Feeling Stressed and Unproductive? A Field Evaluation of a Therapy-Inspired Digital Intervention for Knowledge Workers

KEVIN CHOW, Department of Computer Science, University of British Columbia, Canada
THOMAS FRITZ, Department of Informatics, University of Zürich, Switzerland
LIISA HOLSTI and SKYE BARBIC, Department of Occupational Science and Occupational Therapy, University of British Columbia, Canada
JOANNA MCGRENERE, Department of Computer Science, University of British Columbia, Canada

Today's knowledge workers face cognitively demanding tasks and blurred work-life boundaries amidst rising stress and burnout in the workplace. Holistic approaches to supporting workers, which consider both productivity and well-being, are increasingly important. Taking this holistic approach, we designed an intervention inspired by cognitive behavioral therapy that consists of: (1) using the term "Time Well Spent" (TWS) in place of "productivity", (2) a mobile self-logging tool for logging activities, feelings, and thoughts at work, and (3) a visualization that guides users to reflect on their data. We ran a 4-week exploratory qualitative comparison in the field with 24 graduate students to examine our *Therapy-inspired* intervention alongside a classic *Baseline* intervention. Participants who used our intervention often shifted toward a holistic perspective of their primary working hours, which included an increased consideration of breaks and emotions. No such change was seen by those who used the *Baseline* intervention.

CCS Concepts: • **Human-centered computing** → **Empirical studies in HCI**; *Interactive systems and tools*; Field studies;

Additional Key Words and Phrases: Knowledge worker, productivity, well-being, work intervention, cognitive-behavioral therapy, stress, burnout, time well spent

ACM Reference format:
Kevin Chow, Thomas Fritz, Liisa Holsti, Skye Barbic, and Joanna McGrenere. 2023. Feeling Stressed and Unproductive? A Field Evaluation of a Therapy-Inspired Digital Intervention for Knowledge Workers. *ACM Trans. Comput.-Hum. Interact.* 31, 1, Article 12 (November 2023), 33 pages.
https://doi.org/10.1145/3609330

This work was supported by funding from NSERC Highly Personalized User Interfaces (RGPIN-2017-04549), ABB Industrial Research Grant (F17-05273-22R77358), and NSERC CRDPJ (530226-18).
Authors' addresses: K. Chow and J. McGrenere, Department of Computer Science, University of British Columbia, Vancouver, BC, Canada; emails: {kchowk, joanna}@cs.ubc.ca; T. Fritz, Department of Informatics, University of Zürich, Zürich, Switzerland; email: fritz@ifi.uzh.ch; L. Holsti and S. Barbic, Department of Occupational Science and Occupational Therapy, University of British Columbia, Vancouver, BC, Canada; emails: {liisa.holsti, skye.barbic}@ubc.ca.

1073-0516/2023/11-ART12
https://doi.org/10.1145/3609330

1 INTRODUCTION

Stress and burnout have become increasingly prevalent in the workplace [2, 12]. Knowledge workers are tasked with cognitively demanding problems often with immense flexibility in both when and where this work occurs. The blurring of boundaries between work and life that is common for such workers can make it difficult to maintain a healthy work-life balance [116, 120]. In particular, prevailing societal expectations, such as the "culture of busyness" [83], "workaholism" [61], or "hustle culture" [21], may especially reinforce the classic, output-focused perspective of productivity and work where knowledge workers always need to be busy, producing output, or even have no time for leisure [26] to succeed. The challenges associated with such a perspective may be exacerbated for graduate students, who can be considered a subset of knowledge workers, especially those in research-oriented programs; it has been shown that they experience an above average level of stress in North America [20].

Alleviating this growing occupational burnout is becoming an area of concern in the fields of human-computer interaction [69, 88, 91], occupational sciences [22, 40, 111], psychology [34, 74, 112], and even in the popular press [68, 94, 99]. One recent approach focuses on promoting a wider perspective of work and productivity, such as by emphasizing a more "holistic" and human-oriented perspective of work [36, 64, 75, 98]. By a "holistic" perspective of work, we mean a broad consideration that includes both classic notions of productivity as well as worker well-being, treating them as interconnected and jointly necessary when thinking about work as a whole. This is in contrast to more traditional perspectives about work that more narrowly focus on *classic productivity*, which optimizes for increased work output per input. Of high relevance to our work, Guillou et al. [64] characterized the term "**Time Well Spent**" (**TWS**) at work based on definitions of TWS elicited after a week-long experience sampling study with 40 knowledge workers. They found that knowledge workers defined whether or not their time at work was well spent (i.e., if it was TWS) based onfour main themes: "what I work on", "how I work", "how I feel", and "how I take care of myself", encompassing both classic productivity and also the worker's feelings and well-being.

While shifting perspectives of work was not the intention of their study, Guillou et al. [64]'s findings hinted that some people may "change their feelings toward work" even with just the reflection induced by logging entries as part of the experience sampling method. Thus, viewing this finding as an opportunity to could be expanded upon, we designed a *Therapy-inspired* intervention that asks about "Time Well Spent" [64], but also incorporates empirically-validated **cognitive behavioral therapy** (**CBT**) style reflection questions and CBT's cognitive model into the design of existing worker support tools for knowledge workers, with the specific goal of encouraging knowledge workers to adopt a more holistic perspective toward time at work. CBT has been shown to be effective in treating a variety of mental health problems (e.g., reducing anxiety [65, 110], eating disorders [47, 96], stress in the workplace [33, 69]), where one of its key techniques is to challenge one's beliefs and to encourage alternative perspectives [56].

Our first research question was:

- **RQ1**: How can we incorporate both the term "Time Well Spent" and CBT-inspired elements into the design of a *Therapy-inspired* intervention that enables knowledge workers to shift from a classic, work output-focused perspective of how to spend their primary working hours toward a more holistic perspective?

Our goal with **RQ1** was to capture *shifting perspectives* rather than outcomes associated with behavior change, which is a "complex, long-term process with high relapse rates" [78], given the early stage of our novel *Therapy-inspired* intervention. Changed attitudes and perspectives have

been well-studied in their own right, as a precursor in various models of long-term behavior change [18, 106].

To further capture initial insights on the impact of the term TWS as well as the CBT-inspired design elements in our *Therapy-inspired* intervention, we also implemented a basic self-monitoring tool (the *Baseline* intervention) that asked about productivity instead of TWS and did not include CBT-inspired elements. This provided a baseline for comparison that would enable us to account for both the already known effects of self-monitoring on awareness and the Hawthorne effect [93], leading to our second research question:

—**RQ2**: What is the impact on knowledge workers of our *Therapy-inspired* intervention compared to a classic, productivity-focused *Baseline* intervention?

To answer our research questions, we conducted a 4-week exploratory field evaluation ($n = 24$ graduate students, as a sample subset of knowledge workers, 12 used each intervention) of our *Therapy-inspired* intervention, comparing it qualitatively to a classic productivity-focused, *Baseline* intervention. Our findings suggest that our graduate student participants who used the *Therapy-inspired* intervention shifted their perspective from a narrower, classic productivity perspective of what it meant to spend their time well during their primary working hours (i.e., their definition of TWS) toward a more holistic one whereby participants had an increased consideration of their well-being, including the importance of taking breaks and the impact of their emotions on workday activities. In contrast, the *Baseline* intervention led to no change in participants' definition of "productivity". Through an increased awareness of the relationship between their activities and emotions in the workday, some participants who used our *Therapy-inspired* intervention reported that they were able to better optimize their schedules for greater enjoyability and productivity. We also saw signs of how the intervention's CBT-inspired features may have helped participants reframe negative moments or emotions in the workday.

In summary, we make the following *design* and *empirical* contributions [123]:

—Our novel *Therapy-inspired* intervention. It combines the term TWS and key ideas and techniques from CBT, such as the cognitive model, thought records, and cognitive reappraisal, with features of existing worker support tools to promote a more holistic perspective of time at work that jointly considers both classic productivity and well-being.
—Preliminary empirical findings from a 4-week exploratory field evaluation that replicate and notably extend Guillou et al.'s [64] findings. Among other findings, we show that our *Therapy-inspired* intervention may shift workers toward a broader, more holistic perspective of what it means to spend their time well during the workday, while the *Baseline* intervention showed no such shift in perspective.

Altogether, we provide preliminary evidence that our *Therapy-inspired* intervention can encourage knowledge workers to adopt a more holistic perspective toward their time at work which should serve as a precursor to longer-term changes in behavior that can lead to measurable increased well-being and productivity-related outcomes [18, 106]. Understanding the impact of this intervention on behavior change outcomes, which requires a more rigorous form of evaluation like a randomized controlled trial, is a promising future area of study [58, 78].

2 RELATED WORK

In this section, we cover the current state of digital worker support tools and describe recent research that begins to advocate for alternative, holistic perspectives of work. We conclude with an overview of cognitive behavioral therapy, and discuss existing CBT-style digital interventions both outside of and within the workplace context.

2.1 Digital Worker Support Tools

Current digital worker support tools (i.e., digital tools that aim at supporting knowledge workers at work) and interventions range from ones that focus strictly on improving productivity, to tools that aim at improving worker well-being, such as by reducing stress or encouraging breaks. Productivity-focused interventions primarily employ distraction blocking [80, 81, 86, 117] and self-monitoring [9, 76, 95, 121] techniques to improve worker productivity. However, recent research has shown that such productivity-focused techniques like distraction blocking, a popular approach among commercial apps [4, 60], have costs, such as increased stress [76, 86], or feeling less connected to their social circle [104]. These tools espouse a classic, narrow perspective of productivity: to improve worker output and efficiency. Our *Baseline* intervention is a representation of such classic productivity-focused tools as its design resembles a basic self-monitoring tool that asks users to log how they spent their time and assess their own productivity during their primary working hours.

With respect to well-being, the HCI community has conducted a variety of studies to identify and mitigate stress-related factors in the workplace, such as email [82, 89, 90], digital distractions/interruptions [86, 88], and context switching [45, 91]. A growing body of HCI research has also focused on understanding and promoting break-taking at work [55, 84, 113], and even automatically predicting best times to transition to a break [73]. Researchers have also looked at tracking emotions at work, as it is known that people who feel happier and satisfied also tend to be more productive at work [62, 85, 87, 97, 122]. More broadly, there are a plethora of digital well-being applications [5, 8, 11] that target improving overall mental health (e.g., reducing stress and anxiety). However, the latter general tools are not typically designed for knowledge workers and the workplace context, and thus may fail to balance well-being with productivity-based outcomes at work [33].

In our *Therapy-inspired* intervention, we combine elements of self-monitoring that are present in existing productivity-focused worker support tools (represented via our *Baseline* intervention, a basic self-monitoring tool) while taking a more holistic approach to supporting knowledge workers, or one that promotes both well-being as well as more classic productivity. For instance, users of our intervention not only log both work and non-work activities, but also their emotions and thoughts during their primary working hours. In addition, our intervention employs CBT-based concepts and skills to help workers challenge logged negative emotions and thoughts on a daily basis to practice reframing them in a more balanced and positive way.

2.2 Perspectives on Work and Productivity

Perspectives on work and productivity have evolved throughout the past few decades, but especially in the post-pandemic era [27, 92], where many are starting to move toward a broader and more holistic perspective of work, in an attempt to push back against the "culture of busyness" [83] that is still so pervasive.

"Productivity" has been *classically* defined as the amount of output produced per input [109], with roots in the manual work of the Industrial Age. This classic definition of productivity emphasizes work output. However, given the complex nature of knowledge work, outputs are varied and not easily quantifiable [75], leading to challenges in measuring and defining productivity for knowledge workers. In fact, to date, there is still no clear consensus on a definition of productivity for knowledge work, with many commonly adopting the classic definition despite its limitations [75].

The organizational psychology literature has instead focused on identifying, measuring, and mapping out the factors associated with knowledge worker productivity in an attempt to

operationalize the term. Examples of factors that have been identified include company climate [63], autonomy [48], and office environments [39]. In particular, Oskarsdottir et al. [102] have drafted a "holistic theory of knowledge worker productivity" that includes factors related to an individual knowledge worker like one's job satisfaction, job commitment, motivation, engagement, and well-being, suggesting a widening consideration of knowledge worker productivity.

