Overcoming Distractions during Transitions from Break to Work using a Conversational Website-Blocking System

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ABSTRACT

Work breaks–both physical and digital–play an important role in productivity and workplace wellbeing. Yet, the growing availability of digital distractions from online content can turn breaks into prolonged "cyberloafing". In this paper, we present *UpTime*, a system that aims to support workers' transitions from breaks back to work–moments susceptible to digital distractions. Combining a browser extension and chatbot, users interact with UpTime through proactive and reactive chat prompts. By sensing transitions from inactivity, UpTime helps workers avoid distractions by automatically blocking distracting websites temporarily, while still giving them control to take necessary digital breaks. We report findings from a 3-week comparative field study with 15 workers. Our results show that automatic, temporary blocking at transition points can significantly reduce digital distractions and stress without sacrificing workers' sense of control. Our findings, however, also emphasize that overloading users' existing communication channels for chatbot interaction should be done thoughtfully.

CCS CONCEPTS

• **Human-centered computing → Interactive systems and tools**;

KEYWORDS

Workplace; wellbeing; work breaks; interruption management; conversational agents; cyberloafing

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1 INTRODUCTION

Taking regular breaks at work has been shown to contribute to workers' wellbeing and productivity and prevent burnout. Workplace breaks range from physical breaks (e.g., going for a walk, to the bathroom, or to get a coffee) to short digital breaks (e.g., responding to personal email, visiting a social networking site, or catching up on the news). However, as more and more work and personal activities take place online, the separation between workers' personal and professional spheres is disappearing. In fact, personal internet usage while at work is common, with workers reporting spending 51 minutes on average over a workday in a 2012 study [44].

Prior research has shown that workers experience difficulty when resuming their main task after an external- or self-interruption [26, 49, 51] and thus might seek a diversion to a distracting website. In particular, self-interruptions account for 40% of interruptions [22] and may be more disruptive than external interruptions [10]. Epstein et al. [23] identified that resuming work after a break can often be difficult if the worker does not feel ready to work. As a result, workers will often engage in non-work-related online activities when they return to their desk (e.g., reading news, checking personal email, browsing Facebook) rather than engaging in work tasks, potentially leading to a "chain of diversions" [33] and "Cyberloafing" — defined as the voluntarily use of digital technologies for non-work purposes during working hours [27, 43].

One approach for combating cyberloafing is to block access to non-work sites altogether. However, preventing workers from taking digital breaks is inadvisable, as recent studies have pointed to the importance of digital breaks for combating boredom [53], increasing productivity [23], and for managing the work/life balance and reducing stress

[12]. Another approach controls access to non-work sites but relies on the worker to self-regulate their break-taking behavior.

Instead, we propose that focusing on supporting workers through transitioning back to work — moments shown to be particularly vulnerable to self-distractions — will still allow them the reprieve afforded by digital breaks. Additionally, we examine how a proactive, conversational interaction approach for managing distractions may provide workers with awareness and encouragement for staying on task.

We present *UpTime*, a system that aims to support workers' transitions from breaks back to work. UpTime comprises a browser extension and a Slack chatbot. The UpTime system senses transitions between computer inactivity and activity states to automatically, but temporarily block the worker's access to distracting websites. The chatbot interacts with the worker through a set of proactive and reactive chat prompts, providing friction, allowing control, and offering encouragement. In the remainder of this paper, we describe the UpTime system and design rationale and report findings from a 3-week comparative in-situ study with 15 information workers. Specific contributions include: 1) a novel conversational website-blocking system that focuses on transition back to computer work, 2) a comparative evaluation showing empirical evidence that automatic, temporary blocking at transition points can significantly reduce digital distractions and stress without sacrificing workers' sense of control, but that overloading users' existing communication channels for chatbot interaction should be done thoughtfully.

2 RELATED WORK

Cyberloafing behaviors

Cyberloafing is the behavior of employees using the Internet for personal or non-work-related purposes during work hours [17, 31, 43, 59]. Approximately 80% of information workers reported cyberloafing behaviors during work hours [25], spending an average of 51 minutes during work [44]. Further enabling cyberloafing is the proliferation of ICT in the workplace [56], providing many more opportunities for micro-breaks and blurring the boundaries between personal activity and work. Many factors are related to the likelihood of workers engaging in cyberloafing, including personality [54], organizational culture [14], inter-employee dynamics [50], and generational habits [36]. One of the most direct triggers is feeling bored or stressed, for which cyberloafing is a means of escape [12].

The Importance of physical and digital work breaks

Studies have shown that taking breaks at work can improve overall work performance despite the short-term cost to productivity and overhead of task resumption [18]. Physical breaks can disrupt sedentary behavior, shown to be detrimental to health [30, 57]. Interventions to promote moving breaks show an increase in physical activity [19, 29] and habit formation [45]. Workers tend to take *non*-physical digital breaks when they feel unproductive [23]. Short digital breaks to "graze" social media can be beneficial [47]. Recent research has emphasized that some forms of cyberloafing can have a positive impact [44, 53]. Therefore, allowing workers the benefits of both physical *and* digital breaks is desirable.

