Supporting Workplace Detachment and Reattachment with Conversational Intelligence

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ABSTRACT
Research has shown that productivity is mediated by an individual's ability to detach from their work at the end of the day and reattach with it when they return the next day. In this paper we explore the extent to which structured dialogues, focused on individuals' work-related tasks or emotions, can help them with the detachment and reattachment processes. Our inquiry is driven with *SwitchBot,* a conversational bot which engages with workers at the start and end of their work day. After preliminarily validating the design of a detachment and reattachment dialogue framework with 108 crowdworkers, we study SwitchBot's use in-situ for 14 days with 34 information workers. We find that workers send fewer e-mails after work hours and spend a larger percentage of their first hour at work using productivity applications than they normally would when using SwitchBot. Further, we find that productivity gains were better sustained when conversations focused on work-related emotions. Our results suggest that conversational bots can be effective tools for aiding workplace detachment and reattachment and help people make successful use of their time on and off the job.

Author Keywords
Detachment; reattachment; resumption; productivity; bot.

ACM Classification Keywords
H.5.m [Info. Interfaces and Presentation (e.g., HCI)]: Misc.

INTRODUCTION
Adequate recovery from work is vital for replenishing resources depleted during work hours and maintaining good psychological health and well-being [71]. Among the many influential factors that promote recovery, the ability to psychologically detach from work is recognized as particularly important for its core role in facilitating mental rejuvenation and refreshment in subsequent workdays [14,68]. Recent research has posited that rebuilding a mental connection with one's work before the start of the workday (i.e., reattaching with work) is equally as important for ensuring workplace engagement and productivity, particularly in the morning [64]. A variety of approaches, ranging from brief planning to extensive therapy, have been proposed and studied in support of these goals. The efficacy of these techniques ranges with much variation, making this an active and open area of research for novel interventions.

In this work, we study the extent to which structured dialogues, focusing on individuals' work-related tasks or emotions, can help them with the detachment and reattachment processes. Ranging from paper-based diaries to online surveys, an array of possible intervention types exists for administering such dialogues to individuals. Prior work, however, emphasizes the importance of social support that individuals may receive from others during the detachment process [27,61]. While this constraint belies many types of technical interventions, conversational intelligence, or *bots*, embraces these scenarios with prior research demonstrating their ability to provide such social support through active listening and guided conversation [31,70] as shown by systems such as ELIZA [70] and ALICE [31]. Further, conversational systems are known to offer the added benefit of inducing feelings of accountability in individuals when setting goals [7], a process that generally occurs during both the detachment process and the reattachment process.

We present and study *SwitchBot,* a conversational bot that helps workers detach from and reattach with their work. By identifying similarities between interruption and task resumption with detachment and reattachment, we leverage prior research to design two dialogue styles for SwitchBot, one that is task-centric and the other emotion-centric. We validated the practical value of each dialog via an online study with 108 crowd workers, and then conducted an in-situ study for 14 days where 34 information workers used SwitchBot as they began and concluded their workday. Our results show SwitchBot's dialogues were an effective intervention for supporting detachment from and reattachment with the workplace. In particular, we find that:

- Participants felt more productive and engaged during the first hour of their work when using SwitchBot;

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- Participants sent fewer after hour work e-mails after detaching from their workday with SwitchBot; and
- The emotion-centric dialogue was perceived as more effective than the task-centric dialogue, but the task-centric dialogue helped participants jump right back into work at the start of the day.

These findings provide evidence that conversational intelligence can provide effective support for psychological detachment from and reattachment to work and suggest how they might most effectively be implemented.

RELATED WORK

SwitchBot is a tool aimed at helping people detach from and reattach with work. Here we detail the related literature for both topics from the lens of both psychology and HCI.

Recovery and Psychological Detachment from Work

Psychological *detachment* from work has been most commonly described as "an individual's sense of being away from the work situation" [22]. This typically includes not being involved in work-related activities after physically leaving work, such as phone calls, e-mails, and other work-related tasks. Research has demonstrated that overall daytime work engagement improves as a result of adequately detaching from work [14] and feeling recovered [40,41,59]. There is also evidence that suggests detaching from work facilitates long term benefits for well-being, such as work performance (i.e., productivity) [8] and higher satisfaction with life [63]. In contrast, failing to adequately detach from work has been shown to yield elevated levels of stress as a result of reflections about unfinished tasks or stressful work-related events outside of workhours [12,18].

The importance of psychologically detaching from work is well understood in recovery theory. Two different (but compatible) theories are used to conceptualize recovery in the context of work: the Effort-Recovery Theory [47] and the Conservation of Resources Theory [32]. Collectively these theories posit that individuals tax their mental and physical resources throughout the workday and are inherently motivated to regain the lost resources [62], otherwise if they continue to expend these resources they will never fully recover [47,56]. If individuals seek to regain their expended work-related resources, they should therefore avoid work both physically and mentally.

Despite the clear advantages in psychologically detaching from work, only a few studies have examined the efficacy of practical interventions in support of this goal. The most commonly studied theme of interventions for helping individuals detach from work are therapy-based techniques that center around teaching individuals to practice *mindfulness*, which is defined as "an awareness that emerges through paying attention in the present moment" [34]. Mindfulness interventions have been primarily studied with the goal of facilitating recovery, treating psychological detachment as a secondary interest [35]. Nevertheless, the interventions have demonstrated success in facilitating not only recovery, but psychological detachment from work over both short [34] and long periods of time [53].

Therapy-based techniques aside, prior work has also examined numerous arbitrary interventions for detachment including eating lunch with a particular colleague [21], volunteering [48], weekend activities with a partner [26], and creating plans on paper for unfinished tasks [57]. However, while most of the interactions studied in the literature refers to human-human interaction, how effective interactions with automated agents are in realizing similar effects on detachment is not well understood.

Resumption and Psychological Reattachment with Work

Psychological *reattachment* with work has been defined as: "the process of mentally reconnecting to one's work after a nonwork period" by creating an anticipatory "mental contact" that facilitates bringing one's attention back to work [64]. For example, an individual may mentally consider and prepare for the meetings or tasks they expect to see in their workday. It is important to note that the act of mentally reattaching with one's work generally takes place before any work actually occurs [64].

Closely related to reattachment, task interruption and resumption have been extensively studied in the HCI literature. Interruptions are generally characterized as short periods of time in which ongoing work is terminated, and resumption is characterized as the act of recommencing an interrupted task. A variety of theoretical frameworks have been proposed for explaining how people strategically handle interruptions and resume interrupted tasks [1,46,50]. Studies observing individuals in the workplace have collectively emphasized the challenge that individuals have in returning to an interrupted task, particularly in the context of multitasking [9,19,24,46,49].

Research has examined a range of tools for helping people manage and resume their interrupted tasks. The overarching goal of these systems is to help individuals maximize productivity while simultaneously reducing the resumption overhead. Evaluated systems include simple note-taking tools [67], personal task list managers [6,28], agent-assisted task management tools [37], and software for recording and reestablishing task history and context [20,36]. Many of these same concepts have been explored in digital reminder systems and memory aids as well [11,29,54]. A very small number of systems have been proposed in the HCI literature toward the goal of mentally priming individuals for work [15,58]. The effectiveness of these systems is unknown as these works-in-progress have yet to be evaluated.