Popular media [98, 99, 100, 115] and industry reports [19] have also recently begun to push back against the classic, output-focused definition of productivity, seeking a more broader consideration that considers well-being [115], collaboration [59], and is more personal [75]. A study by Kim et al. [75] characterized knowledge workers' *perceived* productivity, showing that people's perceptions of the term are multifaceted, diverse, and subject to individual differences. In particular, they found preliminary evidence that a knowledge worker's emotional or physical state can impact their perceived productivity. However, despite the somewhat broadening use of the term "productivity", being busy and chronically stressed continues to be a cultural norm [16, 46, 83], especially in the North American context. Belleza et al. [26] found that not having time for leisure is perceived as a status symbol, as people believe that you need to be busy and productive to succeed.

Aforementioned research by Guillou et al. [64] proposed an alternative term to "productivity", "**Time Well Spent**" (**TWS**) at work, showing that knowledge workers' definitions of TWS holistically included elements of not only classic productivity, but also the worker's feelings and well-being, in-line with the broadening consideration of productivity. As some workers are likely to still associate the term "productivity" with the output-focused classic definition, we deliberately designed our *Therapy-inspired* intervention to use the term TWS while also including CBT-style reflection questions to encourage broader and more alternative perspectives of one's time at work.

2.3 Cognitive Behavioral Therapy Interventions

Cognitive behavioral therapy (**CBT**) is one of the most popular and widely researched psychotherapeutic methods, commonly used in Western healthcare. Because of the large body of empirical support for the CBT method across diverse populations, it has been recommended as a treatment for a range of mental health conditions, such as depression, anxiety, or obsessive-compulsive disorder [24, 56]. CBT is typically delivered in a face-to-face setting with a therapist, but its structured nature lends itself to digital forms of delivery via apps or online (also known as computerized CBT, or internet-delivered CBT) [35, 43, 79, 107]. Computerized CBT has been shown to be comparable to face-to-face therapy in terms of clinical effectiveness [32, 125] and can support increased access to mental health treatments.

Digital CBT interventions typically involve self-guided modules delivered in an interactive multimedia format that are meant to teach patients CBT-based skills, such as identifying cognitive distortions. For example, SilverCloud [49] uses trained client supporters that regularly write messages to clients to encourage program adherence and sustain engagement. Woebot [57] is a conversational agent that administers CBT-derived self-help content and was shown to be an engaging and effective way to deliver CBT programs among college students. PopTherapy [103] delivers micro-interventions for users to practice CBT- and other therapy-based skills with the goal of reducing stress through the repurposing of popular websites (e.g., viewing one's Facebook timeline for an example that showcases one's strengths, a skill from positive psychology). Interactive storytelling and gamification have also been effective in increasing engagement with digital CBT apps [67].

Alternatively, other digital CBT interventions focus on self-monitoring instead of delivering CBT-based educational content. For example, FaceIt [110] uses guided mood logging to help treat social anxiety. There is a multitude of commercially available mobile apps, like CBTDiary [1], Rise

Up and Recover [10], or Mindshift CBT [7], that help bring awareness to momentary thoughts and feelings through logging to help individuals change maladaptive behaviors, such as in addressing eating disorders [47, 96]. These self-monitoring approaches share similarities with current activity-based tracking techniques, but with an increased emphasis on one's thoughts and feelings.

Digital CBT interventions have also found success in the work environment. Recently, from the HCI community, Howe et al. [69] designed a workplace stress-reduction intervention that incorporates strategies from CBT, such as cognitive reframing, to reduce stress. A review of CBT intervention studies in the workplace found that although many led to improved well-being outcomes (e.g., reduced stress levels), most studies ignored occupational outcomes (i.e., impact on productivity) [33, 69], leaving well-being and productivity outcomes as an opportunity to consider together holistically.

To the best of our knowledge, there has not been an intervention like ours in the workplace context that incorporates CBT ideas and techniques with existing self-monitoring worker support tools and the aim of shifting workers toward a more holistic and broader perspective of their time at work to jointly consider both well-being as well as productivity.

3 THE THERAPY-INSPIRED INTERVENTION

The *Therapy-inspired* intervention consists of three components that all comprise one intervention: (1) the use of the holistic term "Time Well Spent" in place of "productivity", (2) the *TWS Logging App*, a mobile app that prompts users to regularly log their activities, feelings, thoughts, and TWS ratings, and (3) the *TEA-Viz*, a visualization of users' logged data that highlights associations in a heatmap-like chart and also guides users to reflect on their logged data with Socratic questioning [38] inspired from CBT. We first describe the theoretical underpinnings of the intervention, then outline the key features of the *TWS Logging App*, the *TEA-Viz* and its accompanying reflection questions, and report on implementation details. We conclude this section with a brief description of the *Baseline* intervention, which was included for the purposes of comparison in the field evaluation. A video demonstration of both the *Therapy-inspired* and *Baseline* interventions can be found in the supplementary materials.

3.1 Theoretical Underpinnings

The core CBT-inspired idea behind our *Therapy-inspired* intervention is the cognitive model [24], which states that our emotions and behaviors are influenced by our thoughts about events, and that thoughts, emotions and behaviors are all interconnected. As such, our intervention adds logging of thoughts (i.e., keeping a thought record, a key practice of CBT) and emotions to existing self-monitoring tools that typically only track activities or behaviors.

Another key CBT concept integrated into our *Therapy-inspired* intervention is that of guided discovery through Socratic questioning [38], which is the process whereby a therapist asks carefully sequenced questions to help clients "become aware of their underlying assumptions and discover alternative perspectives and solutions for themselves" [56]. Some examples of Socratic-style questions [25] include questions like: "*What is the evidence that supports this idea? What about evidence against it?*" or "*Is there an alternative explanation or viewpoint?*" When applied to how workers spend their time during the workday, we posit that such questions can help to encourage a broader range of perspectives and thus promote a more holistic view toward the workday. For example, knowledge workers may struggle with thoughts about needing to constantly be busy working throughout the day [83]. Socratic-style questions can challenge these workers to consider other perspectives, such as the idea that taking care of themselves by taking a break might actually help them produce their best work. In the *TEA-Viz*, the accompanying daily reflection questions are Socratic-style questions (with the exception of the long-term pattern reflection question). In

designing these reflection questions (see Section 3.4 for our exact wording), we carefully selected and adapted the wording from example questions and therapist-client conversations found in CBT workbooks [24, 25, 101] based on our work-specific context.

Although inspired by CBT, we note that the *Therapy-inspired* intervention is not a traditional digital CBT intervention that aims at delivering CBT-based learning modules with remote therapist support. Rather, it more closely resembles existing self-monitoring and reflection tools designed for productivity but integrating ideas and practices from CBT. We note that the intervention is not intended to replace therapeutic treatment, and is designed for the broader population of knowledge workers, even if they do not currently experience acute challenges with their mental health.

Finally, we chose to use "Time Well Spent" instead of "productivity" due to the holistic characterization of the term as identified by Guillou et al. [64], and to avoid preconceived notions of what it means to be "productive". Although the nature of the term "productivity" is diverse and nebulous [75], it is classically associated with the amount of work output produced. We posited that incorporating the term TWS, along with the aforementioned CBT concepts, can best broaden knowledge workers' perspective regarding how to spend their time during their primary working hours toward a holistic one that jointly considers their well-being and productivity.

3.2 TWS Logging App

The *TWS Logging App* was built from a custom version of the OmniTrack research platform [77], which runs exclusively on an Android phone. OmniTrack enables researchers to define their own trackers to log data that they might be interested in.

In the *TWS Logging App* (see Figure 1), for the past hour of their workday, users are asked to rate how well they spent their time on a 5-point Likert scale (Q1: TWS rating), log what they have been doing (Q2: activity), log what they have been feeling (Q3: feeling), and log their thoughts about the *relationship* between what they have been doing and how they have been feeling (Q4: thoughts).

For Q2 and Q3, users are able to select one or more options from a default list of activities and feelings. The default list of activities explicitly includes both work-related and non-work related options, and is kept short (4 activities: Meeting, Email, Eating a Meal, and Social Media) intentionally to encourage users to add their own work or non-work activities. Similarly, for Q3, the default list of feelings was populated based on piloting that informed which feelings were most common among knowledge workers during their self-defined primary working hours and can be expanded by users.

Users record their thoughts in Q4 in an open-ended manner. In our study, participants were asked to keep responses brief to prevent logging from becoming too onerous. Phrases or keywords were encouraged instead of complete sentences. We found from pilot testing that asking about thoughts in general was too broad, and so we focused on users' thoughts about the *relationship* between their activities and feelings. This is analogous to keeping a thought record in CBT, a technique used to teach clients to distinguish thoughts from facts and to observe how their thoughts can impact their feelings.

The *TWS Logging App* is configured to remind users to log at a random time each hour, during their primary working hours for a workday. Random time points are used to prevent anticipation around logging at a particular time. Reminders persist as a banner notification on users' phones for 15 minutes before disappearing on their own, and there is a minimum interval of 45 minutes before another reminder would be issued. In our study, participants were encouraged to log when they were notified by the app, but they were also reminded that they could ignore or postpone the reminder and log retroactively in situations where they might not be available to log (e.g., in a meeting) or if they were fully immersed in their work, by going into the app and completing an entry directly.

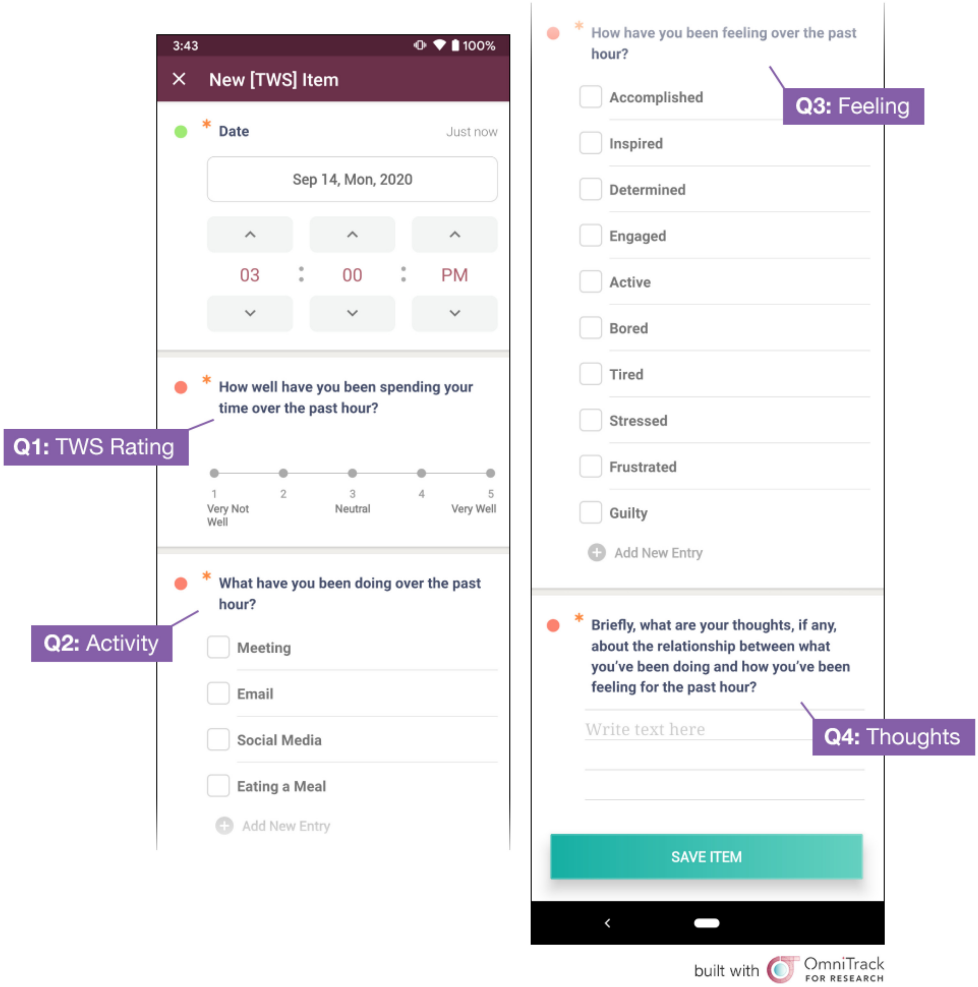

Fig. 1. The *TWS Logging App* (screenshot on the left continues on the right), built from the OmniTrack research platform. By default, the date is set to the current date and time of logging. For Q2 (activity) and Q3 (feeling), the user can select more than one label, and can add their own custom labels. The user scrolls to reach the remaining questions and the save button.