Transitions and susceptibility to distraction

Certain attentional states (such as boredom, stress, cognitive fatigue, and even a "fear of missing out") can lead workers to self-interrupt [10, 22, 28, 34, 55] and seek distracting stimuli to bring their cognitive/emotional state back to equilibrium [48]. In particular, prior work (c.f., [23]) found that workers often have difficulty resuming work after breaks and may extend their break and risk starting a chain of diversions [33] (i.e., going down a "rabbit hole" of non-work activities). In these moments, workers can be susceptible to cyberloafing to distract themselves. In our approach, we focus on moments in the workday where workers may be particularly vulnerable to distractions and provide support for managing access to distractions. We start by answering the following research question:

- RQ1: Are workers more prone to cyberloafing when transitioning back to computer work?

Interventions for reducing cyberloafing

A wide range of approaches have been explored for reducing cyberloafing and the associated loss of productivity. At one extreme, tools such as TimeAware [37], the Moment app [5], and [52] monitor computer or mobile device usage to help individual workers to reflect on, be more aware of, and ultimately change their behavior. At the other extreme, organizations may altogether ban employees from visiting non-work sites; however, the resulting loss of autonomy and perceived trust may lead to poorer productivity, effort, and morale [21, 38]. Some browser plugins and mobile apps block access to apps or websites only after the user has exceeded a time budget [9, 32]. Other plugins can block access to particular apps or websites at particular times of the day or on demand by the user [2–4, 7, 46]. PomodoLock [35] combines timeboxing, a productivity technique that focuses the worker on a task for a defined time frame, with distraction blocking across multiple devices. These tools all rely on the user to recognize when they are susceptible to distractions and then willingly self-initiate blocking.

In this work, we explore a hybrid approach that uses proactive, automatic but temporary blocking in

distraction-susceptible moments, aiming to give workers control to take digital breaks when necessary. We explore the following questions:

- RQ2: How does automatic, temporary site blocking at transition points affect workers':
  a) susceptibility to online distractions?
  b) stress due to internal coercion?
  c) sense of control?

Conversational bots for behavior change & reflection

Conversational agents, or chatbots, have been shown to be effective for supporting behavior change in a range of domains. These include, for example, conversational agents for health coaching [16] and fitness [40]. In the workplace domain, recent work has looked at chatbots for reflection and wellness: SwitchBot [61] interacts with workers at the beginning and end of their work day to help reflect, plan, and attach/detach from work. Robota is a chatbot that supports workplace reflection and journaling with text and voice [39]. Indeed, technology-supported reflection has been shown to be a powerful but complex tool [15, 41, 42]. Asking people their reasons for doing an activity has been shown to trigger underlying motivations and lead to focus on higher-level goals [58]. Specifically, asking 'why' questions has been shown to be effective [24]. In our system, we explore whether conversational interaction for managing workplace distractions can help workers maintain awareness and a sense of control over their digital break-taking behavior. We explore the following research question:

- RQ3: Does conversational negotiation of website blocking encourage reflection and self-control?

3 THE UPTIME SYSTEM

We designed and implemented UpTime, a novel system that uses computer-state sensing to identify a transition back to computer work and proactively block access to distracting websites temporarily to help workers focus on their work. The system comprises a Google Chrome-browser extension, a Slack chatbot, and a web-server back-end. In this section, we describe the implementation and how the system interacts with users.

The Chrome extension

In order for UpTime to detect transitions between activity states and monitor workers' interaction with distracting sites, we developed a Chrome extension (deployable across operating systems) that has the following main functions:

Managing a list of distracting websites. As in other website blocking tools, our extension allows the user to create and edit a personalized list of sites they find distracting to their work. UpTime allows the user to edit the list only when the system is not in a blocking state.

Sensing transitions. The UpTime extension uses the Google Chrome extension API [1] to track the state of the computer (idle / active / locked). UpTime considers the user to be on a break if the system is locked or idle (no user input for at least 5 minutes). Once the computer is unlocked or activity resumes, UpTime considers the user to be back. This state is used to trigger a 25-minute blocking session (we chose 25 minutes for blocking following [35]) and an event is sent to the server that sends a chat message to the user.

Website blocking. After detecting a transition to computer work, a blocking session is triggered and the extension's icon is changed to a red 'X'. Using the Chrome extension API, UpTime observes any attempts to visit websites on the user's block list. If such a visit is attempted by the user, the browser tab is automatically redirected to a local page that informs the user that the site is blocked and shows the current time of day. An event is also sent to the UpTime server to trigger conversational negotiation (more details below).

Tracking cyberloafing. When UpTime is not blocking, the extension's icon is changed to a green check mark. The extension still identifies whenever the user spends time on sites on their distracting-sites list. If the cumulative time spent before the next blocking session crosses a predefined threshold, an event is sent to the server and the chatbot engages in simple nudging (more details below).

The conversational agent (Slackbot)

A novel aspect of the UpTime system is that user interaction is embodied in a chatbot, a modality previously shown to be effective for behavior change. We built our chatbot on the widely used Slack platform. With Slack's APIs, the UpTime bot can receive the user's input messages and send notifications and messages to the user. The chatbot communicates with the browser extension in the background to coordinate access to distracting sites.