An important consideration when discussing resumption in the context of both detachment and reattachment is that individuals have and manage unique work-life boundaries [3]. For example, some individuals enjoy being attached to their work outside of work hours and having the freedom to bring work home with them [55]. Research shows that preventing

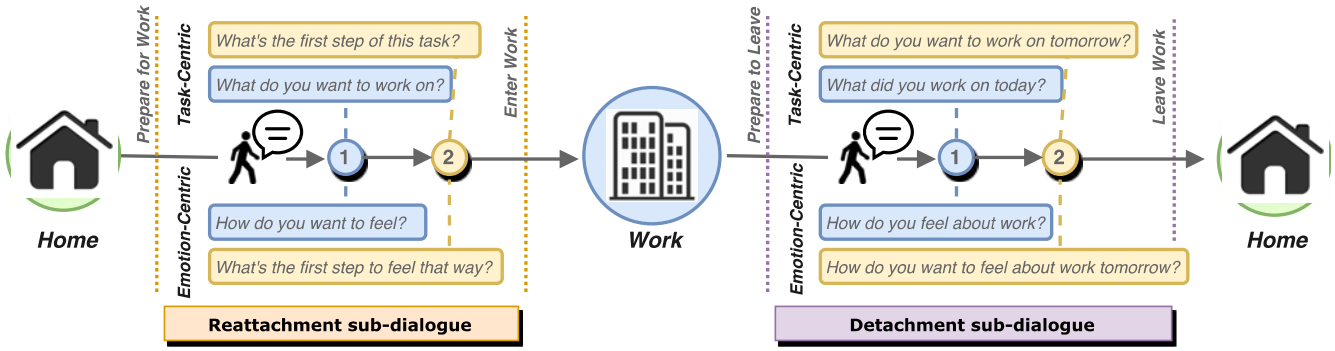

Figure 1. Switchbot helps people disengage at the end of their workday with a detachment dialogue, and reengage with work at the start with a reattachment dialogue. Both dialogues are facilitated with two different styles: task-centric and emotion-centric.

individuals from choosing their own work-life boundary styles can harm their productivity and affect their general well-being [39].

In this work, we study the extent to which structured dialogues, focusing on individuals' work-related tasks or emotions, can help them with the detachment and reattachment processes. Collectively, the landscape of needs and challenges presented by the detachment and reattachment literatures reinforce the suitability of bots as an intervention for the problem space. These bodies of literature suggest the need for social support alongside the ability to set and manage goals, each of which have demonstrated success in conversational systems [7,70]. We extend this prior work by designing, building, and studying a bot to mediate the detachment and reattachment processes through conversation. The interaction of the bot was designed to closely follow strategies for detaching and reattaching from work leveraging recovery theories from psychology and interruption management theories from the HCI literature. That said, we are not aware of any prior work related to conversational bots aimed at assisting individuals with these processes.

SWITCHBOT

We present *SwitchBot*, which conversationally assists information workers in detaching from and reattaching with their work through brief conversations before the start and end of the workday. SwitchBot appears as a contact on Skype and users converse with it via Skype's chat interface.

How It Works

SwitchBot was built with the Microsoft Bot Framework and the Language Understanding and Intent Service (LUIS), services that provide a development ecosystem with support for easily integrating intelligence into bots. SwitchBot was designed specifically for the purpose of studying detachment and reattachment, and its functionally is currently limited to helping workers transition in and out of work.

Getting started with SwitchBot was designed to be quick, simple, and intuitive. New users begin by adding the bot as a contact on Skype. When receiving messages from new users, SwitchBot will introduce itself and collect the new user's name. Afterwards, it will present the user with a brief overview of the content and timing of future interactions.

SwitchBot automatically assigns a new user to one of the two dialogues of choice. After signing up, users can utilize SwitchBot to detach from and reattach with their work, as illustrated in Figure 1. At the end of the day users engage in a *detachment* sub-dialogue where they offload the day's activities and prepare to leave work. Likewise, users engage in the *reattachment* sub-dialogue at the start of the work day, where they prepare to return to work.

When receiving a message from a known user, SwitchBot will try to intelligently determine whether to engage the reattachment or detachment sub-dialogue based on the user's message content and time-of-day. If unable to do so reliably, SwitchBot will reply with a general-purpose menu that asks users to specify which sub-dialogue they would like to invoke.

SwitchBot implements a pull rather than a push model of interaction, meaning that users initiate any conversation with SwitchBot at their moments of choice. Once initiated, SwitchBot then leads the user through the conversation experience following the sub-dialogues described below.

Theoretical Underpinning of SwitchBot Sub-Dialogues

The process of detaching and reattaching between work and home can be considered analogous to the process of transitioning from one task to another, where the former task will be resumed at a later point. Task resumption research models the resumption process using two key characteristics: interruption lag (i.e., time allocated toward preparing to switch to a different task) and resumption lag (i.e., time allocated toward preparing to resume an interrupted a task) [2]. As inspiration for the structural design of our dialogues, we refer to and leverage one particular well-established framework: Altmann and Trafton's Goal Activation Model [1]. The Goal Activation Model hypothesizes that people utilize two primary cognitive techniques during their interruption lag to minimize subsequent resumption lag [10,25,51]:

- **Prospective goal encoding**: the action of "looking ahead" mentally to determine how to proceed.

Detachment Sub-dialogue	Task-centric Dialogue	Emotion-centric Dialogue
(1) Active listening	*What did you work on today?*	*How do you feel about work today?*
(2) Goal setting	*What do you want to work on tomorrow?*	*How do you want to feel about work tomorrow?*
Reattachment Sub-dialogue	**Task-centric Dialogue**	**Emotion-centric Dialogue**
(3) Goal confirmation	*Do you still want to work on [..]?*	*Do you still want to feel [..]?*
(4) Goal priming	*What's the first step you can take toward completing this task?*	*What's the first step you can take toward feeling this way?*

Table 1. Overview of the task-centric and emotion-centric dialogue frameworks.

- **Retrospective rehearsal**: the action of rehearsing what was being done.

Per Altman et al. [66], these two conceptually translate to, "Now what was I doing?" and, "What was I about to do?", each which can be characterized as setting goals.

Before setting goals in each detachment sub-dialogue, individuals are asked a question centered around reflection. In both dialogues, a simple form of active listening [4] is employed during the detachment sub-dialogue to allow people to continuously supply input. By doing so, we afford them the opportunity to dump their work-related thoughts as much as they would like to before leaving work.

Dialogue Frameworks in SwitchBot

We studied two different frameworks for how SwitchBot directs the detachment and reattachment sub-dialogues: a *Task-centric* and *Emotion-centric* dialogue. These dialogues are shown in Table 1 and described in greater detail below. For each question, word choices of equal sentiment were randomly selected from a large array to prevent repetition.

Task-centric Dialogue

The *Task-centric* dialogue framework is named after its topical emphasis on task interruption. In the model's detachment sub-dialogue, the bot asks individuals what they worked on during the day and what they want to work on the when they return to work. In the reattachment sub-dialogue, the bot reminds and confirm with individuals what they want to work on as well as ask them to specify the first actionable step toward doing the task.

The *Task-centric* dialogue framework heavily reflects the process of preparing a task for interruption and subsequent resumption. In support of detachment, the framework leverages active listening and Altman and Trafton's Goal Activation Model [66], asking the individual "What did you work on today?" and "What do you want to work on tomorrow?". Reattachment is facilitated with a task-focused goal priming cue, which motivates the individual to act on the goal [1]. This framework's design is supported by research that shows the suitability of task-focused planning as an intervention for detachment and reattachment [13,57,66].

Emotion-centric Dialogue

The *Emotion-centric* dialogue framework emphasizes emotional and mood-related discussions. In the model's detachment sub-dialogue, the bot asks individuals how they feel about work today and how they want to feel about work when they return. In the model's reattachment sub-dialogue, the bot reminds and confirms with individuals how they want to feel about work and asks them to specify the first actionable step toward feeling how they want to.