3.3 TEA Visualization

The **T**houghts-**E**motions-**A**ctivity **Visualization** (*TEA-Viz*; see Figure 2) displays all logged entry data for a user in a heatmap-like chart, and is designed to encourage users to reflect on associations between their TWS ratings, their feelings, and their activities. Although both the *TWS Logging App* and the *TEA-Viz* use the term "feeling" instead of "emotion", in this study, we use both terms loosely and interchangeably as is often done in everyday use; even though there are nuanced differences [105]. The visualization runs on a web browser (accessible on mobile or desktop), and is separate from the *TWS Logging App*.

The Y-axis row labels are grouped into 3 sections: TWS, Feelings, and Activities – these correspond to Q1, Q3, and Q2 from the logging app (see Figure 1), respectively. The actual labels themselves are answers to the questions. The X-axis represents time and includes both hour and day labels.

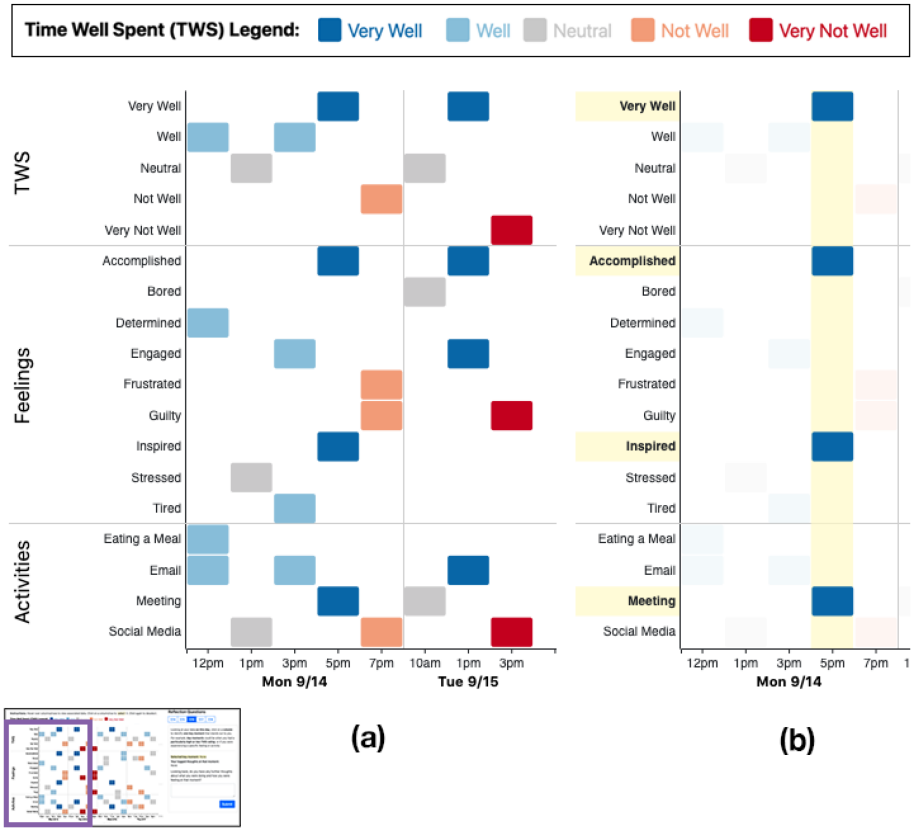

Fig. 2. (a) The default view of the *TEA-Viz* (screenshots are cropped, note the bottom-left mini-preview window). Each column represents one logged entry. Cells that are colored within a column represent logged answers from that one entry, and are color-coded according to that entry's TWS rating. (b) When the user selects a logged entry (e.g., here, the column for 5 PM on Monday), other columns are faded out, and row labels are highlighted to emphasize associated TWS ratings, feelings, and activities.

Each column in the *TEA-Viz* represents one logged entry. Colored cells within a column represent answers that were chosen for that logged entry. For example, in Figure 2(b), the selected logged entry at 5 PM on Monday is one where the user rated how they spent their time as "Very Well" (dark blue; colors map from dark blue to dark red, where dark red is "Very Not Well"), where they felt "Accomplished" and "Inspired", and where they were in a "Meeting". All cells within a column are given the same color based on the TWS rating. The logged data is encoded in this way to draw attention to the associations between a user's TWS ratings, feelings, and activities.

Users can interact with *TEA-Viz* by clicking on either a column or a row to select a logged entry or a row label (see Figures 2(b) and 4, respectively). When a row label is selected, only logged entries that include that row label are fully opaque and in focus. For example, if "E-mail" is selected as a row label, only logged entries where "E-mail" was one of the logged activities are opaque (the other entries are faded, see Figure 4). This allows users to get a sense of longer-term patterns or outliers of associated feelings, activities, or TWS ratings. In the "E-mail" example, a user might see that email is mostly time well spent, based on the number of blue-colored cells, and get a sense of associated feelings when they check their email.

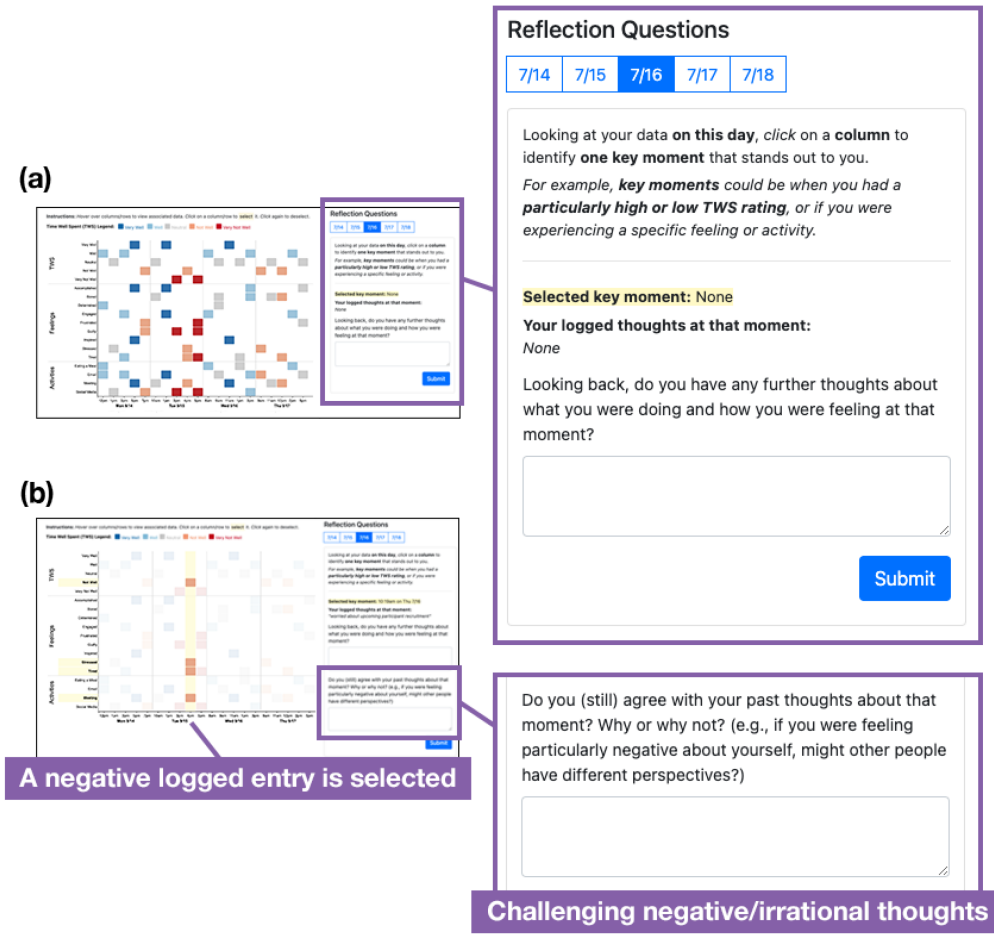

Fig. 3. (a) Users can access the daily reflection questions after filling out at least 5 logged entries for the day. This is what the user sees prior to selecting a logged entry. See Figure 2(a) for zoomed-in version of the *TEA-Viz*. (b) Shows after an entry has been selected. Because it is a negative entry (orange), the user receives an additional Socratic-style reflection question to challenge their thoughts around that negative moment.

3.4 Reflection Questions

To encourage engagement, the intervention includes daily, Socratic-style reflection questions positioned next to *TEA-Viz* (see Figure 3) that require users to look at and reflect on their own logged data to answer them. Users are asked on a daily basis to select and reflect on a "key moment" (i.e., a logged entry) during their workday. Key moments are described to participants as "moments when you had a particularly high or low TWS rating, or if you were experiencing a specific feeling or activity." Once a key moment is selected, *TEA-Viz* displays their logged thoughts (Q4) for that moment, and they are asked to further reflect and expand on them: *Looking back, do you have any further thoughts about what you were doing and how you were feeling at that moment?* This is a Socratic-style question that encourages clarification. If the moment selected by the user has a negative TWS rating, then they are further prompted to challenge their thoughts at that moment (i.e., to encourage alternative perspectives): *Do you (still) agree with your past thoughts about that moment? Why or why not? (e.g., if you were feeling particularly negative about yourself, might*

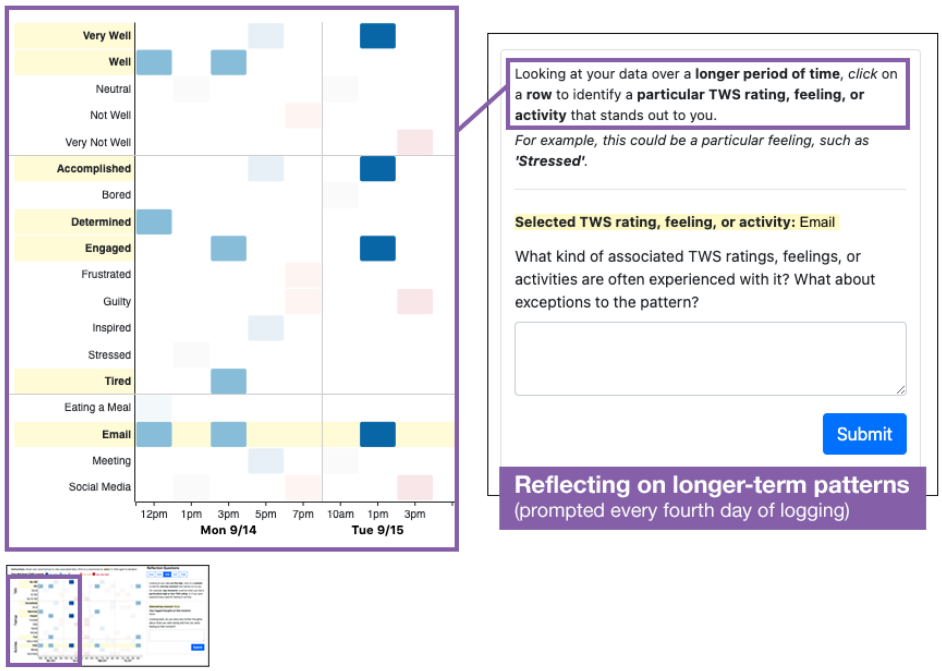

Fig. 4. Every fourth day of logging, an additional reflection question prompts users to reflect on possible longer-term patterns in their logged data by selecting a row of interest in the *TEA-Viz* (in purple enclosing box, see bottom-left for context in mini-preview window). When the user selects a row label (here, the Email row is selected), only logged entries that include that label are in focus. Associated row labels from all in focus logged entries are highlighted as well.

other people have different perspectives?) The wording of this Socratic-style "challenge" question specifically aims at facilitating cognitive reappraisal by encouraging users to consider alternative perspectives and to reframe negative emotional events [38].

Every fourth completed day in the logging phase (twice in total for each participant), users are also asked to reflect on longer-term patterns in their data (see Figure 4), by selecting a row label of interest (a specific TWS rating, activity, or feeling), and answering the following question: *What kind of associated TWS ratings, feelings, or activities are often experienced with it? What about exceptions to the pattern?* Although this particular reflection question is not a Socratic-style question, it is inspired by CBT's cognitive model [24] as it aims at bringing attention to the interconnected nature of the user's feelings and activities.

