Guiding Attention with Tasks and Emotions in Conversational Agents

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ABSTRACT

Task-oriented conversational agents are designed to assist users in achieving a particular set of goals. The assistance offered by these systems is often grounded in dialogues that embody discussion around task-related progression. In this paper, we challenge the status quo by exploring the utility of agent dialogues that prioritize emotion-related goals instead of those that relate to task progression. We detail findings from two studies that explore this style of assistance in two unique settings: (1) information work, and (2) crowdwork. Collectively these studies explore the trade-offs in task-related and emotion-related goals and articulate a call-to-arms for conversational agent research aimed at supporting productivity and well-being within and beyond the work context.

KEYWORDS

Conversational agent, attention, goals, tasks, emotions, user studies.

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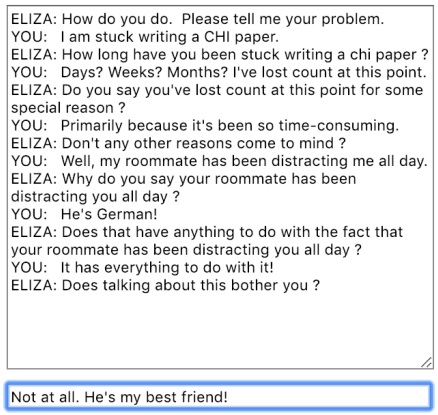
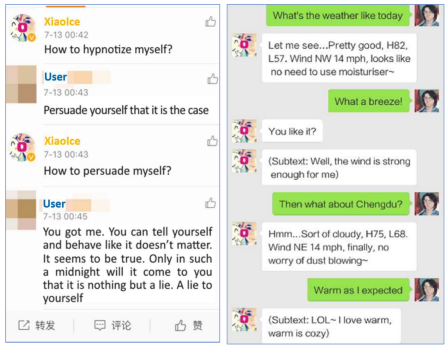


Figure 1: An Interaction with ELIZA. [19] (https://www.masswerk.at/elizabot/)



(a) (b)

Figure 2: Interactions with Xiaoice. [12]

INTRODUCTION

Task-oriented conversational agents are designed to assist users in achieving a particular set of goals. In recent years, the introduction of affordable and accessible AI services (e.g. Microsoft Bot Framework) have given rise to a slew of task-oriented agents that help us accomplish tasks in a variety of ways, ranging from providing simple customer service needs to guiding the shopping experience on large-scale eCommerce websites [21]. Further, the wide-spread adoption of voice assistant devices (e.g. Amazon Alexa, Cortana) has improved the perception of relevance of task-oriented conversational agents to the general public, making this an active and interdisciplinary area of research for academia and industry alike.

A central and often overlooked component of reaching one's task-related goals is the emotions that come with doing so [18]. Studies in organizational psychology have highlighted that positive work-related emotions help workers obtain favorable outcomes (e.g. achievements) while negative work-related emotions hamper organizational productivity [8, 17]. While many predictions of intelligence augmentation broadly centered around task enhancement (e.g., Vannevar Bush's "As We May Think" [3]), the earliest examples of conversational agents, such as ELIZA [19] shown in Figure 1, were grounded in administering emotional support based on principles of Rogerian psychotherapy. Over the course of the last half-century, a collection of systems, ranging from simple ELIZA extensions (e.g. PARRY [5]) to complex social chatbots (e.g. Microsoft's Xiaoice [12]), have been proposed and evaluated in practice with success. However, despite technical progression in conversational systems, the gap for supporting work-related emotions in the workplace context has largely remained unfilled.

In this paper, we discuss a new style of dialogues for conversational agents that emphasizes emotion-related aspects of tasking instead of task-related aspects of work. Specifically, we highlight findings from two studies of conversational agents that utilize such dialogues in two, unique settings. First, we introduce SwitchBot, a conversational agent that leverages principles of occupational health psychology and task interruption theory to help information workers psychologically detach from work and later reattach with their work. Second, we introduce Rae, a conversational agent that leverages principles of sports psychology to improve task performance and engagement in crowdwork. In each of these studies, we find that enabling a discussion on users' task-related emotions and self-perceptions yields positive outcomes for each type of scenario.