The *Emotion-centric* dialogue's design reflects research on the psychology of mindfulness -- being nonjudgmentally aware of one's emotional state in the present [33]. Each step in the dialogue draws individuals' attention to their present emotional state as a means to improve emotional awareness and set future emotion-related goals related to work [52]. The overall structure of the *Emotion-centric* dialogue is inspired by the task resumption model and structured behavioral therapy, which generally begins by asking people how they feel about work and the actions they want take to feel differently (i.e., better) [5]. These design concepts and their suitability toward workplace detachment and reattachment are well-supported by research in occupational health psychology and goal setting [33,42,51,52].

DIALOGUE VALIDATION

Before deploying and studying SwitchBot in the workplace, we conducted an experiment on Amazon Mechanical Turk[1] to preliminarily validate the efficacy of the dialogue frameworks. We simulated the workday experience through a scenario where the workers will take a break in the middle of their workday and engage with the detachment and reattachment dialogues as part of their break. We collected user perceptions around key traits related to detachment and reattachment as a result of the interactions. Prior work has demonstrated the validity in using MTurk both for preliminary research and large-scale user studies [38]. While there are differences between MTurk and the workplace, the notion of pausing and resuming work is analogous, and findings in one context should be observable in the other.

Task and Procedure

We designed a HIT to simulate the detachment and reattachment process by asking workers to take a 5-minute break in the middle of their workday. Assuming that the workers had been working before engaging with the HIT, the first step of the HIT asked them to prepare for their break by engaging

[1] http://www.mturk.com

Measure	Statement	Source
Productivity	*How productive do you feel?*	[45,46]
Engagement	*How busy do you feel?*	PANAS
Relaxation	*How relaxed do you feel?*	PANAS
Inspiration	*How inspired do you feel?*	PANAS

Table 2. The four statements used to measure psychological detachment or reattachment with work. Participants are asked if they agree with each on a 5-point Likert scale.

with the detachment dialogue, drawn from either the *Task-centric* or *Emotion-centric* dialogue framework. The HIT interface then simulated a forced break that lasted at least five minutes by preventing workers from moving to the next stage. At the end of the break they were told that they were about to resume their workday and were subsequently given the reattachment dialogue from either the *Task-centric* or *Emotion-centric* framework, selected to match whatever they saw in the detachment dialogue. Workers were paid $2.00 for completing the HIT.

Measurement

Between each stage of the HIT, we measured the effectiveness of a dialogue through a set of probes based on the Positive Affect Negative Affect Scale (PANAS) [69], a common proxy for measuring detachment from work [65]. Research has shown that adequate psychological detachment or reattachment with work can be predicted with four, key emotional traits: performance [23], engagement [64], stress [63], and burnout [60]. We therefore selected 4 measures – three from PANAS (Active, Relaxed, Inspired) and one from the productivity literature [43,44] – that correspond to a key emotional trait (Table 2). Our probe presented each measure in the form of a 5-point Likert scale ranging from very negative (1) to very positive (5). Before finishing the HIT, we asked workers what they did during their break and to provide feedback on the dialogue questions they were given. The probes were presented at four points in the process: 1) at the start of the HIT, before engaging in any dialogue, 2) after completing the disengagement dialogue, 3) after their break, and 4) as they returned to work after completing the reattachment dialogue.

To analyze the data for each self-reported measure, we used a mixed-design ANOVA with the worker's assigned dialogue (*Task-centric*, *Emotion-centric*) as the between-subjects factor and the HIT stage of the self-report as the within-subjects factor. Statistical significance was further examined using Bonferroni post-hoc tests. We ensured no assumptions were violated using graphical assessments to verify normality alongside a Mauchly's test of sphericity.

Results

We recruited 108 workers to complete the HIT; 54 were assigned to the *Task-centric* dialogue framework, 54 to the *Emotion-centric* dialogue framework. Nine workers (5 from the *Emotion-centric* condition and 4 from the *Task-centric* condition) were removed for incorrectly completing the task

Measure	Effect	*F*	*p*
Productivity	Dialogue	2.61	0.11
	Stage	*5.94*	0.04*
	Dialogue x Stage	1.87	0.13
Engagement	Dialogue	0.37	0.54
	Stage	3.91	0.01*
	Dialogue x Stage	0.26	0.26
Relaxation	Dialogue	12.76	0.00***
	Stage	19.12	0.00***
	Dialogue x Stage	38.62	0.00***
Inspiration	Dialogue	3.34	0.07
	Stage	1.74	0.16
	Dialogue x Stage	1.93	0.11

Table 3. Results of a mixed-design ANOVA on self-reported measures from workers in the 4-stage MTurk validation study (* : $p < 0.05$, ** : $p<0.01$; *** : $p<0.001$).

(i.e., spammer behavior, not taking a break as requested). Across both frameworks, workers took breaks ranging anywhere from five minutes to upward of an hour. There were no statistically significant differences in task completion time between frameworks.

Table 3 shows the results from our mixed-design ANOVA. We found that the HIT stage had a significant effect on workers' self-reported productivity and engagement. The Bonferroni post-hoc test showed that that workers in both conditions felt significantly more productive ($t(99)=3.04$; $p<0.001$) and engaged ($t(99)=3.38$; $p<0.001$) with work after going through the reattachment dialogue compared to when they had started the HIT.

Dialogue, stage, and the interaction of the two all had a strong effect on workers' self-reported relaxation ($p<0.001$), as shown in Table 3. While workers were more relaxed after the detachment dialogues, there was no difference across the different dialogue types. However, the post-hoc test showed that workers who were assigned the *Emotion-centric* dialogue felt significantly more relaxed after reattaching with their work than workers who were assigned the *Task-centric* dialogue ($t(99)=3.41$; $p<0.05$).

Finally, we find that the assigned dialogue had a small effect on workers' self-reported inspiration. Specifically, the post-hoc test showed that workers who were assigned the *Emotion-centric* dialogue felt more inspired after the reattachment dialogue than *Task-centric* workers, but the difference was not statistically significant ($t(99)=0.59$; $p=0.08$).

In summary, these findings validate our dialogues' design. We find that the detachment dialogues helped all workers to be more relaxed afterwards. The reattachment dialogues helped all workers feel more productive and more engaged in their task following the interaction. Workers who were shown the *Emotion-centric* dialogue also felt more relaxed and slightly more inspired after the reattachment dialogue. These results strengthen the rationale behind studying multiple dialogues guided by distinct theory and practice.

SWITCHBOT FIELD STUDY

Given the two dialogues we developed appeared impactful and differentiated in an artificial setting, we set out to understand their impact on people's work behavior in a field study where the dialogues were used by people to actually detach from and reattach to their workday. We conducted an in-situ study of SwitchBot for 14 days with 34 information workers at a large technology corporation during the summer of 2017. Here we describe the methodology and analysis methods we employed.

Participant Recruitment

41 participants (M=29, F=12) were recruited by randomly sampling e-mail addresses from an organization-wide employee list. Job roles of those recruited include program manager (10), engineer (21), designer (1), analyst (1), and administrator (2). Seven participants dropped out during the study, and we therefore present data for 34 people. Participants received a $50 gift card for their participation.

Data Collection

We collected the following participant data via workstation logs, experience sampling probes and post study surveys.

Detachment questionnaire: We modified validated self-report measures for assessing psychological detachment [62] into a 4-item measure as follows: "After interacting with the bot at the end of my workday – 1) I forgot about work, 2) I didn't think about work at all, 3) I distanced myself from work, 4) I got a break from the mental demands of work." These questions were presented to participants at the end of the study to assess their overall perception on the deattachment experience.