When UpTime detects a transition to computer work, the bot sends the user a message *"Hi again. Access to your distracting sites is disabled for the next 25 minutes."* Figure 1 top, to inform the user that blocking has been automatically turned on and to remind the user to focus on their work for the next 25 minutes. By default, UpTime does not notify the user when blocking is released after 25 minutes to avoid interrupting the user's workflow. However, the user can type 'notify' to the bot to tell UpTime to notify them when the current blocking session is over. The user can also type 'disable' to the bot to end the current blocking session, and after confirming their decision, UpTime turns off blocking until the next transition when it will once again

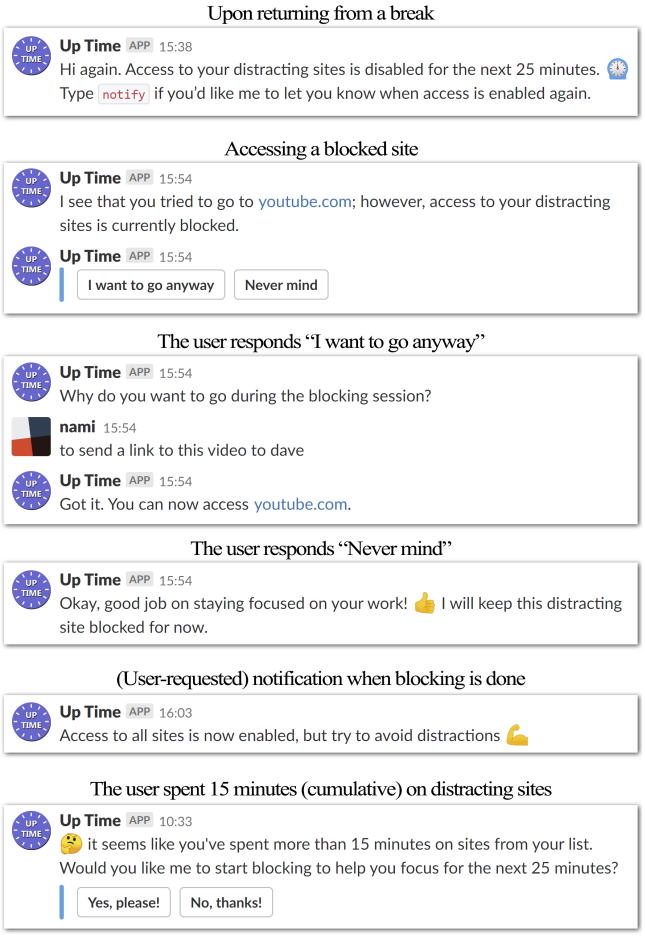

Figure 1: Proactive prompts from the chatbot provide workers with awareness, control, and encouragement.

automatically block distracting sites. Users can also manually turn on blocking for a set period (5, 15, 25, or 60 minutes) by typing the 'block' command to the bot.

Negotiating Unblocking. If the user attempts to visit a blocked site during the blocking period, the browser extension will redirect the tab to a local page and the bot will send a message, *"I see that you tried to go to a blocked site; however, access to your distracting sites is currently blocked"*, and ask whether the user really wants to access the blocked site (Figure 1 middle). The user can click the *"I want to go anyway"* button, and the UpTime bot will ask for a reason. After the user enters a free-text reason, the UpTime bot will unblock that particular site for the rest of the current blocking period. The negotiation between the user and bot introduces a point of reflective friction that can help users manage distractions.

As mentioned above, when the system is not blocking, it silently monitors the cumulative time spent on distracting sites. The bot proactively alerts the user with the message *"It seems like you've spent more than 15 minutes on sites from your list. Would you like me to start blocking to help you focus for the next 25 minutes?"* (Figure 1 bottom). The user can then agree to the blocking suggestion, dismiss it, or ignore it.

The UpTime Server

We implemented our back-end server using node.js [6] hosted on an internal server. The server manages all chat communication with the user through the Slack API [8]. The server maintains a record of each user's blocking state in case the user quits and restarts their browser. The server is responsible for passing events between the extension and bot, because in our design, chat interaction triggers changes in the extension and browsing behavior triggers chat interaction.

4 FIELD EVALUATION

In order to evaluate the appropriateness of UpTime's automatic website blocking at points of transition, and the potential role of a conversational interface in distraction management, we conducted a three-week in-situ study, comparing UpTime with baseline behavior and with a state-of-the-art system. The study was conducted within our organization, where employees can communicate with the UpTime bot using the lab's corporate Slack team.

Study Design

We conducted a three-week, within-subjects controlled deployment in which participants experienced each of three conditions. In the first week (the "Baseline" condition), participants engaged in their normal workplace activities without intervention. The extension silently logged browsing data and computer activity states, and participants completed daily surveys. No blocking was done or even mentioned. In the two weeks that followed, participants experienced the UpTime system for one week and experienced a version emulating Kim et al.'s PomodoLock system [35] for one week.

UpTime Pomodoro condition: mirroring PomodoLock. In their UbiComp'17 paper, Kim et al. introduced and evaluated the PomodoLock system [35]. Their system, inspired by the Pomodoro technique [20], allows users to self-initiate 25-minute sessions during which access to their list of distracting sites is blocked. In their evaluation, they found that participants' perceived coercion and stress was lower compared to participants without website blocking. We chose to compare UpTime to PomodoLock since they vary across a set of interesting dimensions; specifically, a) whether blocking begins automatically at transition points or is left to the user to initiate, and b) interaction modality. For comparison, we implemented a second version of

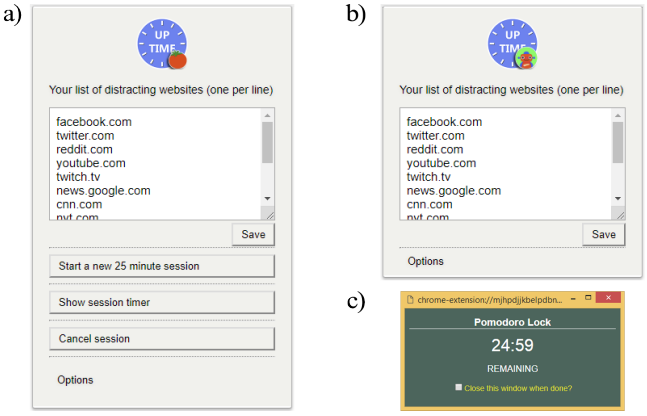

Figure 2: The menu dialogs in the browser extension for a) UpTime Pomodoro for manually starting and stopping sessions, b) UpTime Bot for entering distracting sites for automatic blocking, and c) Pomodoro timer window.

the system called "UpTime Pomodoro" that replicated the website-blocking functionality of Kim et al.'s PomodoLock.