As a collective, the studies presented in this paper establish a new frontier for research on conversational systems in practice. Even in our limited research, we find that small emotion-centric interventions can have a meaningful effect on both an individuals' productivity and their well-being. Our studies form the basis of a new research agenda for the field, highlight the requirement of interdisciplinary collaboration, and motivates the building of conversational systems that improve personal productivity.

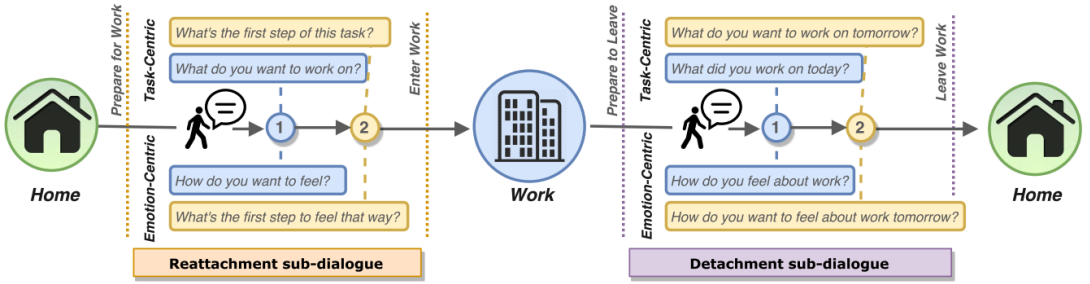


Figure 4: SwitchBot's dialogue paradigm inspired by Trafton and Altmann's Goal-Activation Model.

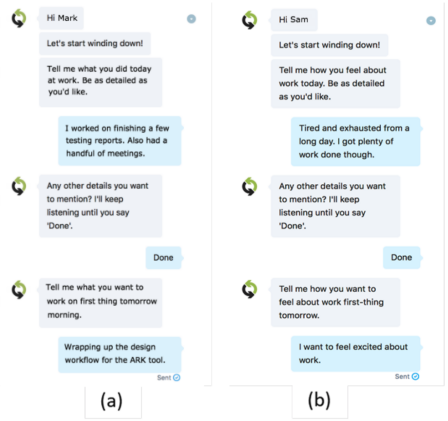


Figure 3: A snapshot of each of SwitchBot's dialogues: (a) Task-centric and (b) Emotion-centric.

STUDY I: A CONVERSATIONAL AGENT FOR HOME-WORK TRANSITIONS

Research has shown that productivity is mediated by an individual's ability to psychologically detach from their work at the end of the day and reattach with it when they return the next day. Studies in productivity suggest that reattachment is best facilitated with proper planning (e.g., maintain a to-do list [13]), while occupational health psychology posits that discussing emotions can yield gains in detachment [16]. In this study, we explore the extent to which structured dialogues, focused on individuals' work-related tasks or emotions, can help them with their detachment and reattachment processes. We drive our inquiry with *SwitchBot*, a conversational agent that engages with workers at the start and end of their work day. Through SwitchBot, we design and study two dialogue frameworks for guiding the detachment and reattachment processes: a Task-centric dialogue and an Emotion-centric dialogue. The dialogue paradigm, inspired by Altmann et al. [1], is shown in Figure 4.

Procedure

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. 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 SwitchBot after a weekday versus after a 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.

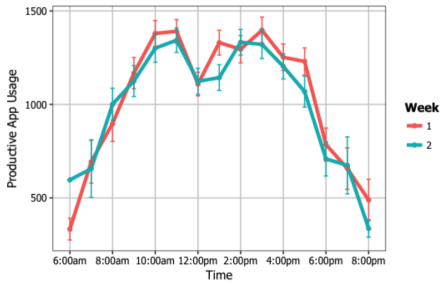


Figure 5: Averaged productivity app usage across the workday between weeks.

Figure 6: Differences in productivity app usage between weeks by workhour.

[1]Statistical significance and p-values have been omitted for space, but can be found in [20].

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 of the study, and we therefore present data for 34 people. A $50 gift card was given for participation.

Measures and Results

Across the 14-day study, we collected information about individuals' productivity application usage (e.g. Microsoft Word, Excel, etc) relevant to their work. We also leveraged an experience sampling approach to collect hourly information about subjective perceptions of four key characteristics related to detachment and reattachment: perceived productivity, engagement, stress, and inspiration. At the end of the study, we administered validated questionnaires for measuring psychological reattachment [15] and detachment [14] to collect information about individuals' experience in using SwitchBot, and also asked people to report the number of after-hour e-mails sent each day during the study period as measured by their email client.