Number of work emails sent after hours: In lieu of subjective measures, we use email as an objective proxy for day-level involvement in work outside of work-hours. Workplace email usage outside of work-hours was automatically monitored with Delve Analytics, an add-on built into participants' corporate e-mail, which reports time spent in both reading and sending e-mails.

Reattachment measures

In order to measure how well participants reattached with work after the reattachment dialogues, we collected the following data:

Productivity application logs: To understand participants' work patterns on their workstations, we monitored and logged their application usage with AppsTracker, an open-source utility that captures all application event activity on the Windows 10 Operating System. We leverage these data to develop objective measures of productivity, including how much time participants spent on specific applications, when they switched applications, and when they were actively using their machine.

All logged information was stored locally on participants' machines in a SQL database. An anonymization script was run across the log files to remove identifiable information and aggregate information sources for participants who actively used multiple machines during the study. We logged a total of 278,939 instances of application usage.

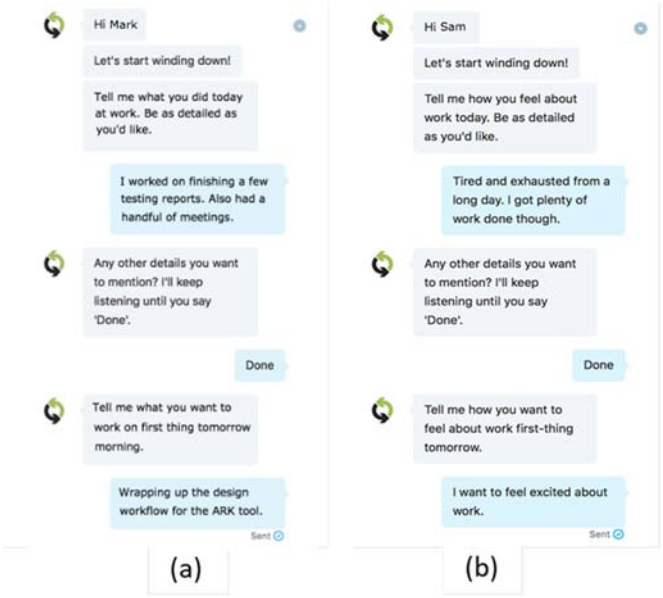

Figure 2. Snapshots of SwitchBot interactions: (a) Emotion-centric dialogue; (b) Task-centric dialogue.

Self-reports of reattachment and productivity: Using the same questions from the Turk study (Table 2) we collected multiple responses on participants' perceptions of their productivity, relaxation, engagment, and inspritation via experience sampling probes (ESM) throught the day. This was done via a small pop-up window that appeared on their workstation machine. Participants were instructed to dismiss the window if the pop-up appeared at an inconvenient time. In total, we collected 2,271 responses. All information collected from the application was written to a text file.

Reattachment questionnaire: Similar to the recovery experience questionnaire, at the end of the study we presented participants with a 5-item modifed Reattachment questionnaire [66] for assessing their overall reattachment perception from their experience, as follows: "After beginning my workday by interacting with the bot: 1) I mentally tuned into my work, 2) I prepared mentally for my work, 3) I reflected about/considered my upcoming workday, 4) I thought about what I wanted to achieve at work, and 5) I thought about what I will encounter at work."

Additionally, we logged all of the participants' interactions with the bot including timestamps, content, and length. Over the course of study, we recorded 1,745 messages between SwitchBot and our 34 participants. Figure 2 shows a sample interaction. At the end of the study participants were also asked if they had an existing ritual for detaching from or reattaching with work, and for feedback on the bot's functionality.

The study began on a Tuesday, and ran across a two-week period, which included 10 working days and two weekends. By including a weekend in our study timeframe, we afforded

ourselves the opportunity to discern whether or not individuals respond differently to detaching and reattaching with a bot after a subsequent weekday versus after a subsequent weekend. The first 5 workdays of the study (Week 1) were considered a baseline week where participants went about their normal workday while the second 5 workdays (Week 2) were supplemented with access to SwitchBot.

The study was managed remotely, and participants were asked to install AppsTracker and the experience sampling tool on their workstations on the morning of the first day of the study. If participants had multiple workstations, they were asked to install the software on both machines. After installing the software, participants were asked to submit a particular set of screenshots to confirm the software was both installed and that it recorded data correctly.

For week 1, participants engaged in their workplace activities as usual and were asked to respond to the ESM probes as they appeared throughout the day. In week 2, additionally, they were instructed to interact with the bots at the beginning of the day before they headed into work, and at the end of the day before heading out of work. The bot was deployed to the Skype messaging service, which was actively used by participants in the workplace.

At the end of Week 2, participants were given the post-questionnaire that included the detachment and the reattachment questions to assess perceptions of the bot as a tool for detachment and reattachment.

Upon concluding the study, participants deposited their log files in a shared network drive.

Analysis Methods

We focus our analysis primarily on parts of the workday where we anticipate seeing the most change: the start and end of the workday. However, we are also interested how the effects of interacting with the bot affect overall productivity and engagement with one's work. Here, we detail our methods of analysis that we employ to study the effects of the bot at both the day-level and at specific times of the day (first-hour, last-hour).

Dependent Variables: Subjective measures of productivity, engagement, inspiration, and relaxation are used as dependent variables to understand the effects of interacting with the bot at different times during the workday.

Difference in total time spent using productive software applications between Weeks 1 and 2 is used as the dependent variable to assess the bot's effect on participants' objective daytime productivity and engagement.

Independent Variables: The independent variable that we were most interested in was Dialogue (*Task-centric*, *Emotion-centric*). We also considered two other binary variables specifying whether or not the participant has an existing ritual for detaching from work (*NoDetachmentRitual*) or reattaching with work (*NoReattachmentRitual*).

Statistical Methods: We use a generalized linear mixed model (GLMM) [16] to assess each self-reported measure between weeks and between dialogues. Similarly, we use a linear mixed model to examine productive application usage between weeks and between dialogues as it is a continuous variable. We specify the participant as a random effect in each GLMM. We used graphical assessments for each model to ensure that all assumptions about the model (i.e., residual distribution, constant variance) were not violated.

To assess differences between participants' responses in Detachment and Reattachment questionnaires in the post-study survey, we employ Mann-Whitney *U* tests, a common procedure for analyzing non-normal ordinal data [17].

Where appropriate, we employ t-tests for assessing group differences and use descriptive statistics (e.g., mean) to describe our data.

RESULTS

Using the data, we collected from the in-situ study, we set out to answer two comprehensive research questions:

[RQ1] How effective are dialogue exchanges with a bot in helping information workers detach from and reattach with work?

[RQ2] How do individuals respond to different dialogue frameworks?

Here we present what we learned about both in detail.

[RQ1] Detaching from and Reattaching to Work

The reception of SwitchBot was generally positive. In the post-study survey, 21 of the 34 participants stated the bot complemented their everyday work life and indicated they would continue using the bot if it were available. The impact of the bot on the participants can be seen in how participants were able to detach from work in the evening, and how they were able to reattach in the morning.

