfoll. 2004. *Stress, culture, and community: The psychology and philosophy of stress*. The Plenum series on stress and coping, Vol. imm. Plenum Press, New York. 316 pages. <https://doi.org/10.1007/978-1-4899-0115-6>
- [24] Ute R. Hülshager, Hugo J.E.M. Alberts, Alina Feinholdt, and Jonas W.B. Lang. 2013. Benefits of mindfulness at work: The role of mindfulness in emotion regulation, emotional exhaustion, and job satisfaction. *Journal of Applied Psychology* 98, 2 (2013), 310–325. <https://doi.org/10.1037/a0031313>
- [25] Ute R. Hülshager, Jonas W.B. Lang, Franziska Depenbrock, Carmen Fehrmann, Fred R.H. Zijlstra, and Hugo J.E.M. Alberts. 2014. The power of presence: The role of mindfulness at work for daily levels and change trajectories of psychological detachment and sleep quality. *Journal of Applied Psychology* 99, 6 (2014), 1113–1128. <https://doi.org/10.1037/a0037702>
- [26] William Jones and Brian H Ross. 2007. Personal information management. *Handbook of applied cognition* (2007), 471–496.
- [27] Ece Kamar and Eric Horvitz. 2011. Jogger: models for context-sensitive reminding. In *AAMAS*. 1089–1090.
- [28] Rosabeth Moss Kanter. 1977. *Work and family in the United States: A critical review and agenda for research and policy*. Russell Sage Foundation.
- [29] Jun Kato, Daisuke Sakamoto, Takeo Igarashi, and Masataka Goto. 2014. Shared: To-do list interface for human-agent task sharing. *HAI 2014 - Proceedings of the 2nd International Conference on Human-Agent Interaction* (2014), 345–351. <https://doi.org/10.1145/2658861.2658894>
- [30] Harmanpreet Kaur, Alex C. Williams, Daniel McDuff, Mary Czerwinski, Jaime Teevan, and Shamsi T. Iqbal. 2020. Optimizing for Happiness and Productivity: Modeling Opportune Moments for Transitions and Breaks at Work. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. ACM, New York, NY, USA, 1–15. <https://doi.org/10.1145/3313831.3376817>
- [31] Joseph 'Jofish' Kaye, Janet Vertesi, Shari Avery, Allan Dafoe, Shay David, Lisa Onaga, Ivan Rosero, and Trevor Pinch. 2006. To have and to hold: exploring the personal archive. In *Proceedings of the SIGCHI conference on Human Factors in computing systems - CHI '06*. ACM Press, New York, New York, USA, 275. <https://doi.org/10.1145/1124772.1124814>
- [32] Ellen Ernst Kossek, Marian N. Ruderman, Phillip W. Braddy, and Kelly M. Hannum. 2012. Work-nonwork boundary management profiles: A person-centered approach. *Journal of Vocational Behavior* 81, 1 (8 2012), 112–128. <https://doi.org/10.1016/j.jvb.2012.04.003>
- [33] Mik Lamming and Mike Flynn. 1994. Forget-me-not: Intimate computing in support of human memory. In *Proc. FRIEND'94, 1994 Int. Symp. on Next Generation Human Interface*, Vol. 4.
- [34] Laura Lascau, Sandy Gould, E Cox Anna amd Karmannaya, and Duncan Brumby. 2019. Monotasking or Multitasking: Designing for Crowdworkers' Preferences. In *CHI Conference on Human Factors in Computing Systems Proceedings (CHI 2019)*. ACM Press, New York, New York, USA. <https://doi.org/10.1145/3290605.3300649>
- [35] Jonathan Lazar, Jinjuan Heidi Feng, and Harry Hochheiser. 2017. *Research methods in human-computer interaction*. Morgan Kaufmann.
- [36] Sophie Leroy. 2009. Why is it so hard to do my work? The challenge of attention residue when switching between work tasks. *Organizational Behavior and Human Decision Processes* 109, 2 (7 2009), 168–181. <https://doi.org/10.1016/j.obhdp.2009.04.002>
- [37] Wendy E. Mackay. 1988. More than just a communication system: diversity in the use of electronic mail. In *Proceedings of the 1988 ACM conference on Computer-supported cooperative work - CSCW '88*. ACM Press, New York, New York, USA, 344–353. <https://doi.org/10.1145/62266.62293>
- [38] Gloria Mark, Victor M. Gonzalez, and Justin Harris. 2005. No task left behind?: examining the nature of fragmented work. In *Proceedings of the SIGCHI conference on Human factors in computing systems - CHI '05*. ACM Press, New York, New York, USA, 321. <https://doi.org/10.1145/1054972.1055017>
- [39] Gloria Mark, Daniela Gudith, and Ulrich Klocke. 2008. The cost of interrupted work: more speed and stress. In *Proceeding of the twenty-sixth annual CHI conference on Human factors in computing systems - CHI '08*. New York, New York, USA, 107. <https://doi.org/10.1145/1357054.1357072>
- [40] Gloria Mark, Shamsi T. Iqbal, Mary Czerwinski, and Paul Johns. 2014. Bored Mondays and focused afternoons: the rhythm of attention and online activity in the workplace. In *Proceedings of the 32nd annual ACM conference on Human factors in computing systems - CHI '14*. ACM Press, 3025–3034. <https://doi.org/10.1145/2556288.2557204>
- [41] Gloria Mark, Shamsi T. Iqbal, Mary Czerwinski, Paul Johns, Akane Sano, and Yuliya Lutchny. 2016. Email Duration, Batching and Self-interruption. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems - CHI '16*. ACM Press, 1717–1728. <https://doi.org/10.1145/2858036.2858262>
- [42] Theo F Meijman and Gijsbertus Mulder. 1998. Psychological aspects of workload. In *Handbook of work and organizational psychology*, [Vol. 2: {Work} psychology (2nd ed.)]. 5–33. <https://doi.org/10.2307/2392800>
- [43] Eva J. Mojza, Sabine Sonnentag, and Claudius Bornemann. 2011. Volunteer work as a valuable leisure-time activity: A day-level study on volunteer work, non-work experiences, and well-being at work: A day-level study on volunteer work. *Journal of Occupational and Organizational Psychology* 84, 1 (3 2011), 123–152. <https://doi.org/10.1348/096317910X485737>
- [44] Karen Myers, Pauline Berry, Jim Blythe, Ken Conley, Melinda Gervasio, Deborah L. McGuinness, David Morley, Avi Pfeffer, Martha Pollack, and Milind Tambe. 2007. An intelligent personal assistant for task and time management. *AI Magazine* 28,

- 2 (2007), 47.