As shown in Figure 2a, in UpTime Pomodoro, after creating a list of distracting sites, the user can start a 25-minute blocking session. Starting a session causes a popup browser window to appear showing a countdown timer (see Figure 2c) and changes the extension icon to a red X to indicate that blocking is on. The user may use the "Cancel session" button to terminate an ongoing session. Once a session is completed (or canceled by the user), the extension's icon changes to a green checkmark to indicate that access to all websites is available. We note that unlike in PomodoLock, which included browser, mobile, and app blocking, our implemented system can only block websites in the user's Chrome browser.

Managing study conditions remotely

To control the timing of switching between conditions and to avoid installing and reinstalling different extensions at the beginning of every week, we implemented all three system behaviors into one extension. An online panel allowed us to remotely switch the functionality of the extension for each participant. Once switched, the extension's behavior and menus are changed. Figure 2a and b shows the extension's pop-up menu for each of the conditions.

Striving to capture real baseline behavior

One potential risk in a study of this nature that participants' behavior during a "baseline" week will be influenced and not representative of their true unobserved behavior. Obviously, one would expect behavior to be influenced by virtue of data being collected and from answering daily surveys reporting productivity and focus. However, we were particularly concerned that if users were aware that study examines their browsing habits around breaks and their browsing behavior with sites they consider distracting, then they will change their natural behavior. We thus did the following: first, in the invitation, the study purpose was described more generally to participants as "investigating the usefulness of short interventions for managing distractions at work." Second, we did not introduce the surveys questions about distractions and self-control until the end of the Baseline week. Finally, and most importantly, to avoid influencing participants' browsing behavior with specific websites, we did not have users input their personal lists of distracting websites until the end of the Baseline week. One resulting challenge, however, was that in order to analyze participants' behavior with distracting sites, collected domain names could only be masked at the end of the week, once participants provided their personalized lists. Thus, during the Baseline week, we temporarily collected domains of visited sites and then masked and labeled them in post-processing.

Data Collection

We collected the computer's idle/active state using the Chrome extension API. Additionally, we logged all interactions with the extension, either through the chatbot or directly (editing the list of websites, starting or cancelling a Pomodoro blocking session, etc.), and logged all visits to websites both on and not on the user's list of distracting sites (and whether they were blocked or not by our system).

End-of-day surveys. At the end of each day, participants were asked to complete a short online survey. They were asked whether the workday was unusual in any way, whether they worked from home, and asked to rate (on a 7-point Likert scale) how productive they felt in the morning and in the afternoon, how focused they felt throughout the work day, and how stressed they felt as a result of using their willpower to avoid distractions at work.

End-of-week surveys. At the end of each week, participants were asked to rate (on a 7-point Likert scale) their sense of control of how they spent their time at work, control of how they took digital breaks, and their ability to manage self-distractions. At the end of the Baseline week, participants rated their susceptibility to various distractions. Finally, at the end of weeks 2 & 3, participants answered several questions about their experience with that week's version of the UpTime tool, for example, how focused they felt during blocking and during non-blocking periods.

Post study survey. At the end of the study, participants answered a range of open-ended questions about their experiences with the two versions, and rated the value and importance of various features of the two versions.

Procedure

Participants responded to the invitation email by completing a short survey and data-collection agreement. In this agreement, participants were informed that domain names would be collected only during the first week of the study before being masked. After agreeing, participants were sent a link to download and install the browser extension.

Once installed, the extension asks the user to enter their Slack username. To verify that the user has entered the correct name, they are sent a 4-digit code through Slack that they then enter into the extension. The extension was set initially to only record data (Baseline mode) for all participants. At the end of each day (Mon-Thu), participants were sent a link to a daily survey via email, and were sent a link to the end-of-condition survey each Friday.

To control for the order effects, participants were split at random into two groups of equal sizes, with half of the participants experiencing the Pomodoro condition first and half the UpTime condition, then switching in week 3. Importantly, participants only learned about the intervention when introduced to each version of the tool: On the Monday morning of each experimental condition week, the extension mode was set remotely, and participants were sent an email informing them of the start of the condition. They were also sent a link to a user guide explaining how to use the extension (the guide for the UpTime Pomodoro condition also included a brief description of the Pomodoro technique). For the Pomodoro condition, participants were encouraged to start at least one session. However, as in [35], choosing to block in the Pomodoro condition is ultimately up to the user.

At the end of the study, participants were instructed to uninstall the extension, asked to fill out the end-of-study survey, and were given a $15 gift card as a token of our thanks (participants did not expect to receive any reward).

Participants

We recruited participants from our organization, which is part of a larger multinational corporation. We accepted only volunteers who accepted the data collection agreement, used Chrome as their primary browser, and did not have more than 1 day of planned absence in each of the three weeks.