Detachment

The responses on the Detachment questionnaire suggested that participants were generally neutral about SwitchBot as a

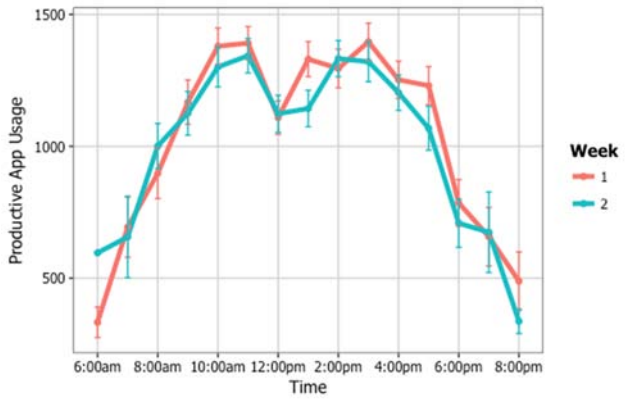

Figure 3. Averaged productivity app. usage over time of day.

tool for detachment. The average response among all participants for the adapted Detachment questionnaire in the post-study survey was exactly neutral (μ=3.0; σ=0.9). The response remains nearly the same even when limiting consideration to those without an existing detachment ritual (μ=3.1; σ=0.9). However, a paired t-test showed that participants sent less work-related email after work hours when they engaged in the detachment dialogue with SwitchBot compared to the baseline week (t(32)=2.29; p=0.03).

Reattachment

Unlike detachment, however, SwitchBot's ability as a tool for reattachment was generally seen as extremely positive (μ=4.7; σ=0.9) by participants in the Reattachment questionnaire in the post-study survey. The average response for participants with an existing reattachment ritual was only slightly lower and remained positive (μ=4.3; σ=1.4).

Productivity application usage was noticeably similar between Week 1 and Week 2 as shown in Figure 3. In both Week 1 and Week 2, productivity application usage peaks at 11:00 am and 3:00 pm. Prior in-situ studies with information workers at larger technology corporations have seen identical peaks in productivity and focus at these same time frames, reinforcing the reliability of the logged application data [44,45]. An analysis of application logs as an aggregate showed that there were no statistically significant differences between weeks in average productive application usage when the logs were aligned with time of day, indicating that the interaction with SwitchBot does not influence this well-established productivity curve.

However, we see a different picture when considering user self-reports collected through the ESM data. Considering all collected self-reported measures of productivity, relaxation, inspiration, and engagement collected through the ESM probes, we found that workers felt significantly more productive (β=0.11; ε=0.05; p=0.02), but also less relaxed (β=-0.16; ε=0.05; p<0.01) throughout the workday during Week 2. We are particularly interested in the first hour of the participant's work day as it immediately follows the reattachment dialogues. Limiting our GLLM's scope to the first hour of participants' workday, we found that participants felt more productive (β=-0.58; ε=0.09; p<0.01), more engaged (β=0.29; ε=0.10; p<0.01), and less relaxed (β=-0.40; ε=0.11; p<0.01) when starting their workday during Week 2 when using SwitchBot. While users may not overall show differences in their productivity interactions, their perceptions of productivity increase after the reattachment.

[RQ1] Summary of Findings

In summary, we learn how SwitchBot helped participants detach from and reattach with work in the course of 10 workdays. We find that after engaging with the detachment dialogues, users send less work-emails after hours. The stronger results were seen after the reattachment dialogues–compared to the baseline week participants overall felt to have increased productivity throughout the day, but also felt less relaxed. Looking at just the first hour at work, which was right after the reattachment dialogue we observe that users report increased productivity, increased engagement but less relaxation after interacting with SwitchBot.

Alongside measures of productivity and emotional state, we are also interested in perceptions of the bot's utility. Although the design of both dialogues is strongly grounded in research, participants remained neutral in their assessment of SwitchBot as an effective tool for psychologically detaching from work. However, we did find they strongly recognized SwitchBot as an effective tool for psychologically reattaching to work.

[RQ2] Respond to Different Dialogue Frameworks

Detachment

Though we found that overall participants sent less after-hour emails in Week 2, we did not see differences across the two dialogues. Comparing the detachment questionnaire responses between the two dialogues using Mann-Whitney *U* tests, we also see no difference, suggesting that neither dialogue was subjectively preferred more than the other. However, limiting the scope to participants who had no existing detachment ritual (19), we found that the participants who were given the *Emotion-centric* dialogue reported significantly higher responses on the Detachment scale than participants who were given the *Task-centric* dialogue (U=16; Z=2.33; p=0.02; r=0.26). Detachment ritual included driving home, exercise, turning off computers and mentally shifting to focus on home. This suggests that for people who do not have any existing practices of actively detaching from work, the *Emotion-centric* dialogue helps them detach through reflection and goal setting.

Reattachment

Looking at the responses on the Reattachment questionnaires, we found that workers in the *Emotion-centric* dialogue reported significantly higher responses on the Reattachment scale than workers who were given the *Task-centric* dialogue (U=64.5; Z=2.77; p<0.01; r=0.47). Surprisingly, the same observation was not statistically significant when only considered participants who had no existing reattachment ritual (7). Reattachment rituals typically included creating to-do lists. However, this particular observation may be due to the small sample.

Looking at the application usage, we see differences across the different dialogues. Figure 3 shows the differences in productive application usage between both weeks for each dialogue model binned by workhour. Using a GLMM to assess the difference in productive application usage, we found that workers who were given the *Emotion-centric* dialogue spent significantly less time using productive applications during their first hour of their work in Week 2 compared to workers who were given the *Task-centric* dialogue (β=-518.5; ε=246; df=413.2; t=-2.1; p=0.04).

On average, participants in the *Task-centric* dialogue had improved their productivity application usage between Weeks 1 and 2 in five of the eight workhours where workers who

Study	Detachment	Reattachment
Turk	Feel more relaxed (B)	• Feel more productive (B) • Feel more engaged (B) • Feel more relaxed (E) • Feel more inspired (E)
Field	• Send less after hour emails (B) • Users with no detachment ritual feel more detached (E)	• Feel more productive (B), E>T • Feel less relaxed (B) • Feel more productive in the first hour (B), E >T • Feel more engaged in the first hour (B) • Feel more reattached (B), E>T • E less productive in the 1st hour., but increase in subsequent hours • T more productive in the 1st hour, but not sustained

Table 4: **Summary of findings showing significant results with the bot interactions. B=Both dialogues, E= Emotion centric, T= Task centric.**

were given the *Emotion-centric* dialogue demonstrated improvements in every workhour except the first. On average, participants who were given the *Task-centric* dialogue showed a small improvement in the first hour of their workday, but the improvement was not consistently maintained over the course of the workday.

In terms of the self-reports on productivity and other metrics through the ESM probes we see no statistically significant differences between the two dialogues when considering the entire day. However, limiting our analysis to the first hour of participants' workday, we found that participants felt more productive (β=0.50; ε=0.15; p<0.01) and more inspired (β=0.27; ε=0.14; p=0.05) during Week 2 when they were assigned the *Emotion-centric* dialogue. We observed no statistically significant differences within the last hour of the work day.

Differences in Bot Interaction

We also looked at how the conversations with the bot differed across the two dialogues. We found that participants who were given the *Emotion-centric* dialogue sent messages significantly longer in length (t(487)=2.11; p=0.03) and sent significantly more messages both for detachment (t(4.5)=2.4; p=05) than participants who were given the *Task-centric* dialogue. To explain these results, we tested for a possible correlation with participants' self-reported measure of relaxation but found no significance.

[RQ2] Summary of Findings

We found that people who received the *Emotion-centric* questions and did not have any existing detachment ritual were able to detach better according to the detachment questionnaire, compared to those receiving the *Task-centric* dialogue. We did not see differences in the number of after-hour work-emails sent across the two dialogues.