3.5 Implementation Details

The OmniTrack research platform and our *TEA-Viz* web app was set up on an Ubuntu 18.04.2 virtual machine (20 GB disk space, 4 GB RAM, 1 CPU) hosted on university servers. All logged data was stored on a MongoDB instance on the virtual machine. The *TEA-Viz* web app utilized the MEAN stack [6] and the D3.js library [29].

3.6 The Baseline Intervention

The *Baseline* intervention was designed to be a basic productivity-focused self-monitoring tool and was built using the same OmniTrack platform [77] as for the *Therapy-inspired* intervention. The mobile logging app for the *Baseline* intervention only asks participants to rate: (1) their

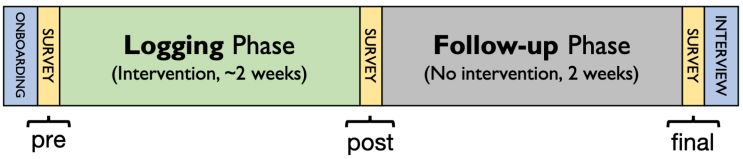

Fig. 5. Diagram of the study procedure. Participants were first onboarded to the study, engaged in 10 complete workdays of using either the *Therapy-inspired* or *Baseline* intervention, did not use the intervention for 10 workdays in a follow-up phase, and finally were asked about their study experiences in a wrap-up interview.

productivity, instead of how well their time was spent (TWS): *How productive were you during the past hour?*, and (2) what activities they were engaged in (equivalent to the activity logging in the *Therapy-inspired* intervention). The *Baseline* intervention does not include a corresponding visualization for "productivity", or any CBT-related elements, like the reflection questions.

We chose to include this basic, lightweight self-monitoring tool as a baseline so that we could compare how users' might respond to the use of the term TWS to "productivity", and also to account for the Hawthorne effect and the impact of regularly logging on time spent at work. We recognize that while there could be other approaches to a baseline, there is no perfect single option for a baseline condition in this study. For example, another approach would have been to include no intervention, or to take a more feature-rich approach in the design of the *Baseline* intervention to achieve closer parity to the *Therapy-inspired* intervention (e.g., such as by including classic productivity-based visualizations), which would have required additional design effort.

4 METHOD

We conducted a 4-week exploratory field evaluation, implemented entirely remotely, where we investigated the impact of our *Therapy-inspired* intervention alongside a *Baseline* intervention. The 4-week study duration was split into two phases: logging and follow-up, each lasting approximately 2 weeks (see Figure 5). The logging phase continued until 10 logging days were completed. Participants did not use the intervention during the follow-up phase and were instructed to continue to go about their workdays as usual. Surveys were administered before the logging phase (*pre*), after the logging phase (*post*), and at the end of the follow-up phase (*final*). Participants were assigned to one of two groups: *TWS* or *Productivity*, depending on if they used the *Therapy-inspired* or *Baseline* intervention, respectively. We conducted two rounds of pilot testing; the first round focused primarily on design iterations of the *Therapy-inspired* intervention, and the second round focused primarily on finalizing the details of the study procedure. Study instruments and additional data analysis are all provided in supplementary materials.

Overall, we referenced Guillou et al.'s [64] study in designing our study procedure and materials, to achieve a level of parity between studies. For example, the *TWS Logging App* and the equivalent in the *Baseline* intervention asked similarly worded questions regarding TWS rating and workday activities.

4.1 Participants

We recruited participants through public study recruitment platforms, online study mailing lists, and convenience sampling, such as through the research team's personal networks. To be eligible for the study, participants needed to be a graduate student enrolled full-time in a research-based program at a North American (US/Canada) post-secondary institution (REQ1); not take an extended (>3 days) holiday for the approximate 4-week study duration (REQ2); not be satisfied with

how they currently spend their time at work, and desire improvement in that area of their life (REQ3); own an Android phone (REQ4); and not have taken part in our pilot testing (REQ5).

We required participants to own an Android phone (REQ4) because the OmniTrack app only supports Android phones. We chose to only recruit research-oriented graduate students (REQ1) primarily for their ease of access as a convenience sample. We consider graduate students to be a unique subset of knowledge workers as they share many of the facets that make up a modern knowledge worker, such as flexible schedules, task autonomy, and frequent interactions with technology. However, they are also positioned in a distinct context of work compared to more traditional knowledge workers. There may also be benefits in picking a more homogeneous participant pool in graduate students, as (1) we have a clearer sense of the challenges they face in terms of managing their time, and (2) compared to a traditional knowledge worker, they may have greater time availability and willingness to participate in a research study.

REQ3 was based on our piloting which showed that this type of self-reflective intervention was more helpful for individuals who are dissatisfied with the way they spend their time. It's also known that engagement is critical in interventions involving self-monitoring, reflection, and in CBT itself [41, 42], so participants should have an active interest in self-improvement.

In total, we recruited 31 participants who met our eligibility requirements. Three participants (*Productivity* = 1, *TWS* = 2) dropped out; two participants mentioned deadlines or shifting work contexts as reasons for dropping out and one did not respond to our request to explain why they dropped out. Four participants (*Productivity* = 2, *TWS* = 2) were excluded for non-compliance, leaving 24 participants (woman = 17, man = 7, non-binary = 0) for analysis, 12 in each group. There was a balanced distribution of gender in each group (woman: *Productivity* = 9, *TWS* = 8; man: *Productivity* = 3, *TWS* = 4). Participants were excluded for non-compliance if there were four continuous days without any logged entries, or if the total length of their logging phase exceeded 28 days before they completed 10 days of the required logged entries of 5 per day. Participants were pursuing graduate degrees in diverse fields, such as Civil Engineering, Electrical Engineering, Bioinformatics, Education, Clinical Psychology, Computer Science, History, and Sociology. Participants were compensated with $50 CAD for their involvement in the study. We refer to participants in the *Productivity* and *TWS* groups as P_x and T_x, respectively.

4.2 Procedure

Participants were onboarded to the study with an initial 30-minute remote Zoom call with the primary researcher (to comply with physical distancing COVID-19 pandemic requirements), where they were given an overview of the study, installed the mobile logging app and (*TWS* group only) logged into the *TEA-Viz* website. Part of the installation process for the mobile app included customizing the time range for when participants would receive reminder notifications to fit their primary working hours. Participants were familiarized with using all aspects of their assigned intervention. They completed the pre-intervention survey as soon as possible after the onboarding session.

The logging phase began the day after the pre-intervention survey was filled out and lasted until participants completed 10 logged workdays. This gave participants approximately one work week to get acclimated to logging with the interventions at work and another week of regular use. In order for a day to be counted as complete, participants needed to log at least five entries per workday on the mobile app and (*TWS* group only) answer the daily reflection questions on the visualization website. If a day was not complete, it did not count toward the 10 logged workdays, extending the logging phase. Workdays were not limited to weekdays; participants were free to log during weekends if they chose to do so, accounting for the flexible work schedules of graduate students. Participants filled out the post-intervention survey the day after the logging phase and

were asked to no longer use the intervention for two weeks in the follow-up phase while working as usual (all were compliant). We included the follow-up phase so that participants had time to reflect further on their experience with the intervention, and to be able to compare their time at work with the intervention (logging phase) and without it (follow-up phase). They then filled out the final survey and engaged in a 20-minute wrap-up Zoom call for a semi-structured interview and debriefing with the primary researcher. Interviews were audio-recorded and transcribed for further analysis. The study was reviewed and approved by our university's ethics board, and all participant data was pseudonymized and securely stored on university servers.

4.3 Data Collection

Given the exploratory nature of the study, we focused on qualitative data derived from: (1) the *pre*, *post*, *final* surveys, and (2) the semi-structured interview.

4.3.1 Surveys. In all three surveys, participants defined their personal concept of what it means to be "productive" (*Productivity* group) or what it means to "spend your time well" (*TWS* group), in the *context of the workday*. We explicitly avoided using terms that may bias participant definitions in all our study materials, such as "productive" (only possible to avoid for the *TWS* group) or "holistic". They also listed their top three productive or TWS (positive) activities and their top three unproductive or not TWS (negative) activities. In the *post* and *final* surveys, participants were also asked to compare their responses to the above open-ended questions from the previous surveys and elaborate on any differences. *TWS* group participants were asked additional open-ended questions about their experiences with the intervention and its design. In addition, they rated the usefulness and effortfulness of both individual components of the *Therapy-inspired* intervention (mobile logging app and visualization) and also as a whole.

4.3.2 Semi-structured Interview. Participants were asked to elaborate on the impact of their study experience. Specifically, we were interested in any self-reported changed awareness, beliefs, or behaviors and probed on the nature of and reasons behind any described changes. We sometimes asked participants follow-up questions based on their survey responses, such as to expand on why their TWS definition had changed. Participants were also asked design-specific questions about their respective intervention, such as if there were missing features, or ones that were most/least helpful. For *TWS* group participants, questions were also centered around their reactions to CBT-inspired aspects of the *Therapy-inspired* intervention, such as the logging of thoughts and emotions.

4.3.3 Intervention Logged Entries. Although logged entry data from the interventions was collected as part of the study, they were not designed for quantitative analysis or to capture signs of behavior change. For the *TWS* group, this also included their responses to the daily reflection questions from the visualization. Rather than for analysis, both sources of data were really intended for the participant to use for self-monitoring and reflection. We checked the data for compliance and quality, to ensure that participants were making meaningful entries. Logging is a core practice of CBT and logs can be used by therapists to evaluate client progress, but we did not expect any signs of behavior change in the logged data over the short 2-week logging phase. Where appropriate, we included limited analysis from the logged entry data to help contextualize our findings, but readers should be wary of interpreting this data as behavior change.

Similarly, for comprehensiveness, we also included several quantitative measures in the repeated surveys, such as perceived productivity, satisfaction, and well-being scales (e.g., K-10 [17]) to explore possible impacts across interventions and time points, but we also did not anticipate nor

observe any significant effects ($\alpha = .05$) given the small sample size and short study duration. The data from these scales are included in supplementary materials.

4.4 Data Analysis

Interview transcripts and open-ended survey responses were analyzed using the Braun and Clarke approach to reflexive thematic analysis [30]. Themes were identified via both an inductive and deductive approach. Three members of the research team first independently coded a subset (6/24) of the data to discuss and generate preliminary codes. Once an initial level of understanding among the coders was reached, the remainder of the participants were coded by one member of the research team, who had also conducted all of the interviews. Throughout the entire analysis process, the research team continued to meet frequently and regularly to review our codes, discuss different interpretations, and introduce alternative perspectives, making sure that our interpretations were coherent, reasonable, and consistent with the data. Specifically, for TWS or productivity definitions in the surveys, two independent coders (the main interviewer and one other research team member) went through the entire dataset. We did not calculate inter-rater reliability, instead choosing to use multiple coders to achieve "crystallization" [53]. Our data collection and analysis process was recursive: the research team moved back and forth between discussing interpretations, coding the data, categorizing the codes, and iterating on the semi-structured interview questions. Although we reported participant counts per theme, we acknowledge (in line with Braun and Clarke [30]) that there are limitations to this convention for representing prevalence, as counts do not account for the strength to which a particular participant may be articulating a theme.

4.4.1 Researcher Positionality and Reflexivity. We reflect on our positional stance as researchers to further contextualize the process and lenses in which we viewed the data analysis. Throughout the analysis process, members of the research team reflected, discussed, and shared our own working experiences, our personal concepts of productivity and TWS, and encounters with existing productivity tools. The research team consists of one graduate student, one undergraduate student, and the other members are professors. With the exception of the undergraduate student, all members of the team would be considered knowledge workers. Additionally, two of the authors are professors and researchers in occupational therapy and have significant expertise with CBT research and clinical practice. All authors hold the view that a holistic approach to work that accounts for both well-being and productivity is needed, and practice that in their own work. We also acknowledge that our attitudes toward work, productivity and designing worker support tools are influenced by our position as researchers in a Western academic institution.

5 FINDINGS

First, we describe usage statistics and overall reactions to the *Therapy-inspired* and *Baseline* interventions to contextualize the findings. Then, we delve into the four main themes we conceptualized from the data, which focus on exploring the potential impact of the *Therapy-inspired* intervention: (1) Shifts in Definitions of TWS and Productivity, (2) Emotion-Activity Relationship Awareness, (3) Reframing Negative Moments and Emotions, and (4) Broader Contextual Nature of TWS. We conclude this section with participant-suggested refinements to the *Therapy-inspired* intervention.