15 of the individuals who expressed interest in participating in the study also met the participation criteria — this represents 1/3 of our lab's members. Four women and 11 men, participant's job roles included 7 researchers, 5 summer students, and 3 business development staff. Eight of the participants indicated an age between 25 and 34, five between 35 and 44, with one participant younger than 25 and one older than 44. 11 participants used Mac OS, 3 used Windows, and one used Linux. 11 participants used Slack's native application, while 4 used Slack in the browser. Additionally, eight participants also use Slack on their mobile device.

During the three weeks, four participants each were absent for exactly one day (3 participants were absent for one day of the baseline week and 1 participant was absent for one day of the UpTime Pomodoro condition). We thus collected data representing 221 workdays for our 15 participants out of the potential 225. In 7 of these workdays, the participant reported working remotely. On 36 occasions, participants indicated that their workday was not ordinary. These included long meetings (11 mentions), being away part or the entire day (8 mentions), attending a lab event (6 mentions), as well as hosting a guest, changing plans, being particularly busy, etc.

5 RESULTS

In this section, we first describe the browsing and break-taking behaviors of study participants, followed by how participants used UpTime Pomodoro and UpTime Bot to manage distractions. We then compare across conditions how likely participants were to visit distracting sites when resuming work after a break. We also compare self-reported measures of productivity, stress, and control across conditions based on responses to post-condition questionnaires. We round out this section by describing the subjective experience of participants to specific UpTime features, automatic blocking and negotiating with the bot.

Overview of browsing and break behaviors

During the study, we recorded a total of 1,415 hours of data from participants' workdays using our Chrome extension. The data contained a total of 35,165 site visits and over 300 hours of browser interaction–about 1.5 hours per day, per participant (Min=0, Max=4.3 hours, SD=1.08).

To gain intuition about the way our participants spend their time online, we used aggregate browsing data from the Baseline week, during which we temporarily recorded visited domain names. The sites with the highest number of visits during the baseline week were google.com, with 13.3% of all visits, and github.com with 7% of all visits, followed by visits to Amazon AWS, with 6%. The site on which participants spent the most cumulative time was Slack.com, with a combined 27.6 hours for all 15 participants during the Baseline week (spread across 482 visits).

For common social networking sites, we found that our participants did not spend much time on these sites, with twitter.com the most visited of these sites adding up to just less than 3 hours, followed by linkedin.com at just over 1 hour across all 15 participants over 3 weeks.

Participant's Lists of Distracting Sites. At the end of the Baseline week, participants created a personalized list of distracting sites for blocking. UpTime provided a default

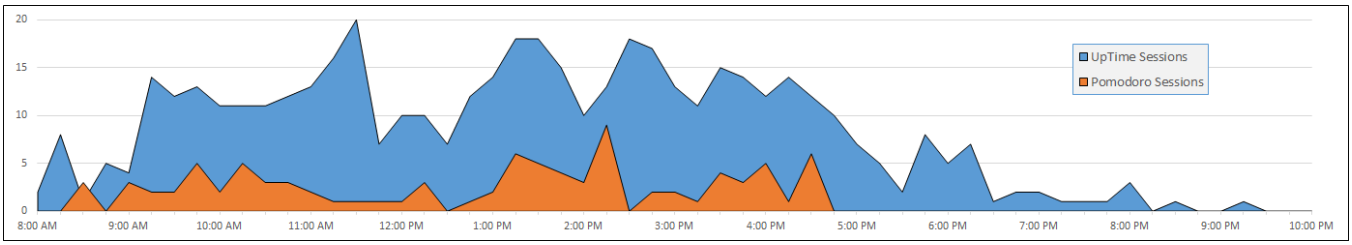

Figure 3: Histogram showing distribution of blocking sessions throughout the workday for all participants.

Table 1: Number of blocking sessions for the Pomodoro and Uptime conditions.

	Mean (SD)		
	Baseline	Pomodoro	UpTime
# blocking sessions (total)	-	91	481
# blocking sessions (average per day)	-	1.26 (1.49)	6.5 (3.6)
# blocking sessions (canceled by user)	-	2	11
% blocking sessions with an attempt to visit a blocked site	-	8.1%	13.2%

list that participants could edit throughout the study. Our participants listed 59 different sites altogether, of which 13 sites were suggested in the default list and used by multiple users, and 46 sites were unique. Sites added by participants included shopping sites (e.g., amazon.com, landoftomorrow.jp), blogs (e.g., medium.com, kottke.org), travel sites (e.g., booking.com, kayak.com), personal webmail (e.g., gmail.com) and others. On average, participants' lists contained 7.1 sites (Min=3, Max=27, Median=6).

Breaks and Computer Inactivity. In our implementation, we consider transitioning from a period of computer inactivity greater than 5 minutes as a trigger for automatic blocking. Even though some cases of a period of computer inactivity were not physical breaks (e.g., a meeting, reading a paper offline), for brevity, we will refer to these periods as "breaks." We examine this distinction between breaks and computer inactivity further in the qualitative results and the Discussion section. In our study, participants had an average of 8.9 breaks per workday (Min=1, Max=27, SD=5.5) for a total of 1,820 breaks. The average duration of a break was 17 minutes (Min=5 minutes, Max=343 minutes, SD=25). Only 12% of breaks lasted longer than half an hour, and less than 4% lasted over an hour. A comparison of the *number* of breaks taken and of break *duration* showed no significant difference between conditions ($F[2,157]=2.3$; n.s.) and ($F[2,1811]=2.07$; n.s.) — the use of UpTime or Pomodoro does not appear to have affected participants' break-taking behavior.