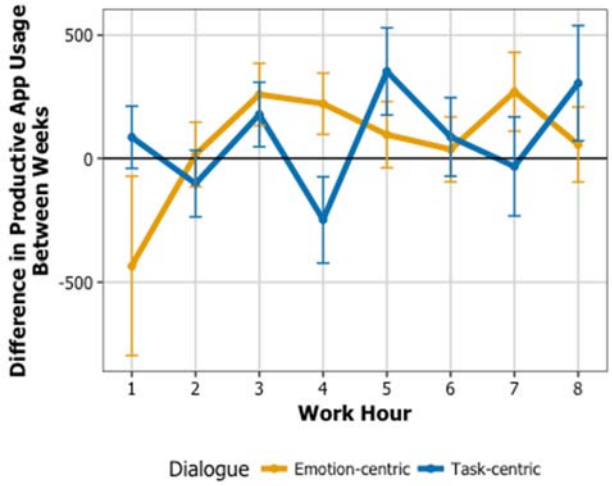

Figure 4. Differences in productive application usage between both weeks and dialogue models for all 34 participants aligned by the start of the 8-hour workday. Difference in productive application usage is shown in seconds.

In terms of reattachment, we show that the participants receiving the *Emotion-centric* dialogues scored higher on the Reattachment questionnaires, and they showed significant increase in their interactions with productivity applications throughout the day, except the first hour – compared to the baseline week (Figure 4). The participants in the *Task-centric* dialogues used more productivity applications in the first hour compared to the baseline week. However, this improvement in productivity was not sustained throughout the day. Interestingly, the *Emotion-centric* group reported feeling more productive and more inspired in the first hour compared to the *Task-Centric* group, even though this feeling translated into actual action only after the first hour.

The *Emotion-centric* dialogue is inherently more open-ended than the *Task-centric* dialogue, giving users the opportunity to continue conversation in arbitrary ways. We found that participants' conversations with the *Emotion-centric* dialogue were longer in both the detachment and reattachment sub-dialogues.

DISCUSSION AND IMPLICATIONS

We summarize our key findings in Table 4. Our study shows that bots can be effective, supplemental tools for helping information workers successfully reattach with work. We find that conversing with a bot about task-related or emotion-related goals for the workday can induce feelings of productivity and engagement at the start of the workday. We also find that priming information workers about their task-related goals can boost productivity application usage in the first hour of work but find no evidence of consistency throughout the remainder of the workday. We see positive perceptions from users about its overall effectiveness in helping people reattach with work.

While SwitchBot seemed reasonably successful in helping people reattach with their work, we see less positive results in terms of detachment. There could be a few reasons for this. First, we chose not to probe people with detachment questions while they

were in the detachment period as this may cause them to start thinking about work. We used a proxy of work related emails which showed a decrease when the bot was used for detachment but this may present only part of the picture. Our Turk study suggests that the detachment dialogue did make users feel more relaxed. In future studies, we intend to use more passive measures, such as physiological metrics through wearables, to get insights into relaxation and detachment.

Our research shows that a simple, but well-designed bot can have a noticeable effect on workplace engagement and productivity. One natural extension to our work is integration and extended intelligence. The success of our work indicates that bots may not only be sufficient for easing people in and out of work, but also for helping individuals transition between tasks within the workplace, too. While our work examined the efficacy of a bot with limited intelligence, future work can explore how the feasibility of bots with integration additional systems (e.g., calendar) and awareness of user preferences (e.g., learning users' mood schedules). With additional intelligence, such a bot could suggest strategic breaks throughout the workday, retrieve relevant documents for meetings, and even help find the best time of day to detach from work in their best interest.

In our study, participants detached and reattached with their work at certain times based on principles of goal setting and priming. Prior work, however, has noted that the ideal location for mentally transitioning in and out of work is during the commute [58,64]. While there are clear challenges in interacting with a system while driving (e.g., mind wandering [30]), we see the commute to work as an important frontier for detachment and reattachment, namely in novel scenarios (e.g., self-driving cars) and hands-free interaction.

While most productivity solutions focus on supporting task management, we address the problem at the core of worker psychology – demonstrating that helping workers manage and reflect on their thoughts around productivity can also improve productivity. A small number of participants suggested additions to their bot's dialogue that existed in the dialogue they weren't assigned. For example, participants who were assigned the *Task-centric* dialogue suggested dialogue additions that focused on work-related reflection:

> "(I would have liked the bot to ask me) something that I don't like about the work, what I like about the work during the day." (P28, *Task-centric*)

Likewise, those assigned to the *Emotion-centric* dialogue suggested additions for task management:

> "I would have liked the bot to have been able to keep a todo list or track things I was working on to help me pick back up in the morning." (P6, *Emotion-centric*)

These suggestions pose an interesting direction for future work that examines dialogues models incorporating elements of interruption management and mindfulness-based therapy simultaneously.

Our study has important implications for the design of conversational systems and future interventions for facilitating psychological detachment from and reattachment to work. Future systems may not only use and extend our studied dialogues, but may also reemploy the methodology used to create them for contexts outside of detachment and reattachment. Our work's findings highlight the rich opportunity for technical interventions in the problem space, showing that simple interventions can yield powerful effects, leaving room for more complex and personalized interventions.

Limitations

Our study has several limitations. First, the findings related to our bot are grounded in the context of information workers that work at a large technology corporation. We make no claim about the efficacy of bots for workplace detachment and reattachment in smaller organizations that do not emphasize technology in their work.

Second, our study was conducted using a between-subjects design where each participant was introduced to only one of SwitchBot's dialogues. Our study's findings are unable to speak to whether there may be individual differences in the effects of the two dialogues. The key purpose of the presented work, however, was to examine the feasibility of bots as support tools for reattachment and detachment. As our findings reinforce this application, we acknowledge a within-subjects study as important future work.

Third, our study examined the effectiveness of only a single intervention. While prior work suggests that conversational systems can be superior to their non-conversational counterparts (e.g., paper) [7], we make no claim about the effectiveness of a bot as it compares to alternative interventions.

The final limitation of our study is its timeframe. The last day of our study was August 21, 2017, the day of a solar eclipse. The vast majority of our study was assessed using statistical models that detect and account for anomalies in data. While we saw no noticeable effect in our models and by manual assessment it is important to recognize the possibility of such an external factor on our subjects' workday.

CONCLUSION

In this study, we reported findings from an in-situ study that indicate bots can be effective tools for helping information workers detach from and reattach with work. We introduced a conversational detachment-reattachment framework in which we included two, unique models of dialogue for detaching from work and reattaching with work. We presented and evaluated SwitchBot, a bot that implements the detachment-reattachment framework. We showed evidence that suggests interacting with SwitchBot before the start and end of the workday assists information workers in psychologically detaching from work and reattaching with work the next day. Future work includes studying non-information workers, examining more hybrid models of dialogue, and examining how bots can be tools for transitioning between tasks in the workplace as well as at home.