- [45] Christena E Nippert-Eng. 2008. *Home and work: Negotiating boundaries through everyday life*. University of Chicago Press.
- [46] Don Norman. 2013. *The Design of Everyday Things: Revised and Expanded Edition*. Basic books.
- [47] Anicia Peters, Susan Dray, and Jofish Kaye. 2012. SIG: Work life balance in HCI. In *Proceedings of the 2012 ACM annual conference extended abstracts on Human Factors in Computing Systems Extended Abstracts - CHI EA '12*. ACM Press, New York, New York, USA, 1229. <https://doi.org/10.1145/2212776.2212430>
- [48] Kirsten Sadler, Toni Robertson, Melanie Kan, and Penny Hagen. 2006. Balancing work, life and other concerns: a study of mobile technology use by Australian freelancers. In *Proceedings of the 4th Nordic conference on Human-computer interaction changing roles - NordiCHI '06*. ACM Press, New York, New York, USA, 413–416. <https://doi.org/10.1145/1182475.1182525>
- [49] Morgan Klaus Scheuerman, Katta Spiel, Oliver L. Haimson, Foad Hamidi, and Stacy M. Branham. 2019. HCI Guidelines for Gender Equity and Inclusivity. <https://www.morgan-klaus.com/sigchi-gender-guidelines>
- [50] Sabine Sonnentag and Charlotte Fritz. 2015. Recovery from job stress: The stressor-detachment model as an integrative framework. *Journal of Organizational Behavior* 36, S1 (2 2015), S72–S103. <https://doi.org/10.1002/job.1924>
- [51] Carlos Toxtli, Andrés Monroy-Hernández, and Justin Cranshaw. 2018. Understanding Chatbot-mediated Task Management. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems - CHI '18*. ACM Press, New York, New York, USA, 1–6. <https://doi.org/10.1145/3173574.3173632>
- [52] J. Gregory Trafton, Erik M. Altmann, Derek P. Brock, and Farilee E. Mintz. 2003. Preparing to resume an interrupted task: Effects of prospective goal encoding and retrospective rehearsal. *International Journal of Human Computer Studies* 58, 5 (5 2003), 583–603. [https://doi.org/10.1016/S1071-5819\(03\)00023-5](https://doi.org/10.1016/S1071-5819(03)00023-5)
- [53] Johanne R. Trippas, Flora D. Salim, Mark Sanderson, Damiano Spina, Falk Scholer, Ahmed Hassan Awadallah, Peter Bailey, Paul N. Bennett, Ryan W. White, Jonathan Liono, and Yongli Ren. 2019. Learning About Work Tasks to Inform Intelligent Assistant Design. In *Proceedings of the 2019 Conference on Human Information Interaction and Retrieval - CHIIR '19*. ACM Press, New York, New York, USA, 5–14. <https://doi.org/10.1145/3295750.3298934>
- [54] Steve Whittaker and Candace Sidner. 1996. Email overload: Exploring Personal Information Management of Email. In *Proceedings of the SIGCHI conference on Human factors in computing systems common ground - CHI '96*. ACM Press, New York, New York, USA, 276–283. <https://doi.org/10.1145/238386.238530>
- [55] Alex C. Williams, Harmanpreet Kaur, Gloria Mark, Anne Loomis Thompson, Shamsi T. Iqbal, and Jaime Teevan. 2018. Supporting Workplace Detachment and Reattachment with Conversational Intelligence. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems - CHI '18*. ACM Press, New York, New York, USA, 1–13. <https://doi.org/10.1145/3173574.3173662>
- [56] Alex C. Williams, Gloria Mark, Kristy Milland, Edward Lank, and Edith Law. 2019. The Perpetual Life of Crowdworkers: How Tooling Practices Increase Fragmentation in Crowdsourcing. *Proceedings of the ACM on Human-Computer Interaction* 3 (2019), 24–52. <https://doi.org/10.1145/3359126>
- [57] Eviatar Zerubavel. 1993. *The Fine Line: Making Distinctions in Everyday Life*. University of Chicago Press.