Distracting sites are visited soon after breaks. During the Baseline and Pomodoro conditions–with neither blocking automatically–of the time spent at the computer, 53% was during the initial 25-minute transition periods and 47% was after these 25-minute periods. Yet a significant majority of visits to distracting websites (75%) took place disproportionally within the initial 25-minute transition periods. This addresses our first research question (RQ1) and supports our primary design motivation to help manage distractions during transitions from breaks.

UpTime and Pomodoro Session Usage

During the UpTime condition, participants experienced a total of 481 blocking sessions, with each user averaging 6.5 blocking sessions per day. These included 473 sessions started automatically by UpTime when participants return from breaks and 8 sessions (1.7%) that participants started manually through the chatbot. As shown in Table 1, this number is much higher than the 91 blocking sessions (each user averaging 1.26 per day) in the Pomodoro condition. A histogram (Figure 3) shows that Pomodoro blocking sessions were used mostly during typical working hours whereas UpTime sessions included late-evening work periods.

Automatic blocking reduces visits to distracting sites

To understand whether automatic, but temporary, blocking during times of transitions can reduce workers' visits to/time spent on distracting sites, we used a mixed-model analysis of variance to analyze browsing behavior in the initial 25-minute period after returning from a break; specifically the number of visits and amount of time (log10) spent on distracting sites. Condition (Baseline, Pomodoro, UpTime), the Week of the study, nested in Condition (to control for

Table 2: The effect of Condition on engagement with distracting sites at transition points.

	Mean (SD)				
	Baseline	Pomodoro	UpTime	*F*	*p*
Proportion of transition periods with visits to distracting sites	14.8% (20)	17.8% (21)	5.5% (8.9)	8.5	.0012*
Time spent (seconds) on distracting sites during 25 minutes after a break (average per break)	20.5 (96.9)	29.7 (110.2)	8.9 (63.9)	28.4	.0001*

order), and the day of the week were used as fixed effects, with participantID as a random effect.

Our analysis shows that, as expected, participants in the UpTime condition were significantly less likely to visit a distracting site after returning from a break compared to both the Baseline and Pomodoro conditions ($F[2,29]=8.5$; $p=.0012$). As shown in Table 2, in the Baseline and Pomodoro conditions, participant visited distracting sites in 14.8% and 17.8% of cases, respectively. When using UpTime, however, participants visited distracting sites in only 5.5% of cases. This represents a two-thirds reduction in the likelihood of visiting a distracting site. There was no significant difference between Pomodoro and the Baseline. Participants also spent significantly less time on distracting sites when returning from a break when using UpTime (M=8.9sec) compared to both Baseline (M=20.5sec) and Pomodoro (M=29.7sec) ($F[2,2002]=28.4$; $p<.0001$).

To examine whether UpTime caused an increase in cyberloafing behavior through other means, during the two experimental weeks, we asked participants to estimate how much time during each workday they accessed distracting sites on their mobile device or a different browser. In 80% of responses, participants reported spending fewer than 10 minutes cyberloafing on their mobile or other browser, and there was no significant difference between the Pomodoro and UpTime conditions (Chi-sq=33, p=0.84).

Finally, to ensure that participants in the UpTime condition did not simply shift cyberloafing behavior until after automatic blocking was over, we compared across conditions the number of visits to, and amount of time spent per day on distracting sites that took place *after* the first 25 minutes following a return from a break. We controlled for individual differences as well as the order of conditions. Our analysis found no significant difference between the conditions on either visits ($F[2,179]=1.9$; n.s.) or time spent ($F[2,178]=0.18$; n.s.), showing that participants did not shift cyberloafing until after the automatic blocking was over.

While the results presented above indicate that participants in the UpTime condition spent less time on distracting sites on their computer, it is not a direct measure of productivity. We thus turn now to participants' self-reported measures of productivity and focus.

Perceived Productivity, Focus, and Stress

At the end of each day, participants rated their productivity (in the morning and the afternoon), their work focus, and the level of stress associated with avoiding distractions. We found no significant difference between ratings of productivity in the morning and the afternoon and combined them into a single daily productivity rating. We did find a significant difference in ratings of productivity and focus on days self-reported by participants as atypical and exclude these days from the analysis below.

A mixed-model analysis was done with daily ratings of Productivity, Focus, and Stress as the dependent measures. Condition, Study Week (nested), the Day of the Week as fixed effects and participantID as a random effect. The number of inactivity sessions per day, and the number of visits and time spent on distracting sites were used as covariates. As seen in Table 3, our models show a small significant effect of Condition on perceived productivity ($p=.018$). A post-hoc analysis showed ratings in the Pomodoro condition were slightly, but significantly lower than in the Baseline ($t(163)=2.83$; $p<.006$). Ratings of productivity in the UpTime condition were not significantly different from either Baseline or Pomodoro conditions.

While there was no significant main effect of Condition on ratings of Focus, we found a significant main effect of Condition on ratings of Stress ($p=.01$). A post-hoc Tukey HSD analysis showed Stress in the UpTime condition was significantly lower than both Pomodoro and the Baseline, both with $p<.01$. There was no significant difference between Pomodoro and the Baseline. Finally, there was no effect of the order with which participants experienced the conditions or the day of the week.

User experience of Uptime features

In this section, we describe how participants reacted to two specific features of UpTime–automatically blocking and negotiating access to a blocked site with the UpTime chatbot.