REFERENCES

1. E Altmann. 2002. Memory for goals: an activation-based model. *Cognitive Science* 26, 1: 39–83. https://doi.org/10.1016/S0364-0213(01)00058-1
2. Erik M. Altmann. Task interruption: Resumption lag & the role of cues. In *In Proc. Cognitive Science Society*, 43–48.
3. B. E. Ashforth, G. E. Kreiner, and M. Fugate. 2000. All in a Day's Work: Boundaries and Micro Role Transitions. *Academy of Management Review* 25, 3: 472–491. https://doi.org/10.5465/AMR.2000.3363315
4. Eastwood Atwater. 1981. *I hear you: how to use listening skills for profit*. Prentice-Hall, Englewood Cliffs, N.J.
5. Judith S. Beck and Judith S. Beck. 2011. *Cognitive behavior therapy: basics and beyond*. Guilford Press, New York.
6. 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. 735–742. https://doi.org/10.1145/985692.985785
7. Timothy W. Bickmore, Daniel Schulman, and Candace Sidner. 2013. Automated interventions for multiple health behaviors using conversational agents. *Patient Education and Counseling* 92, 2: 142–148. https://doi.org/10.1016/j.pec.2013.05.011
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: 419–441. https://doi.org/10.1348/096317909X418049
9. Jelmer P. Borst, Niels A. Taatgen, and Hedderik van Rijn. 2015. What Makes Interruptions Disruptive?: A Process-Model Account of the Effects of the Problem State Bottleneck on Task Interruption and Resumption. 2971–2980. https://doi.org/10.1145/2702123.2702156
10. Maria A Brandimonte, Gilles O Einstein, and Mark A McDaniel. 2014. *Prospective Memory: Theory and Applications*. Taylor and Francis, Hoboken. Retrieved September 1, 2017 from http://public.eblib.com/choice/publicfullrecord.aspx?p=1639200
11. R. N. Brewer, M. R. Morris, and S. E. Lindley. 2017. How to Remember What to Remember: Exploring Possibilities for Digital Reminder Systems. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 1, 3: 1–20. https://doi.org/10.1145/3130903
12. Jos F. Brosschot, Suzanne Pieper, and Julian F. Thayer. 2005. Expanding stress theory: Prolonged activation and perseverative cognition. *Psychoneuroendocrinology* 30, 10: 1043–1049. https://doi.org/10.1016/j.psyneuen.2005.04.008
13. Duncan P. Brumby, Anna L. Cox, Jonathan Back, and Sandy J. J. Gould. 2013. Recovering from an interruption: Investigating speed−accuracy trade-offs in task resumption behavior. *Journal of Experimental Psychology: Applied* 19, 2: 95–107. https://doi.org/10.1037/a0032696
14. Lieke L. ten Brummelhuis and Arnold B. Bakker. 2012. Staying engaged during the week: The effect of off-job activities on next day work engagement. *Journal of Occupational Health Psychology* 17, 4: 445–455. https://doi.org/10.1037/a0029213
15. Chad Burkey and Denise Ho. 2005. Advanced information gathering for targeted activities. Retrieved September 6, 2017 from http://www.google.com/patents/US6845370
16. V. J Carey and You-Gan Wang. 2001. Mixed-Effects Models in S and S-Plus. *Journal of the American Statistical Association* 96, 455: 1135–1136. https://doi.org/10.1198/jasa.2001.s411
17. Gregory W. Corder and Dale I. Foreman. 2014. *Nonparametric statistics: a step-by-step approach*. Wiley, Hoboken, New Jersey.
18. Mark Cropley, Leif W. Rydstedt, Jason J. Devereux, and Benita Middleton. 2015. The Relationship Between Work-Related Rumination and Evening and Morning Salivary Cortisol Secretion: Work-Related Rumination and Cortisol Secretion. *Stress and Health* 31, 2: 150–157. https://doi.org/10.1002/smi.2538
19. Mary Czerwinski, Ed Cutrell, and Eric Horvitz. 2000. Instant Messaging and Interruption: Influence of Task Type on Performance. *Microsoft Research*. Retrieved September 16, 2017 from https://www.microsoft.com/en-us/research/publication/instant-messaging-and-interruption-influence-of-task-type-on-performance/
20. 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. 75. https://doi.org/10.1145/1040830.1040855
21. Carina von Dreden and Carmen Binnewies. 2017. Choose your lunch companion wisely: the relationships between lunch break companionship, psychological detachment, and daily vigour. *European Journal of Work and Organizational Psychology* 26, 3: 356–372. https://doi.org/10.1080/1359432X.2017.1301428
22. Dalia Etzion, Dov Eden, and Yael Lapidot. 1998. Relief from job stressors and burnout: Reserve service as a respite. *Journal of Applied Psychology* 83, 4: 577–585. https://doi.org/10.1037/0021-9010.83.4.577
23. Charlotte Fritz and Sabine Sonnentag. 2005. Recovery, Health, and Job Performance: Effects of Weekend Experiences. *Journal of Occupational Health Psychology* 10, 3: 187–199. https://doi.org/10.1037/1076-8998.10.3.187
24. Tony Gillie and Donald Broadbent. 1989. What makes interruptions disruptive? A study of length, similarity, and complexity. *Psychological Research* 50, 4: 243–250. https://doi.org/10.1007/BF00309260
25. Thomas Goschke and Julius Kuhl. 1993. Representation of intentions: Persisting activation in memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 19, 5: 1211–1226. https://doi.org/10.1037/0278-7393.19.5.1211

26. Verena C. Hahn, Carmen Binnewies, and Sascha Haun. 2012. The role of partners for employees' recovery during the weekend. *Journal of Vocational Behavior* 80, 2: 288–298. https://doi.org/10.1016/j.jvb.2011.12.004
27. Jonathon R. B. Halbesleben. 2006. Sources of social support and burnout: A meta-analytic test of the conservation of resources model. *Journal of Applied Psychology* 91, 5: 1134–1145. https://doi.org/10.1037/0021-9010.91.5.1134
28. Mona Haraty and Joanna McGrenere. 2016. Designing for Advanced Personalization in Personal Task Management. 239–250. https://doi.org/10.1145/2901790.2901805
29. Celia B Harris, Amanda J Barnier, John Sutton, and Paul G Keil. 2014. Couples as socially distributed cognitive systems: Remembering in everyday social and material contexts. *Memory Studies* 7, 3: 285–297. https://doi.org/10.1177/1750698014530619
30. Jibo He, Ensar Becic, Yi-Ching Lee, and Jason S. McCarley. 2011. Mind Wandering Behind the Wheel: Performance and Oculomotor Correlates. *Human Factors: The Journal of the Human Factors and Ergonomics Society* 53, 1: 13–21. https://doi.org/10.1177/0018720810391530
31. Harry Henderson. 2007. *Artificial intelligence: mirrors for the mind*. Chelsea House, New York NY. Retrieved September 13, 2017 from http://public.eblib.com/choice/publicfullrecord.aspx?p=3009705
32. Stevan E. Hobfoll. 1998. *Stress, culture, and community: the psychology and philosophy of stress*. Plenum Press, New York.
33. Ute R. Hülsheger, 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: 310–325. https://doi.org/10.1037/a0031313
34. Ute R. Hülsheger, Alina Feinholdt, and Annika Nübold. 2015. A low-dose mindfulness intervention and recovery from work: Effects on psychological detachment, sleep quality, and sleep duration. *Journal of Occupational and Organizational Psychology* 88, 3: 464–489. https://doi.org/10.1111/joop.12115
35. Ute R. Hülsheger, 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: 1113–1128. https://doi.org/10.1037/a0037702
36. Shamsi T. Iqbal and Eric Horvitz. 2007. Disruption and recovery of computing tasks: field study, analysis, and directions. 677. https://doi.org/10.1145/1240624.1240730
37. Jun Kato, Daisuke Sakamoto, Takeo Igarashi, and Masataka Goto. 2014. Sharedo: to-do list interface for human-agent task sharing. 345–351. https://doi.org/10.1145/2658861.2658894
38. Aniket Kittur, Ed H. Chi, and Bongwon Suh. 2008. Crowdsourcing user studies with Mechanical Turk. 453. https://doi.org/10.1145/1357054.1357127
39. G. E. Kreiner, E. C. Hollensbe, and M. L. Sheep. 2009. Balancing Borders and Bridges: Negotiating the Work-Home Interface via Boundary Work Tactics. *Academy of Management Journal* 52, 4: 704–730. https://doi.org/10.5465/AMJ.2009.43669916
40. Jana Kühnel, Sabine Sonnentag, and Ronald Bledow. 2012. Resources and time pressure as day-level antecedents of work engagement: Day-level JD-R model. *Journal of Occupational and Organizational Psychology* 85, 1: 181–198. https://doi.org/10.1111/j.2044-8325.2011.02022.x
41. Klodiana Lanaj, Russell E. Johnson, and Christopher M. Barnes. 2014. Beginning the workday yet already depleted? Consequences of late-night smartphone use and sleep. *Organizational Behavior and Human Decision Processes* 124, 1: 11–23. https://doi.org/10.1016/j.obhdp.2014.01.001
42. Edwin A. Locke and Gary P. Latham. 2002. Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist* 57, 9: 705–717. https://doi.org/10.1037/0003-066X.57.9.705
43. Gloria Mark, Shamsi Iqbal, Mary Czerwinski, and Paul Johns. 2015. Focused, Aroused, but so Distractible: Temporal Perspectives on Multitasking and Communications. 903–916. https://doi.org/10.1145/2675133.2675221
44. 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. 3025–3034. https://doi.org/10.1145/2556288.2557204
45. Gloria Mark, Shamsi T. Iqbal, Mary Czerwinski, Paul Johns, Akane Sano, and Yuliya Lutchyn. 2016. Email Duration, Batching and Self-interruption: Patterns of Email Use on Productivity and Stress. 1717–1728. https://doi.org/10.1145/2858036.2858262
46. Daniel McFarlane and Kara Latorella. 2002. The Scope and Importance of Human Interruption in Human-Computer Interaction Design. *Human-Computer Interaction* 17, 1: 1–61. https://doi.org/10.1207/S15327051HCI1701_1
47. T. F. Meijman. 1998. Psychological Aspects of Workload. Retrieved August 31, 2017 from http://www.rug.nl/research/portal/publications/psychological-aspects-of-workload(3adff77b-680b-4cba-81d7-ebcd86ba5db5)/export.html
48. 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: 123–152. https://doi.org/10.1348/096317910X485737
49. Brid O'Conaill and David Frohlich. 1995. Timespace in the workplace: dealing with interruptions. 262–263. https://doi.org/10.1145/223355.223665
50. Chris Parnin and Spencer Rugaber. 2009. Resumption strategies for interrupted programming tasks. 80–89. https://doi.org/10.1109/ICPC.2009.5090030