Looking first at productivity app usage, the robustness of our data collection methods is supported by replicating the findings from [9]. As in Mark et al., we note that workers' productivity is highest at two primary times during the workday as shown in Figure 5.

Contrasting dialogue with SwitchBot and participants' existing practices, our findings suggest that SwitchBot was an effective tool for facilitating both reattachment and detachment. We find that interacting with either of SwitchBot's dialogues increased our participants' feelings of productivity and engagement at the start of the workday. However, we find that participants who discussed their emotion-related goals with SwitchBot not only had higher productivity application usage (as shown in Figure 6, but also sent fewer after-hour e-mails when using the system. Finally, we find that individuals without existing rituals for detaching from work self-reported positive gains in both detachment and reattachment. Qualitative responses in the study post-questionnaire suggested that participants were excited about tools and systems that help them establish clear and robust "cognitive boundaries" between home and work. Recommendations for improvements included support for specific environments (e.g., voice interaction during commutes), a hybrid task-emotion dialogue, and the ability to engage SwitchBot arbitrarily during the day to offload work-related thoughts that arise at the wrong time[1].

STUDY II: A CONVERSATIONAL AGENT FOR ASSISTED CROWDWORK

Crowdsourcing systems inherently rely on worker engagement to reach successful outcomes. However, research has shown that workers experience a plethora of internal deterrents while working that

Table 1: Rae's Dialogue Paradigm.

Challenge	**Solution-Focused Statement**
Easy	*"Try finding 10 Greek Taus"*
Intermediate	*"Try finding 20 Greek Taus"*
Difficult	*"Try finding 30 Greek Taus"*

Challenge	**Emotion-Focused Statement**
Easy	*"Imagine how it feels completing this task."*
Intermediate	*"Imagine how it feels being one of the best workers doing this task."*
Difficult	*"Imagine how it feels being the best worker doing this task."*

Table 2: The Four-Condition Study Design.

Condition	**Description**
Baseline	Participants complete the task without Rae.
Rae: Baseline	Participants use Rae to get their next task.
Rae: Solution	Participants can use Rae's solution-focused dialogue.
Rae: Emotion	Participants can use Rae's emotion-focused dialogue.

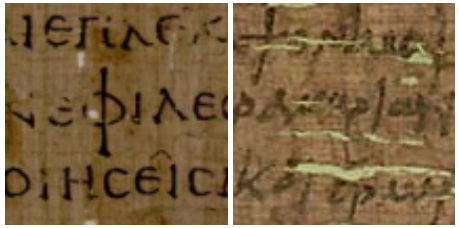


Figure 7: A comparison between easy (left) and challenging (right) tasks.

negatively affect their performance and engagement, such as task correctness [10], self-doubt [4], and self-efficacy [11]. In this study, we explore the extent to which conversational dialogues inspired by sports psychology and goal setting theory can combat the aforementioned stressors that stem from doing challenging work. We embody these theory-driven dialogues in Rae, a conversational agent that sets task-related and emotion-related goals for crowdsourced object detection tasks.

Dialogues for Adaptive Goal Setting

Rae's dialogue structure is built on fundamental theories of stress and coping. Inspired by Lazarus's Transactional Model of Stress and Coping [7], we designed adaptive dialogues that map directly to the two primary styles of coping: *solution-focused coping* or *emotion-focused coping*. Solution-focused coping is a type of strategy in which individuals try to eliminate their stress through resolution (i.e., by performing a solution). Conversely, emotion-focused coping is a type of strategy that encourages individuals to adapt themselves to the current stressors they're experiencing in the moment (i.e., mindfulness [6]). In designing Rae, we map these strategies to dialogues that correspond to (1) reaching task-related performance goal and (2) visualizing an emotion-related goal "in the moment", a mapping widely supported by sports psychology techniques [2]. Further, to ensure that each goal would be challenging yet attainable, we created a challenge hierarchy that enables each dialogue style to span three levels of goal difficulty: (1) easy, (2) intermediate, and (3) difficult. Upon first interaction, Rae introduces itself as a conversational system that "helps you by talking to you" and engages the user with the intermediate dialogue. When a user progresses to their next task, Rae assesses their progress and determines if their goal should be decreased, increased, or remain the same. Examples of each dialogue style and goal difficulty are shown in Table 1.