Automatic Blocking at Transition Points. 481 automatically generated blocking sessions took place in the UpTime condition corresponding to detected instances of transitioning from a computer idle to active state. There were also 10

Table 3: The effect of Condition (Baseline vs. Pomodoro vs. UpTime) on self-reported measures.

	Mean (SE)				
	Baseline	Pomodoro	UpTime	F	p
Self-reported Productivity	5.1 $(0.2)_a$	4.7 $(0.2)_b$	4.9 $(0.2)_{ab}$	4.10	.018*
Perceived Focus	4.9 (1.3)	4.8 (1.0)	4.8 (1.1)	1.42	.245
Perceived Stress due to internal coercion	3.0 $(0.3)_a$	2.9 $(0.3)_a$	2.5 $(0.3)_b$	4.58	.012*
Control over digital distractions	4.5 (1.7)	4.1 (1.3)	4.7 (1.6)	0.8	.46

instances when the system detected participants spending more than 15 minutes on distracting sites outside a blocking session and send a notification (Figure 1, bottom) with an offer to block. In the end-of-study questionnaire, 9 of the 15 participants rated the value of blocking starting automatically at-or-above the neutral point. Participants' open-ended responses to end-of-study questions about automatic blocking tell an interesting but complex story. Six participants said they appreciated blocking starting automatically. P15 said, *"The hypothesis that people get easily distracted when returning to their computer after a break really matched my behavior. The automatic blocking in these situations really helped me to stay focused."* Similarly, P11 learned about their own behavior, saying, *"I tend to go on a digital break immediately after returning to my desk."* P9 said they like that UpTime *"automatically starting a session when I'm back online. It was nice if I was back from a break. Even it's not a break, such as reading paper documents or discussion with others, it was OK because I didn't need any willpower to avoid being distracted."* However, some participants found themselves frustrated when automatic blocking happened when they transitioned from an activity that was not a break, but although, as we expand on in the Discussion section, this may be strongly tied to the disruptive effect of Slack notifications on our users. For example, P8 said, *"Even a short duration of inactivity (e.g. reading something on a printed paper, writing something down) led to a blocking session, even though I haven't left my desk or interrupted my work."*

Maintaining a Sense of Control. A key objective of the UpTime system is to rely on *temporary* blocking of distracting sites at opportune times, such that workers can still benefit from digital breaks However, with blocking being *automatic*, there is a risk of reducing workers' sense of control. To examine how automatic blocking may have affected Control (RQ2c), we analyzed participants' weekly ratings of the statement *"This week, I felt in control of how I took digital breaks at work."* As before, we controlled for individual differences as well as for the order in which they experienced the conditions. Our analysis found no significant difference in participants' sense of control among the three conditions (Baseline=4.5 vs. Pomodoro=4.1 vs. UpTime=4.7; see Table 3). Considering that participants experienced over six automatic blocking sessions each day, on average, this result is both surprising and a positive for our system; participants did not find the automatic blocking to have reduced their sense of control.

Negotiating Access with UpTime Bot. Finally, as illustrated in Figure 1, UpTime provides a user with a mechanism to gain access to a specific blocked site during the blocking session (an interaction we refer to as 'negotiation'). This feature contrasts with other blocking tools, including PomodoLock, where a user must entirely cancel a blocking session to gain access to a single site, or to tools where gaining access to a site requires a simple button click (e.g., [11]). Negotiation provides a more nuanced approach for unblocking rather than all-or-nothing approach found in other tools.

In 64 cases, participants received a negotiation message from the bot after a site was blocked. 39 of these were ignored. Of the remaining, in 19 cases the participant interacted with the negotiation message but did not type in a free-text reason to request access to the site. Only in 6 cases (9%), they proceeded to type in a reason so the bot would unblock the site. In exploring RQ3, we asked participants at the end of the study about this conversational capability. Four participants expressed great appreciation for this feature. P7 said, *"It was really nice to have, because if I really needed to go to a site, then it would allow me. Because of this feature, I had to think twice about whether or not I actually needed to go to site."* P3 expressed that the effort required to unblock the site may help change their behavior. These reactions align with Fujita and Han [24] who showed that subjective construals can influence self-control without effortful deliberation. While one participant stated they did not like this feature, particularly not liking *"having to explain myself to a robot."* (P4), others appreciated the additional friction. P9 described situations where they used this feature, saying it was *"Easy and convenient. It was good to (a) access Facebook which is listed to use its authentication for other sites not listed, (b) access listed sites just one sec to confirm or check something. It was not too distracting, and I wanted to be done."*

6 DISCUSSION

Our three-week study provides empirical evidence that workers are more prone to cyberloafing when transitioning back to computer work (RQ1), corroborating Epstein et al's diary study [23]. We also show that our approach for automatically-triggered temporary blocking sessions at transition points can significantly reduce digital distractions and stress without sacrificing workers' sense of control. Our system's conversational approach, which offered users a means to negotiate access to sites, received both positive and negative comments. We now discuss interesting yet challenging areas for tool improvement and future research.