As we were most interested in the impact of the TWS- and CBT- inspired features in the *Therapy-inspired* intervention, our findings here primarily focus on the experience of the *TWS* group. Many of the insights from the *Productivity* group replicate existing findings around the impact of self-monitoring tools for productivity, such as increasing awareness around when they were productive or unproductive during their primary working hours and feeling stressed to log that they produced something each hour [76, 95, 121].

5.1 Intervention Usage Statistics

Overall, participants in both groups actively used their respective intervention. Participants in the *TWS* group spent an average of 16 days (SD = 4.14, including weekends or incomplete days) in the logging phase, whereas the *Productivity* group spent an average of 17 days (SD = 5.40). *TWS* group participants, on average, entered 61 logged entries (SD = 11.07). Interestingly, we saw that the *Productivity* group participants, on average, entered more logged entries per participant, average 77 (SD = 10.87). Although participants were only required to log at least 5 entries in order for a day to be counted as complete, we posit that the decreased number of logging questions for the *Baseline* intervention relative to the *Therapy-inspired* intervention may account for why most *Productivity* group participants tended to log more than the required 5 entries each day, as it was less effortful to do so. This is supported by the data on time taken to complete a logged entry for participants in each group, as the *Productivity* group participants took an average of 13.06 seconds (SD = 8.25, min = 3.42, max = 54.83) to log an entry, whereas *TWS* group participants took 45.73 seconds (SD = 24.34, min = 9.48, max = 183). Outliers were removed using the interquartile range method [118] (87 outlier times removed in *Productivity* group and 59 in *TWS* group). We did not record the time that *TWS* group participants spent on the *TEA-Viz* and on answering the accompanying reflection questions as there are challenges with isolating when participants may simply be viewing the visualization and when they may be engaging in reflection through the questions.

5.2 Overall Reactions to the *Therapy-inspired* and *Baseline* Interventions

All *TWS* group participants reacted positively to the *Therapy-inspired* intervention as a whole, stating that it helped them be more aware of how they spent their time (T_1, T_3, T_4, T_7, T_8, T_{12}) and that it kept them motivated and more accountable to work (T_2, T_5, T_6, T_9, T_{10}, T_{11}). For example, T_4 mentioned how the intervention impacted their awareness of their productivity: "I realized that certain activities I was doing within the hour affected my focus and overall productivity, and so it highlighted things that I needed to remove from my day, and gave me insight as to things that I needed to do to ensure that I was productive." T_1 also elaborated on the additional impact of the *Therapy-inspired* intervention on their mental health as a graduate student: "It was actually more helpful to deal with the grad student imposter syndrome anxiety that comes, so I spent less time feeling guilty because I didn't do work."

Similarly, almost all (10/12) *Productivity* group participants (P_1, P_2, P_3, P_4, P_5, P_6, P_7, P_8, P_9, P_{12}) said that the intervention increased their awareness of time spent during their workday: "It made me more aware of where I was spending my time. I realized that some days I overworked and did a lot of work and some other days I was just being lazy and not doing anything, like doing more grocery shopping, cooking, which are not productive at all" (P_8).

A couple of *Productivity* participants were more negative, stating that using the intervention did not lead to any major changes or impact (P_3, P_9, P_{10}, P_{11}). Further, although their awareness increased, P_3 and P_9 did not feel that the intervention had an impact on their productivity: "I don't think the two weeks that I spent logging my activities were particularly effective at making me be more productive" (P_9). By comparison, we did not hear any similar negative comments with the *Therapy-inspired* intervention.

5.3 Shifts in Definitions of TWS and Productivity

One of the key findings from the study was that reflecting on "Time Well Spent" through the *Therapy-inspired* intervention leads to a more holistic perspective on how you spend your time during your primary working hours compared to reflecting on "productivity". We saw this triangulated across codes of participants' personal definitions of TWS compared to "productivity", and

	Pre- intervention definitions	*Post*- intervention definitions
T_4	**How many tasks** have been completed on my to-do list. Also, the **quality of the work**, how well I was able to organise things so as to reduce major corrections or adjustments in future.	(1) **Mind-work connection**/focus level, (2) how quickly I accomplish tasks relevant to their size or difficulty level, and (3) **balance (work + breaks)**
T_5	The work must be **productive**, wherein key objectives are met consciously. The **output** is **measurable**, impactful and leads to gain in knowledge/ideas or helps **progress the task** at hand.	If I can complete the goals I set for myself during the day (**holistically**), for work, study, **personal development, mental and physical well being**, I consider it time well spent.
T_8	Time well spent is when I get work done, a.k.a. **check off stuff from my to do list** or find solutions to what is blocking my progress.	Time well spent is when work is moving along or when I'm taking a **deserved break**.
P_5	I define productivity as being **focused** on what I'm doing, and **moving forward with tasks** in a visible and timely way.	**Checking tasks off** a list, **completing** things, being **focused**.

Fig. 6. Examples of *pre* and *post* definitions from a subset of the *TWS* and *Productivity* group participants. Bolded orange text represents classic, work-output focused wording, whereas bolded blue text represents holistic, broader wording. Definitions are either of "Time Well Spent" or "productivity", depending on the participants' assigned group.

when we explicitly asked *TWS* group participants to compare the two terms. We note that our study's comparison of the terms "productivity" and "Time Well Spent" is imperfect, given that our conditions did not isolate the terms – our *Therapy-inspired* intervention included not only the term TWS but also the CBT-inspired features.

5.3.1 Half of TWS *Group Participants Shifted Toward a More Holistic Definition After using the Intervention.* Half (6/12) *TWS* group participants shifted their definition of "Time Well Spent" after using the intervention toward a more holistic one; whereas, only one *Productivity* group participant shifted their definition of "productivity" toward holism (see Figure 6 for notable examples of definition shifts). Participants' definitions of either "Time Well Spent" or "productivity" were coded deductively as we looked specifically for indicators of more classic notions of productivity – which are primarily work output related – compared to indicators of holistic definitions that include a consideration of emotions and well-being. Here we focus on reporting differences in definitions only between the *pre* and *post* time points, as this was the most indicative of the interventions' impact. We did not observe notable differences between definitions when we compared definitions between the *post* and *final* time points.

At the *pre* time point, *Productivity* group participants mostly (10/12) defined "productivity" in the classical sense, including elements of work output. For example, being productive meant "being able to check things off my to-do list for the day" (P_3). Only two participants had more holistic notions, considering their emotions in the workday (P_1) and taking appropriate breaks (P_{11}).

Similarly, at the *pre* time point, most *TWS* group participants (11/12) also defined "Time Well Spent" with a classic focus on work output, with three participants (T_5, T_9, T_{12}, see Figure 6) even using the term "productive" in their definitions of "Time Well Spent". Only T_{10} considered the role of emotions before the intervention: "My main criteria are did I feel like I was working on things that move me forward, whether that's emotionally or toward a concrete goal."

However, at the *post* time point, we began to see differences in how participants in the *TWS* and *Productivity* groups define their respective terms. Only one *Productivity* group participant,

P_{10}, appeared to shift their definition away from a classic one focused on work output: "It does not necessarily have to be just work stuff (even things like cooking a new recipe, shooting a new roll of film...)." However, when asked to compare their own *pre* and *post* definition themselves, P_{10} explained that there was "not much of a change... I doubt things like this can change over the course of two weeks." P_1 and P_{11}, who already had holistic definitions of "productivity" in the *pre* time point, remained unchanged in their definition.

By contrast, for the *TWS* group, 6/12 (T_1, T_2, T_4, T_5, T_7, T_8) participants shifted toward more holistic definitions of "Time Well Spent" after using the *Therapy-inspired* intervention. In particular, we see in Figure 6 that T_5, who had originally used "productive" in their previous definition, now defined TWS using the term "holistically". The use of both "productive" and "holistic(ally)" by T_5 was completely unprompted. Other participants also began to include time spent taking breaks (T_4, T_7, T_8, T_{10} – who retained their already holistic perspective across *pre* and *post*) and the role of their feelings (T_2) as part of their TWS definition. All six participants also self-reported changes when asked to compare their own *pre* and *post* definitions, corroborating our coded shifts toward more holistic definitions.

5.3.2 TWS is Broader and Rated Differently than Participants would Rate Productivity. After conducting the first few interviews, some *TWS* group participants recounted unprompted that their ratings for logged entries would have been different had they been asked to rate on productivity. Thus, we explicitly asked the remaining *TWS* group participants to describe whether or not they would have rated entries differently or similarly, if they were asked to rate on productivity, instead of TWS, *in the context of a workday*. Here, 6/10 participants (T_3, T_4, T_7, T_8, T_9, T_{10}) stated that they would rate the two terms differently, giving examples of TWS but not productive activities, such as "reading a book" (T_7), "time with your family" (T_{10}), "exercising and going outside" (T_8), or "meditation" (T_9). Although these examples would not be considered work-related activities, it is notable that participants chose to mention them as examples of TWS activities that they may engage in during their primary working hours. Analyzing the logged entry data for the default activity labels (i.e., Eating a Meal, Social Media, Meeting, and Email, the latter two are work-related activities while the former are non-work) also triangulates this finding. For "Eating a Meal", a non-work activity, the mean TWS rating across all *TWS* group participants is 3.02 ($SD = 0.68$, $n = 109$) but only 2.66 ($SD = 0.86$, $n = 173$) for the *Productivity* group (higher ratings are more TWS or more productive, on a 5-point Likert scale). A Mann-Whitney U-test showed that this difference was statistically significant ($U = 10967.0$, $p = .0145$), suggesting that *TWS* group participants tended to rate "Eating a Meal" higher in TWS than *Productivity* group participants did with productivity. There were no other statistically significant differences ($\alpha = .05$) for the other default activity labels.

In particular, T_{10} appreciated the use of TWS instead of productivity, especially during the COVID-19 pandemic: "It would not have been the same. I was really glad you were asking about Time Well Spent rather than productivity. For me, productivity is pretty loaded right now – it's got a lot of buzz words, and lots of people are talking about it in the news, and I feel like it can end up being like a cudgel. Also, I think it is part of some pretty destructive patterns in how we work right now... I'm not sure if I would have said that the time I spent mentoring people was productive, because it wasn't related to my research, but it was time that I felt good about, and that energized me, and I wouldn't want to remove that from my schedule."

4/10 *TWS* participants (T_1, T_5, T_{11}, T_{12}) would have rated the terms similarly. For T_1 and T_5, we suspect that this is because they also defined productivity broadly. T_1 said of productivity: "It's anything, any time when there is a task, of any nature, that needs to get done." They described examples of both productive and TWS activities as "going outside, meal prepping, getting groceries" (T_1), or "yoga" (T_5) which indicate a broader scope than classic work output-focused

conceptualizations of productivity. Unsurprisingly, T_{11} and T_{12}, who never shifted their definition of TWS toward a holistic one, viewed TWS and productivity in a similar work-output focused way. We did not ask *Productivity* participants to compare ratings against TWS, as we did not expect any meaningful differences given that it would have been their first time exposed to the new term. Guillou et al. [64] observed that knowledge workers needed more time to reflect on the term TWS in the context of their own work before being able to think about it in a deeper and more personal manner.

5.4 Emotion-Activity Relationship Awareness

After using the intervention, most *TWS* participants described an increased awareness of how their feelings impact their workday activities and vice versa. Notably, we also saw signs of how some participants were able to use this *emotion-activity relationship* awareness to better optimize their workdays to be more enjoyable and productive.

5.4.1 Almost All TWS *Participants Found Logging Emotions Helpful, and Most were Able to Connect their Emotions to their Activities.* Almost all *TWS* participants (11/12, only T_6 did not mention emotions) stated that they found emotion logging to be helpful in the context of the workday, even if it was novel (T_1, T_2, T_4, T_{11}, T_{12}) or difficult (T_8, T_{11}). For example, T_4 said that they had "...never really thought about connecting my feelings with my productivity and whatever I'm doing."