Pilot Procedure and Measures

To understand Rae's effect on workers, we recruited 12 participants for a pilot study through Amazon Mechanical Turk. Participants were tasked with identifying ancient Greek Taus in a series of deteriorated and partially-illegible papyrus manuscripts across two task queues: (1) a task queue of 10 easy tasks and (2) a task queue of 10 challenging tasks (see Figure 7). Participants were told that each easy task was valued at $0.10 while each challenging task was valued at $0.40. Participants were forced to start the task with the queue of challenging tasks, and were capable of switching to the queue of easy tasks at their leisure. However, if a participant switched to the easy task queue, they could not switch back to the challenging task queue. Queues were randomized for each participant to reduce ordering effects. Our study design was composed of four, balanced conditions as shown in Table 2. For each participant, we recorded queue switching behavior, task accuracy (i.e. F1 Score), and total task time. We administered the NASA-TLX and collected open-ended feedback with a post-questionnaire survey.

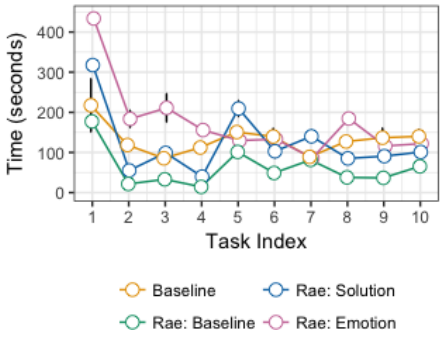


Figure 8: Task completion times by index.

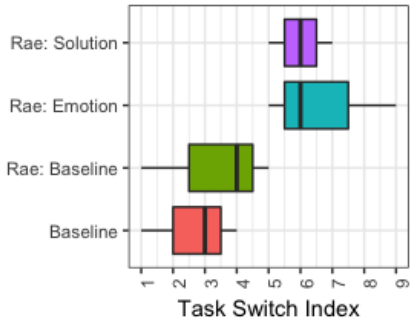


Figure 9: Task switching indicies by condition.

Preliminary Findings

As an intervention, Rae was met mostly with positive reception. Five of the six participants that used an intervention-based version of Rae felt that it was useful for "confronting the task". As shown in Figure 8, we find significant differences in the rate at which people completed their work. Specifically, we find that participants who interfaced with Rae's emotion-focused dialogue demonstrated slower activity at the beginning of their work, which is a surprising parallel with the earlier finding with SwitchBot as shown in Figure 5. We also find that participants who received either intervention-based version of Rae (i.e. solution-focused or emotion-focused) had, on average, higher accuracy than participants in either of the baseline conditions. Speaking to Rae's effect on resilience, we find statistically significant differences in participants' task switching index (i.e. the number of challenging tasks they completed before switching to the easy tasks) between conditions as shown in Figure 9. Specifically, we find that participants who had access to either of Rae's dialogues were more resilient than others. However, given this study's sample size, a larger follow-up study is needed to assess these findings at scale alongside more supplemental forms of data about our participants (e.g. personality). Open-ended feedback from the post-questionnaire largely centered on incorporating Rae as an optional interface component and allowing users to reorient themselves with "mixed goals" (i.e. to reduce repetition).

DISCUSSION AND CONCLUSION

In this paper, we discuss the potential role that dialog systems can play in improving worker productivity and well-being. We demonstrate the potential of these systems through two proof-of-concept dialog systems: SwitchBot, which incorporates work in organization psychology to help workers detach from and reattach to work; and Rae, which leverages research from sports psychology to boost crowdworkers' ability to complete cognitively demanding tasks. Across these unique contexts, we find observable value in exploring dialogues that guide individuals' attention toward inward rather than outward in supporting of helping them reach their goals.

Our research suggests that unique and unexpected benefits may arise from conversational systems that allow individuals to strategically react as they reflect on themselves, their goals, and the emotions they experience as they journey about reaching them. While tasks are often grounded in specific contexts and domains, the feelings that stem from personal experiences are ever-present, and we argue for additional research in conversational systems that leverage and prioritize emotion as a first-class consideration for reaching one's goals. Our studies take the first steps toward setting forth an agenda for research aimed at better understanding the connection between tasking and reflective expression in the context of these systems – a frontier for interdisciplinary research across computing and beyond.

Word Count: 2154 characters.

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