Contrasting with PomodoLock

We compared our UpTime system to Kim et al.'s PomodoLock [35] because they showed a successful reduction in distraction and stress. While UpTime and PomodoLock differ along many dimensions, it is worth praising Kim et al.'s simple but effective design, which was appreciated by our participants. Four participants said they liked the ability to control the timing of blocking sessions in the Pomorodo condition. Two participants said they preferred how *"everything can be done in the Chrome extension"*. Participants also liked the countdown timer, with P15 saying they *"appreciate the additional countdown window which shows explicitly the countdown timer."* However, UpTime's proactive, automatic blocking at transitions was more effective at reducing cyberloafing (both in number of visits and duration) than PomodoLock's self-initiated blocking (RQ2a). Furthermore, participants reported lower stress that results from internal coercion (RQ2b), while maintaining a sense of control (RQ2c). UpTime's chatbot-embodied negotiation feature allowed them to negotiate visits to individual blocked sites as needed, in contrast to PomodoLock's all-or-nothing blocking approach.

Mobile browsing and cross-device blocking

An important feature available in the original PomodoLock but not implemented in UpTime is the ability to operate across devices and block websites as well as apps. Even though there was no difference between conditions in the time reported spent cyberloafing on a mobile device, providing workers with a single conversational control over distractions for multiple devices would be interesting. From a research perspective, such a solution would raise intriguing interaction challenges; for example, it could nudge a worker towards a specific device, if the worker is predicted to likely take a shorter but equally restful digital break on that device.

Detecting breaks vs. sensing inactivity

Physical breaks necessarily result in periods of computer inactivity; however, not all periods of inactivity are physical breaks. For example, the worker may be away but working (e.g., at a meeting), or even sitting next to their computer reading or talking to a colleague. Currently, UpTime's simplistic transition detection will trigger a blocking session (and a notification) after any of these periods. Indeed, three participants said they did not like that a session would start when inactivity was not a real break, likely due to notifications that appear incorrect. Beyond reducing notifications, as described above, another solution is to augment UpTime's sensing capabilities beyond the worker's computer; for example, by considering events on the worker's calendar, or including physical activity and location sensing [19] or sensing activities on the worker's desk [13].

Chatbot-embodied distraction management

UpTime's chatbot was designed to intervene when a worker attempted to visit a blocked site by giving the option to visit the site after requesting a reason as a moment of reflection. This additional friction prevented unnecessary cyberloafing, and participants appreciated the flexibility of negotiating with the bot to gain access to a particular site for a necessary digital break or for work purposes.

However, UpTime's design to notify the user every time a blocking session starts overwhelmed our participants (mentioned 14 times in open-ended comments). As P14 said, *"I wanna mute the notifications of UpTime bot and just keep the logs."* The trade off between keeping the worker informed and minimizing notification overload is challenging. Beyond making notifications configurable by the user, we plan to explore the possibility of sending 'silent' messages (without notification sound) or to automatically mark a sent message as 'read'. While conversational interaction may allow for nuanced negotiation and self-reflection (RQ3), care should be used when designing the notification scheme to avoid making workers hyper-aware of their distractibility, which can lead to more cyberloafing behaviors.

Opportunities for behavior change

In this work, we did not intend to change workers' unassisted behavior–that is, we did not expect that workers will be able to avoid distractions in the long run without system support. However, interestingly, two participants who used the UpTime system first, stated at the end of the study that their experience with UpTime influenced how they interacted with UpTime Pomodoro in the following week. P8 said, *"The first version with automatic blocking had a significant "educational" effect on me. At some point I hardly visited any of the distracting sites regardless of a blocking*

session being active or not," While P2 wrote, *"I tried to follow the example from the first version of UpTime [when using UpTime Pomodoro] where I enabled blocking sessions after breaks."* Thus, tools can model beneficial behaviors and assist workers to learn about and build successful habits.

Another opportunity to affect worker behavior through increased awareness is by providing workers with data about their behavior, similar to meTime [60], TimeAware [37], MyTime [32], and RescueTime [7]. This feature was requested by three participants. As P3 wrote, *"It would be nice to have some stats reports about my browsing history, so I can know myself better."*

Finally, an interesting opportunity for future work, raised by two participants, is to allow the system to propose a personalized list of sites for blocking based on observed worker behavior. Such approach could be done by asking workers to correct system behavior during a learning period.

7 LIMITATIONS

The evaluation results highlight some of UpTime's potential to improve break-to-work transitions and reduce the stress of managing digital distractions. However, several limitations of the evaluation need to be considered. First, the evaluation involved participants from only one organization. Furthermore, these participants were good at avoiding common digital distractions such as social media and news sites. Still, UpTime was able to help our participants reduce self-distractions without taking away control. It is possible our system could be even more beneficial for populations susceptible to distractions such as the students in Kim et al. [35]. The evaluation was also brief; even though it lasted 3 weeks, participants used each version for only one week. A longer deployment is necessary to evaluate users' sustained engagement. Lastly, the two systems studied (UpTime Bot and UpTime Pomodoro) vary along multiple dimensions (e.g., conversational interaction with automatic blocking on the one hand, compared to a simpler countdown timer). Even though the end-of-study survey helped to tease apart the contributions of some dimensions, a study of the connections between individual features and the benefits we found would help future designers.

8 CONCLUSION

We presented UpTime, a tool for supporting workers' transition back to computer work through automatic, temporary blocking of distracting websites. UpTime employs a conversational-interaction approach, combining proactive and reactive prompts and was designed to still allow workers the important benefits of taking digital breaks. A comparative evaluation suggests that UpTime's automatic blocking at transition points can help workers without taking away their sense of control. We also show that even short, conversational "friction" can help workers evaluate their reasons for going to a distracting site, but still visit the site if they need to. An important observation from participants' reactions is a need to balance awareness with the disruptiveness of notifications associated with a proactive conversational system.

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