Specifically, 10 out of the 11 *TWS* participants (T_7 only mentioned general emotional awareness) explicitly described being aware of the *relationship* between their emotions and activities to be most helpful. Participants gave examples that demonstrated the bidirectional nature of this emotion-activity relationship: that how they feel will impact what they are doing, and that what they are doing can also impact how they end up feeling. T_1 stated: "If my mood is really down, I could have been working all day and it wouldn't have mattered, but that's just not true, right, like objectively." In the other direction, T_{10} also found from the *TEA-Viz* that they "got a lot of energy most of the time from interacting with people", recognizing that the activities they engaged in also affected how they felt.

5.4.2 Emotion-activity Relationship Awareness may Help Some Workers Optimize their Schedules for Enjoyability and Productivity. Six *TWS* participants (T_2, T_3, T_4, T_8, T_{10}, T_{12}) mentioned unprompted that their increased awareness of the relationship between their emotions and activities helped them better manage and optimize their workday schedules to be more enjoyable and productive. Referring to the *TEA-Viz*, T_4 summarized: "I saw visual representation connecting my feelings, activities, and how I spent my time. It helped me to adjust my structure during work hours."

T_{12} was able to try and do more enjoyable activities during the workday that they had previously not considered: "I was able to pick up on activities that I never really thought about that I didn't enjoy, and other activities that I really did enjoy that I didn't really think too much about beforehand as well... it made me want to do something that I would enjoy more." T_{10}, who realized they were energized by social activities, said that the intervention made them think: "How can I make the tasks that I need to get done more social, how can I involve more people?"

Aside from increasing enjoyment in their day, participants may have been also able to get more done by using their emotions to see what the best time to write emails was (T_8), or by carefully scheduling in activities that they knew could lead to negative emotions and impact the rest of the day, such as meetings (T_3). T_3 described what they learned from the *TEA-Viz*: "It was quite positive to see I really don't like meetings. So how can I approach meetings differently? I think that it's very important to realize which tasks that may have that negative impact on me and then try to approach them differently so that they don't affect the whole day... meetings that are randomly placed in the day aren't very helpful because it throws off my productivity."

5.4.3 A few Productivity *Group Participants Expressed a Desire for Emotions to be Considered.* Unsurprisingly, none of the *Productivity* group participants expressed increased emotional awareness after using the *Baseline* intervention. However, when queried about improvements to their intervention, both P_1 and P_6 expressed a desire for emotions to be considered in some way. For example, P_1 suggests with regards to the logging component of the *Baseline* intervention: "Maybe you could split productivity into physical productivity versus emotional productivity... I know that's not task-oriented, I'm not sure how to incorporate that, but something about my emotional or mental." P_6 also suggested an emotional component at the start of the day, such as "questions like how do you expect to handle being stressed today?" or "suggestions on how to improve your mood", saying that they "thought it would be a good way to make you realize how you're feeling because it does affect your work and how you perform in the day."

5.5 Reframing Negative Moments and Emotions

We saw signs across both *TWS* and *Productivity* group participants that logging led to increased awareness of unproductive moments, such as when they were distracted or taking breaks. For example, P_2 said that "using the app helped me see how much time I used not being productive, being on websites that are not related to work and getting distracted a lot" while P_3 said "I was super unproductive... and took a lot more breaks, I noticed." Inadvertently, this sometimes contributed to in the moment feelings of guilt, stress, or self-criticism. P_{11} mentioned how they "tended not to make an entry when I didn't do much", and "would feel guilty" whenever they realized they hadn't logged much for the day, while T_9 said that they "often felt guilty" about "breaks and personal project work" during their primary working hours. But, for many *TWS* group participants (T_1, T_2, T_3, T_4, T_5, T_7, T_9, T_{11}, T_{12}), reflecting afterward through the *TEA-Viz* led to a *reframing* of the moment toward a positive outcome: "It was two-prong, doing the hourly logging may have caused a negative reaction, but then the visualization was where I was able to reflect on why, and that led to positive reactions on the next day" (T_3). Four participants (T_1, T_7, T_9, T_{12}) also explicitly mentioned that the CBT-inspired reflection questions were helpful as their answers to those questions became reminders to "not be too harsh on myself" (T_7) and to be "more forgiving of myself" (T_1), suggesting that they too were engaging in the process of reframing their negative thoughts and emotions.

Three participants specifically went into detail about how the *Therapy-inspired* intervention had an impact in helping them feel less guilty about taking breaks (T_1, T_7, T_9). T_1 elaborates: "It had more of an impact on not feeling as guilty taking breaks. In the beginning, it did make me feel a bit more guilty, because I would just log – oh, I didn't do much this hour, but then over time when I actually reflected back and was sort of able to make the connections between my mood, my feelings and my productivity, that was helpful." T_7 explains how *TEA-Viz* helped them notice how they were able to work better after a break: "I saw that at that hour [when I took a break] I felt like I wasted my time, but after that the next few hours I was sitting there and doing my work... that square is red [not TWS], but the subsequent ones are fine."

At the end of the study, we see how T_9 has reframed their view of breaks, which they had previously expressed feeling "guilty" about, saying: "I think breaks are valuable. I recently started playing video games again in breaks. I think having a satisfying game where I can accomplish something has actually been time well spent as long as it doesn't go on too long." In particular, T_9 appreciated the reflection question that challenged their thoughts around a negative moment and encouraged alternative perspectives, saying: "Like someone from the outside would see, I have all these other external stressors going on. And so taking some breaks or time spent with meditation maybe in the end is overall time well spent. When I have the same kind of thought or feeling in the future, I'll take a step back or step up out of myself and think about the other factors going on in

my life." Notably, in this quote, we also see signs of how T_9 is learning the type of meta-cognitive skills that are emphasized by CBT [24].

We did not observe any attempts to *reframe* perceived-to-be negative moments during primary working hours from the *Productivity* group. Instead, a few participants mentioned that they reflected on their increased awareness of unproductive moments to try to figure out "what went wrong today" (P_8) and to identify "things that were hindering my ability to be productive" (P_2), or to think about "how can I eliminate distractions" (P_9), but did not change their perception of these negative moments.

5.6 Broader Contextual Nature of TWS

Our findings suggest that the participants in the *TWS* group, unlike those in the *Productivity* group, are more aware of and able to convey the impact of a broader range of contextual factors beyond work context, such as emotions and energy levels, on their TWS or productivity rating of an activity. This was gleaned by comparison of *TWS* and *Productivity* group participants' reflections on what activities were most and least TWS or productive.

Unsurprisingly, for both the *Productivity* and *TWS* group, shifts in their evaluation of workday activities as either productive or TWS, respectively, occurred because of the context of their work situation. Some examples of these changes in work context include upcoming deadlines (P_3, P_9, T_6, T_9), taking on a new role at work (P_4), taking new classes (T_8, T_{12}), or moving on to a different stage in their work (P_{10}, P_{11}, T_3, T_7). For example, P_3 explained that "peer reviewing articles" dropped out of their most productive activities list as it "...isn't due until the end of August [and] therefore was not the focus of my 2 weeks."

Unique to the *TWS* group was the inclusion of feelings and emotions as an *explanatory* contextual factor in whether or not time was well spent, corroborating findings from Guillou et al.'s [64] themes of TWS (i.e, "how I feel"). Participants often used their feelings as a rationale for assessing TWS for an activity. For example, T_{12}, who experienced a shift in work context (e.g., a new class), additionally mentioned their enjoyment of the activity as a factor: "I started a class in the last 2 weeks which I'm not enjoying, so added that to the list [of least TWS activities]." T_{10}, who realized through the study that they enjoyed social activities, stated: "Recognizing the importance of working with people, for me, was useful. I knew that before but I didn't think it would influence my [TWS] ratings so much." In particular, T_1 was able to see through the *TEA-Viz* that fluctuations in their own emotional state may even impact how *the same activity* is rated: "Logging X activity as time very well spent one day, and then not well spent another day made me realize the role my emotions have to play in how I perceive the quality of my time spent. The visualization really helped with that."

Closely related to feelings is how *TWS* participants' energy levels contextually impacted what was considered TWS. T_7 realized that at times, taking breaks is better than trying to power through: "When I take a break and go for a walk for an hour and come back, I feel more refreshed. As opposed to spending four hours trying to read something and then nothing sticks." In particular, when asked if they would consider breaks as TWS, T_{12} describes that *it depends on their energy levels*: "Sort of - yes and no. If I get to that point I know that I really need the rest, taking the time off enables me to do future work. I would rather not do it, but there are points when I need to."

By contrast, a few *Productivity* group participants mentioned that breaks from work were assessed as the least productive activity if they took up too much time; there was no mention of energy levels. For example, P_2 clarified how "extended breaks" were least productive, while P_9 described how taking a break to reply to a text message "seems harmless to reply right away, but then sometimes it turns into a 20 minute conversation." Only P_1 (who was one of the *Productivity* group participants that had a holistic view of productivity at the beginning of the study; see 5.3),

explicitly considered breaks as productive, adding that: "...if I'm less productive at certain times, I might as well just take a break then instead of trying to keep working." We note that P_1 did not mention their energy levels when it came to taking breaks (in contrast to T_7 and T_{12} above, who mention "feeling refreshed" and "really need[ing] the rest", respectively); rather, P_1 chose to frame their break-taking as a means to being more productive. This focus on productivity was echoed by P_7, who felt like they only deserved to take a break if they had completed enough tasks: "...look at your progress to decide whether or not you need to keep working or whether or not you can take a break." In short, these findings hint that *TWS* group participants included the broader contextual factor of energy levels when evaluating breaks as TWS or not, while *Productivity* group participants only mentioned classic productivity and work output as the context for break-taking.

5.7 Suggested Refinements to the *Therapy-inspired* Intervention

Overall, 7/12 *TWS* group participants said that they would consider continuing to use the *Therapy-inspired* intervention after the study, 2/12 would not, and 3/12 would only continue using the *TWS Logging App*. The two participants cited the mobile logging medium as the main reason for discontinuing usage, as they did not want to use their phone during the workday. When asked to rate on 5-point Likert scales of usefulness and effortfulness of both the individual components of the *Therapy-inspired* intervention (*TWS Logging App* and *TEA-Viz*) and also as a whole, the *TEA-Viz* scored lower on usefulness (M = 2.92, SD = 1.00, higher number means more useful) and higher on effortfulness (M = 2.58, SD = 1.38, higher number means more effortful) compared to the *TWS Logging App* (usefulness: M = 3.92, SD = 0.51, effortfulness: M = 2.08, SD = 1.24). The *Therapy-inspired* intervention *as a whole*, on average, scored 3.75 for usefulness (SD = 0.62) and 2.42 for effortfulness (SD = 1.00). We first outline possible refinements around the timing and delivery of logging, especially when logging thoughts. We conclude by discussing the lower usefulness and effortfulness ratings associated with the *TEA-Viz*, along with associated feature requests and usability improvements to the *TEA-Viz* that may inform future design iterations.

5.7.1 The Timing and Delivery of Logging is Critical, and Likely Needs to be Customizable. Logging was sometimes distracting for work due to its unpredictability (T_3, T_6), but especially helpful for some during non-typical days (T_1, T_4, T_5). T_5 says: "When it was out of the blue or if it was different from normal, it was very, very useful. For example, I had a job interview... thinking about my thoughts helped me pinpoint why I was feeling a certain way."

Five participants (T_1, T_2, T_3, T_4, T_9) found that sometimes there wasn't much to log with respect to their thoughts: "...at times I was out of words to express what I was feeling. I felt like the interface was pushing me too much to think about it, and that was very annoying." Logging thoughts did not work for everyone – in particular, T_8, who was "not someone who really enjoys writing down reflections", felt like it was "time consuming". Interestingly, T_1 mentioned how logging thoughts was "more useful in the beginning, before I had figured out the link between my thoughts and my emotions and my definition of TWS. After that it became like recalling, it became much easier to write." We suspect that we are seeing elements of learning here, suggesting that logging thoughts may be particularly relevant for individuals that are new to this type of reflection. The frequency of logging needed to explicitly induce reflection may be reduced as workers become more familiar with reflecting on their thoughts and emotions. Another option would be to allow workers to bypass parts of logging (e.g., not logging thoughts) at times. Such approaches may help alleviate aforementioned concerns around logging effort and frequency.