51. A Patalano. 1997. Opportunistic Planning: Being Reminded of Pending Goals. *Cognitive Psychology* 34, 1: 1–36. https://doi.org/10.1006/cogp.1997.0655
52. Pierre Phillipot and Z. Segal. 2009. Mindfulness Based Psychological Interventions: Developing Emotional Awareness for Better Being. *Journal of Consciousness Studies* 16, 10–1: 285–306.
53. Dawn Querstret, Mark Cropley, and Chris Fife-Schaw. 2017. Internet-based instructor-led mindfulness for work-related rumination, fatigue, and sleep: Assessing facets of mindfulness as mechanisms of change. A randomized waitlist control trial. *Journal of Occupational Health Psychology* 22, 2: 153–169. https://doi.org/10.1037/ocp0000028
54. Abigail J. Sellen and Steve Whittaker. 2010. Beyond total capture: a constructive critique of lifelogging. *Communications of the ACM* 53, 5: 70. https://doi.org/10.1145/1735223.1735243
55. Anya Skatova, Ben Bedwell, Victoria Shipp, Yitong Huang, Alexandra Young, Tom Rodden, and Emma Bertenshaw. 2016. The Role of ICT in Office Work Breaks. 3049–3060. https://doi.org/10.1145/2858036.2858443
56. Judith K. Sluiter. 1999. The influence of work characteristics on the need for recovery and experienced health: a study on coach drivers. *Ergonomics* 42, 4: 573–583. https://doi.org/10.1080/001401399185487
57. Brandon W. Smit. 2016. Successfully leaving work at work: The self-regulatory underpinnings of psychological detachment. *Journal of Occupational and Organizational Psychology* 89, 3: 493–514. https://doi.org/10.1111/joop.12137
58. Timothy Sohn, Leila Takayama, Dean Eckles, and Rafael Ballagas. 2009. Auditory priming for upcoming events. 4225. https://doi.org/10.1145/1520340.1520644
59. Sabine Sonnentag. 2003. Recovery, work engagement, and proactive behavior: A new look at the interface between nonwork and work. *Journal of Applied Psychology* 88, 3: 518–528. https://doi.org/10.1037/0021-9010.88.3.518
60. Sabine Sonnentag and Ute-Vera Bayer. 2005. Switching Off Mentally: Predictors and Consequences of Psychological Detachment From Work During Off-Job Time. *Journal of Occupational Health Psychology* 10, 4: 393–414. https://doi.org/10.1037/1076-8998.10.4.393
61. Sabine Sonnentag, Carmen Binnewies, and Eva J. Mojza. 2010. Staying well and engaged when demands are high: The role of psychological detachment. *Journal of Applied Psychology* 95, 5: 965–976. https://doi.org/10.1037/a0020032
62. Sabine Sonnentag and Charlotte Fritz. 2007. The Recovery Experience Questionnaire: Development and validation of a measure for assessing recuperation and unwinding from work. *Journal of Occupational Health Psychology* 12, 3: 204–221. https://doi.org/10.1037/1076-8998.12.3.204
63. Sabine Sonnentag and Charlotte Fritz. 2015. Recovery from job stress: The stressor-detachment model as an integrative framework: THE STRESSOR-DETACHMENT MODEL. *Journal of Organizational Behavior* 36, S1: S72–S103. https://doi.org/10.1002/job.1924
64. Sabine Sonnentag and Jana Kühnel. 2016. Coming back to work in the morning: Psychological detachment and reattachment as predictors of work engagement. *Journal of Occupational Health Psychology* 21, 4: 379–390. https://doi.org/10.1037/ocp0000020
65. Sabine Sonnentag, Eva J. Mojza, Carmen Binnewies, and Annika Scholl. 2008. Being engaged at work and detached at home: A week-level study on work engagement, psychological detachment, and affect. *Work & Stress* 22, 3: 257–276. https://doi.org/10.1080/02678370802379440
66. 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: 583–603. https://doi.org/10.1016/S1071-5819(03)00023-5
67. Max G. Van Kleek, Michael Bernstein, Katrina Panovich, Gregory G. Vargas, David R. Karger, and Mc Schraefel. 2009. Note to self: examining personal information keeping in a lightweight note-taking tool. 1477. https://doi.org/10.1145/1518701.1518924
68. Felieke E. Volman, Arnold B. Bakker, and Despoina Xanthopoulou. 2013. Recovery at home and performance at work: A diary study on self–family facilitation. *European Journal of Work and Organizational Psychology* 22, 2: 218–234. https://doi.org/10.1080/1359432X.2011.648375
69. David Watson, Lee Anna Clark, and Auke Tellegen. 1988. Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology* 54, 6: 1063–1070. https://doi.org/10.1037/0022-3514.54.6.1063
70. Joseph Weizenbaum. 1966. ELIZA---a computer program for the study of natural language communication between man and machine. *Communications of the ACM* 9, 1: 36–45. https://doi.org/10.1145/365153.365168
71. F. R. H. Zijlstra, M. Cropley, and L. W. Rydstedt. 2014. From Recovery to Regulation: An Attempt to Reconceptualize 'Recovery from Work': An Attempt to Reconceptualise 'Recovery from Work.' *Stress and Health* 30, 3: 244–252. https://doi.org/10.1002/smi.2604