5.7.2 Challenges with the TEA-Viz *and Suggested Improvements.* Regarding the lower ratings for the *TEA-Viz*, participants disliked the overhead of accessing the two components on separate mediums (T_1, T_2, T_6, T_7, T_8, T_{10}, T_{12}), as the *TEA-Viz* was built for the web and optimized for desktop

usage instead of being integrated into the mobile *TWS Logging App*. In addition, answering daily reflection questions on the visualization may be considered too onerous for some knowledge workers, as participants were also mixed in their reactions to the accompanying reflection questions (T_4, T_8, T_{10}). For example, T_4 felt like the reflection questions were "useful, but they were the least exciting to complete", suggesting a possible need to tweak the frequency of the reflection questions or to rotate between differently-worded reflection questions for variety. Minor usability issues with the *TEA-Viz* may have also tempered user reactions to it. For example, several participants (T_6, T_8, T_{10}, T_{12}) expressed that the number of activity/feeling labels they added had grown too large that it became difficult to understand their data, suggesting a need for a method of managing the number of labels being displayed (e.g., dimensionality reduction). Participants also requested included additional analytic support for identifying insights from their data (T_2, T_4, T_8), such as the "percentage of time I felt 'down' while doing some activity" (T_2). Different time windows (e.g., within the day, or within the past three days, or the past week) for viewing their data could also help participants compare recent trends against longer-term patterns (T_1, T_9).

6 DISCUSSION

Our study suggests that our *Therapy-inspired* intervention may indeed be able to shift knowledge workers away from a narrow, classic work output-focused perspective toward a broader, more holistic perspective of their primary working hours (see 5.3). This is in contrast to our *Baseline* intervention, where no such shift was observed. This shift in perspective from the *TWS* group was accompanied by an increased emotion-activity relationship awareness as well as the reframing of negative moments during their primary working hours for some. Beyond the impact of the intervention, our findings may also extend Guillou et al.'s initial characterization of "Time Well Spent" [64] by highlighting its broader contextual nature (see 5.6). We discuss the significance of our findings and what we envision to be the future of worker support tools that holistically consider context (e.g., a worker's emotional state), and may even draw design inspiration from techniques and concepts from therapies like CBT.

6.1 How Our *Therapy-inspired* Intervention Shifts Workers Toward Broader, More Holistic Perspectives

A key outcome of the study is the shift in perspective of many of the *TWS* group participants toward a more holistic perspective of time at work, one that includes productivity as well as well-being. This shift in perspective can affect knowledge workers' mindsets about engaging in particular activities during the workday; for example, how much they might prioritize or de-prioritize the essential activity of "Eating a Meal" (see 5.3.2). Perspective shifts and increased awareness are well-studied precursors for behavior change, such as in the Theory of Planned Behavior [18] and the Transtheoretical Model of Behavior Change [106], respectively. Even in our study, we already see preliminary signs of how the CBT-based features in our *Therapy-inspired* intervention, such as the visualization and challenge reflection questions appeared to play a role in helping workers take a step beyond shifting perspectives toward behavior change. For example, participants described how our *Therapy-inspired* intervention helped them optimize their work-day for enjoyability and productivity through an increased awareness of the emotion-activity relationship (see 5.4.2). The challenge reflection questions also appeared to help reframe negative moments and emotions during the workday, specifically impacting a few participants in feeling less guilty about taking breaks (see 5.5).

Observing shifts in participants at the *individual* level was possible through the capture of both *pre-* and *post-* intervention data. Including the *Baseline* intervention further allowed our study to (albeit imperfectly) compare the impact of logging and reflecting on TWS (through our

Therapy-inspired intervention) versus doing so with "productivity" (*Baseline* intervention), suggesting that there was no shift in perspective with the *Productivity* group. Notably, these changes address a few limitations of Guillou et al.'s [64] work: first, without a comparison of TWS to the term "productivity", they left open the possibility that knowledge workers might define "productivity" in a similar manner as TWS after the week-long study; and second, that Guillou et al. [64] *only* elicited TWS definitions post-study, meaning that they did not know if their participants' definitions of TWS already exhibited signs of a holistic perspective of work even before the study.

Although we cannot directly tease apart whether the shift in perspective with the *TWS* group is due to the term TWS (in lieu of "productivity") or the CBT-based features, we believe there is some evidence that they both had an impact on participants. We elaborate on how the term TWS may have impacted participants in Section 6.2. Regarding the impact of the CBT-based features, some participants directly referred to the usefulness of the visualization (T_3, T_7) and the challenge reflection question (T_1, T_7, T_9). Without the inclusion of CBT-style questioning that challenge existing thinking, we speculate that for some individuals, it may have been harder to shift their perspectives around their time at work (i.e., their definition of TWS) simply through work-related logging and reflection. In general, CBT focuses heavily on changing and broadening perspectives, which prior work has shown to be difficult, especially if they are core beliefs [56, 70, 101]. Gini [61] argues that our perspective on work forms a core part of our identity as humans; of relevance to our work is Gini's mention of the "rise of workaholism" as one of the "critical problems that lie at the core of the contemporary work experience" [61].

An important nuance in our work is that our *Therapy-inspired* intervention attempts to encourage a broader, balanced, and holistic perspective that considers *both* well-being *and* productivity, not just a well-being focused perspective, which we posit may be just as narrow of a focus as a classic productivity focused perspective. For example, in most contexts, we do not expect knowledge workers to consider their time at work to be well spent if they spend so much of their workday on breaks that they consistently produce minimal work output. At the other extreme, failing to take breaks and feeling as though you must always be working will undoubtedly also lead to burnout in the long-term. This holistic perspective is critical given the increased prevalence of remote and work-from-home jobs due to the COVID-19 pandemic, which may be especially prone to blurred work-life boundaries [116]. In fact, we posit that because this perspective recognizes the need for well-being and non-work activities to sometimes take place during working hours, it could be better suited for helping navigate the complex, uncertain, and dynamic reality of the modern knowledge worker's workday. Many workers are already discussing flexible work arrangements going beyond the pandemic [31, 116], and a holistic perspective may help them better manage that newfound flexibility. Something as simple as acknowledging that non-work activities could, at times, be "Time Well Spent" during work hours may be powerful for reclaiming our relationship with work so we feel less bound by it [61].

6.2 Further Characterizing "Time Well Spent" and its Value in the Workplace

Our findings highlight the broader contextual nature of the term TWS, which extends and adds nuance to how knowledge workers might use Guillou et al.'s four main themes of TWS ("what I work on", "how I work", "how I feel", and "how I take care of myself") [64]. For example, would socializing with colleagues (an example of the subtheme of "social bonds" from Guillou et al.'s work [64]) always be considered TWS because it is part of one of the previously characterized components of TWS? What about when there is an imminent deadline? Would "punctuality" (subtheme from "how I work" [64]) take priority over "social bonds" in this context? Guillou et al.'s work [64] does not discuss this, and our findings only begin to reveal some of the contextual factors that knowledge workers might consider when it comes to what activities are TWS. Perhaps context

acts as a "decision-making layer" on top of all four of Guillou et al.'s themes [64] that impacts the priority of each subtheme at a given moment. Future work could explore this. Unlike "productivity", which is often bogged down by societal expectations and historical roots (e.g., to the factory workers of the Industrial Revolution), "Time Well Spent" is flexible. We posit this flexibility may have contributed to *TWS* group participants' shift in perspective. This flexibility therefore may empower workers to continue evolving and refining their personal concept of what it means to spend their time well.

Although some workers have already chosen to adopt more holistic definitions of productivity to adapt to the realities of today's work, many workers and work environments continue to abide by the classic, output-focused definition [61, 83]. This disparity between a holistic and classic approach may lead to clashing expectations for what is and isn't productive. Shifting the modern workplace toward a holistic perspective and away from narrow, classic productivity may lead to favourable and equitable outcomes for everyone. We note that we are not suggesting to replace the use of productivity with TWS entirely, but simply that emphasizing TWS and its more holistic nature in the workplace is valuable. For example, TWS explicitly considers the "work" of a parent with two young children, and says that making lunch for them, even during primary working hours, may indeed be TWS, and that one should not feel guilty if some flexibility in their schedule is needed to produce the same work output as an individual without caregiving responsibilities. By bringing TWS into the conversation, workplaces may reevaluate the importance of incorporating well-being into the work environment, such as by mandating regular breaks, instead of leaving the responsibility of balancing well-being and productivity solely to the workers themselves. In the section below, we discuss some of the challenges that such a perspective might induce and some practices that could help organizations embrace TWS.

6.2.1 Integrating TWS into Organizations. There are a number of challenges and considerations that remain in order for a holistic, TWS-based perspective of work to be integrated into organizations. Shifting a whole organization to adopt a more holistic perspective requires strong buy-in from executives and managers, especially as it may seem (at least on the surface) to clash with an organization's traditional focus on increasing the productivity of their workers. Such clashes are already present between employees and employers in the workplace today, as employers believe that employees are less productive when working remotely, despite self-reported data from employees showing otherwise [19, 31, 114]. In addition, some managers are even mandating that their employees install so-called "bossware", or monitoring tools, if they want to work remotely [15, 71]. These tools are often marketed to improve worker productivity, despite invasively tracking worker activity over impact, and without any context. Beyond disagreements in perspectives around work, power dynamics between individual managers and employees are an additional consideration that may dampen transparency and honesty around sharing about TWS, possibly leading to a continued emphasis on classic work output.

To foster this shift, leaders of companies need to first recognize that their employees' perspectives toward work have begun to change. In this era of the "Great Resignation" or "Great Reshuffle" [50], talented workers are increasingly quitting their existing jobs to seek new ones at organizations that value flexibility and worker well-being [114]. Adopting a more holistic, person-oriented perspective that strongly values worker well-being but jointly also classic notions of productivity may be the next competitive advantage for retaining and attracting talent [13, 14]. For managers who want to adopt this perspective with their employees, it begins with modeling their own work behavior to signal that their focus is on spending their time well at work, and not simply to be productive all the time. This might mean taking appropriate breaks, valuing social connection, and encouraging flexible ways of working.

Additional examples of concrete practices include creating TWS-centered reflective questions or checklists for managers during check-ins or annual "performance" reviews with their employees. These checklists, rather than focused solely on performance or productivity metrics, could explicitly include questions on mental health or general well-being. Future psychometric research could help develop validated checklists that take a holistic perspective. Even so, care needs to be taken to ensure a psychologically safe environment [52] so that employees feel empowered and secure to be honest with their manager about assessing their own TWS in these mediums. To foster a psychologically safe environment, managers may need to undergo increased emotional intelligence training, or to also model psychological safety by being the first to admit work-related mistakes, or by vulnerably sharing about challenges they may be facing both in and outside of work.

6.3 Envisioning Future Worker Support Tools and Interventions

Our *Therapy-inspired* intervention may provide valuable inspiration for future worker support tools and digital workplace interventions. Future tools should consider incorporating concepts from therapy into the workplace, as well as capturing and including context (i.e., one's emotional state).

Beyond encouraging broader, more holistic perspectives of work, therapy-inspired elements may also help knowledge workers become more aware of and better navigate their internal emotional and cognitive states during their primary working hours. There is growing evidence that workers who can effectively manage their emotional and cognitive states experience *holistically* better productivity and well-being outcomes. For example, studies on procrastination posit that it is more of an emotional regulation problem than a time management one [51]. Many current tools, however, tend to focus on the *symptoms* of procrastination, such as by blocking distractions [80], but fail to address the root cause, which may be more deeply tied to one's emotional and cognitive state [66, 108, 119, 124]. Workplace stress studies have also demonstrated the benefits of adopting a "positive stress mindset" [34, 44].

One approach might be to pose questions to knowledge workers to specifically challenge their existing thought patterns at work, especially those that might be unhelpful. For example, a common thought associated with upcoming deadlines is that "I can't afford to take a break". Future tools could consider addressing this thought in a similar manner as human therapists by showing targeted subsets of data (e.g., showing "visual cuts" of the hours before and after a break) to challenge this unhelpful thought, building upon prior work in personal informatics [54]. Other approaches could employ natural language processing techniques on workers' thoughts to support the user in identifying unhelpful patterns or beliefs, or cognitive distortions [23]. In the marketplace, Microsoft Viva [3] already includes a "virtual commute" for workers to log and reflect on end-of-workday feelings, as well as mindfulness features to reduce stress.

As our findings suggest, context – including but not limited to one's emotions and energy levels – can impact how a knowledge worker decides if an activity is TWS or not. What if time-tracking tools like RescueTime [9] can classify taking a break as TWS when the worker is clearly too tired to continue working? However, there are unresolved challenges in tracking a worker's internal state (e.g., emotions or thoughts). Automatic emotion classification approaches can reduce the effort of manual logging, but suffer from a "lack of consensus on a definition of emotions" [28], privacy issues, potential for misuse, and difficulty in generalizing across populations and contexts [72]. Semi-automatic logging [37] may be promising to support capture of complex, nuanced emotions like "guilt", while moving away from relying on automatic, sensor-based approaches as "ground truth", but as an additional data stream to support workers in their emotional self-reflection. Fully manual logging may still be appropriate and necessary for more intensive, time-limited workplace interventions (e.g., CBT is intended to be time-limited as well); logging frequency could be diminished as workers become more aware or learn the necessary skills.

6.4 Limitations

Our inclusion of the *Baseline* intervention alongside our *Therapy-inspired* intervention was an imperfect comparison. For example, there was no equivalent visualization component for the *Baseline* intervention, making it difficult to tease apart the impact of individual components of the *Therapy-inspired* intervention, like the visualization, from the overall intervention itself. Along these lines, one could add more comparison groups to isolate the impact of the terminology, such as by having one group use the same *Therapy-inspired* intervention, except replacing all mention of TWS with "productivity".

Although graduate students in research-oriented programs can be considered a unique subset of knowledge workers, there are important differences in the context and nature of their work compared to more traditional knowledge workers at companies (e.g., incentives to be productive likely differ), an opportunity for future work and a point to consider in the generalizability of our findings. A next step is a more formal, controlled study that includes larger, diverse sample sizes, quantitative measures and longer intervention and follow-up periods. A longer time frame may help investigate whether or not the impact of the *Therapy-inspired* intervention is stable over time and has lasting effects on behavior change.

7 CONCLUSION

In this study, we designed and demonstrated the feasibility of a holistic, *Therapy-inspired* intervention that implements key concepts from CBT. We ran an exploratory field evaluation to probe the impact of our *Therapy-inspired* intervention alongside a classic productivity-focused *Baseline* intervention. We found that *TWS* group participants shifted their perspective of what it meant to spend their time well during their primary working hours toward a more holistic one, and some were able to make use of their increased emotion-activity relationship awareness to better optimize their workdays. CBT-inspired features of our *Therapy-inspired* intervention, such as the reflection questions that challenged participants' negative thoughts, also allowed some participants to reframe their negative moments more positively. These findings suggest that a holistic approach, that strongly considers emotions in the workday and adopts techniques from cognitive behavioral therapy, has promise and is worth further investigating. Future work should consider more formal and clinically-based methods of evaluating our *Therapy-inspired* intervention, such as a randomized controlled trial involving validated metrics of well-being and productivity. Our *Therapy-inspired* intervention is an important step toward holistic tools that more fully support knowledge workers, focusing on well-being as well as productivity, mitigating the stress and burnout that are pervasive in this population today.

ACKNOWLEDGMENTS

We thank the anonymous reviewers, members of the UBC eDAPT Lab, and Mike Massimi for their valuable and insightful feedback. In particular, we would like to thank Tamara Munzner for their expert guidance on the visualization.

REFERENCES

[1] [n. d.]. CBT Diary – Apps on Google Play. Retrieved from https://play.google.com/store/apps/details?id=pl.com.continuum.cbtbasicemotionsdiary&hl=en_CA&gl=US

[2] [n. d.]. Employee Burnout Report: COVID-19's Impact and 3 Strategies to Curb It. Retrieved from https://www.indeed.com/lead/preventing-employee-burnout-report

[3] [n. d.]. Employee Experience & Engagement | Microsoft Viva. Retrieved from https://www.microsoft.com/en-ca/microsoft-viva

[4] [n. d.]. Forest - Stay Focused, be Present. Retrieved from https://www.forestapp.cc

[5] [n. d.]. *Guided Meditation and Mindfulness - The Headspace App*. Retrieved from https://www.headspace.com/headspace-meditation-app

[6] [n. d.]. MEAN.JS - Full-Stack JavaScript Boilerplate From Creators of MEAN.IO. Retrieved from https://meanjs.org

[7] [n. d.]. MindShift CBT - Anxiety and Panic Relief - Apps on Google Play. Retrieved from https://play.google.com/store/apps/details?id=com.bstro.MindShift&hl=en&gl=CA

[8] TalkLife [n. d.]. *Peer Support Network For Mental Health - Support Group*. TalkLife. Retrieved from https://www.talklife.com

[9] [n. d.]. RescueTime: Automatic Time-Tracking Software. Retrieved from https://www.rescuetime.com/

[10] [n. d.]. Rise Up: Eating Disorder Help - Apps on Google Play. Retrieved from https://play.google.com/store/apps/details?id=com.rur&hl=en

[11] [n. d.]. *Sanvello | On-demand Help for Stress, Anxiety, and Depression*. Retrieved from https://www.sanvello.com/

[12] [n. d.]. WHO | Burn-out an "Occupational Phenomenon": International Classification of Diseases. Publisher: World Health Organization. Retrieved from http://www.who.int/mental_health/evidence/burn-out/en/

[13] 21. The Next Great Disruption Is Hybrid Work—Are We Ready? Retrieved from https://www.microsoft.com/en-us/worklab/work-trend-index/hybrid-work

[14] 21. To Thrive in Hybrid Work, Support Flexibility in Work Styles. Retrieved from https://www.microsoft.com/en-us/worklab/work-trend-index/support-flexibility-in-work-styles

[15] Ifeoma Ajunwa, Kate Crawford, and Jason Schultz. 2017. Limitless worker surveillance. 105 (2017), 735.

[16] Cecilie Schou Andreassen. 2014. Workaholism: An overview and current status of the research. *Journal of Behavioral Addictions* 3, 1 (2014), 1–11. DOI: https://doi.org/10.1556/JBA.2.2013.017

[17] G. Andrews and T. Slade. 2001. Interpreting scores on the kessler psychological distress scale (K10). *Australian and New Zealand Journal of Public Health* 25, 6 (2001), 494–497. DOI: https://doi.org/10.1111/j.1467-842x.2001.tb00310.x

[18] Christopher J. Armitage and Mark Conner. 2001. Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology* 40, 4 (2001), 471–499. DOI: https://doi.org/10.1348/014466601164939

[19] Marcus Ash, Kagonya Awori, Nancy Baym, Mia Bruch, Jenna Butler, Piali Choudhury, Adam Coleman, Scott Counts, Shiraz Cupala, Mary Czerwinski, Ed Doran, Elizabeth Fetterolf, Mar Gonzalez Franco, Kunal Gupta, Aaron Halfaker, Constance Hadley, Brent Hecht, Brian Houck, Kori Inkpen, Shamsi Iqbal, Sonia Jaffe, Eric Knudsen, Stacey Levine, Siân Lindley, Jennifer Neville, Jacki O'Neill, Kate Nowak, Rick Pollak, Victor Poznanski, Sean Rintel, and Abigail Sellen. [n. d.]. Microsoft new future of work report 2022. ([n. d.]).

[20] American College Health Association National College Health Assessment. 2019. *Graduate/Professional Reference Group Executive Summary, Spring 2019*.

[21] Arianna Balkeran. 2020. Hustle culture and the implications for our workforce. *Student Theses and Dissertations* (June 2020).

[22] Hazel Bassett and Chris Lloyd. 2001. Occupational therapy in mental health: Managing stress and burnout. *British Journal of Occupational Therapy* 64, 8 (2001), 406–411. DOI: https://doi.org/10.1177/030802260106400807

[23] Aaron T. Beck. 1963. Thinking and depression: I. idiosyncratic content and cognitive distortions. *Archives of General Psychiatry* 9, 4 (1963), 324. DOI: https://doi.org/10.1001/archpsyc.1963.01720160014002

[24] Judith S. Beck. 2011. *Cognitive Behavior Therapy: Basics and Beyond*, (2nd ed.). Guilford Press, New York, NY. Pages: xix, 391.

[25] Judith S. Beck. 2020. *Cognitive Behavior Therapy: Basics and Beyond*, (3rd ed.). Guilford Publications.

[26] Silvia Bellezza, Neeru Paharia, and Anat Keinan. 2017. Conspicuous consumption of time: When busyness and lack of leisure time become a status symbol. *Journal of Consumer Research* 44, 1 (2017), 118–138. DOI: https://doi.org/10.1093/jcr/ucw076

[27] Tayo Bero. 2022. 'Quiet quitting?' Everything about this so-called trend is nonsense. *The Guardian* (2022).

[28] Sarah Bird. 2022. Responsible AI Investments and Safeguards for Facial Recognition. Retrieved from https://azure.microsoft.com/en-us/blog/responsible-ai-investments-and-safeguards-for-facial-recognition/

[29] Mike Bostock. [n. d.]. D3.js - Data-Driven Documents. Retrieved from https://d3js.org/

[30] Virginia Braun and Victoria Clarke. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology* 3, 2 (2006), 77–101. DOI: https://doi.org/10.1191/1478088706qp063oa Publisher: Routledge_eprint: https://www.tandfonline.com/doi/pdf/10.1191/1478088706qp063oa

[31] Jenna Butler and Sonia Jaffe. 2021. Challenges and gratitude: A diary study of software engineers working from home during Covid-19 pandemic. In *Proceedings of the 2021 IEEE/ACM 43rd International Conference on Software Engineering: Software Engineering in Practice*. IEEE, Madrid, ES, 362–363. DOI: https://doi.org/10.1109/ICSE-SEIP52600.2021.00047

[32] Per Carlbring, Gerhard Andersson, Pim Cuijpers, Heleen Riper, and Erik Hedman-Lagerlöf. 2018. Internet-based vs. face-to-face cognitive behavior therapy for psychiatric and somatic disorders: An updated systematic review and meta-analysis. *Cognitive Behaviour Therapy* 47, 1 (2018), 1–18. DOI: https://doi.org/10.1080/16506073.2017.1401115

[33] Stephany Carolan, Peter R. Harris, and Kate Cavanagh. 2017. Improving employee well-being and effectiveness: Systematic review and meta-analysis of web-based psychological interventions delivered in the workplace. *Journal of Medical Internet Research* 19, 7 (2017), e271. DOI: https://doi.org/10.2196/jmir.7583

[34] Anne Casper, Sabine Sonnentag, and Stephanie Tremmel. 2017. Mindset matters: The role of employees' stress mindset for day-specific reactions to workload anticipation. *European Journal of Work and Organizational Psychology* 26, 6 (2017), 798–810. DOI: https://doi.org/10.1080/1359432X.2017.1374947

[35] Prerna Chikersal, Danielle Belgrave, Gavin Doherty, Angel Enrique, Jorge E. Palacios, Derek Richards, and Anja Thieme. 2020. Understanding client support strategies to improve clinical outcomes in an online mental health intervention. (Feb. 2020). Retrieved from https://www.microsoft.com/en-us/research/publication/understanding-client-support-strategies-to-improve-clinical-outcomes-in-an-online-mental-health-intervention/

[36] Janghee Cho and Stephen Voida. 2020. Envisioning new productivity tools for domestic information work environments. (2020), 8.

[37] Eun Kyoung Choe, Saeed Abdullah, Mashfiqui Rabbi, Edison Thomaz, Daniel A. Epstein, Felicia Cordeiro, Matthew Kay, Gregory D. Abowd, Tanzeem Choudhury, James Fogarty, Bongshin Lee, Mark Matthews, and Julie A. Kientz. 2017. Semi-automated tracking: A balanced approach for self-monitoring applications. *IEEE Pervasive Computing* 16, 1 (2017), 74–84. DOI: https://doi.org/10.1109/MPRV.2017.18 Conference Name: IEEE Pervasive Computing.

[38] Gavin I. Clark and Sarah J. Egan. 2015. The socratic method in cognitive behavioural therapy: A narrative review. *Cognitive Therapy and Research* 39, 6 (2015), 863–879. DOI: https://doi.org/10.1007/s10608-015-9707-3

[39] Derek Clements-Croome and Yamuna Kaluarachchi. 1999. Assessment and measurement of productivity. In *Proceedings of the Creating the Productive Workplace*. CRC Press, 151–188.

[40] Thomas W. Colligan and Eileen M. Higgins. 2006. Workplace stress. *Journal of Workplace Behavioral Health* 21, 2 (2006), 89–97. DOI: https://doi.org/10.1300/J490v21n02_07

[41] Emily I. M. Collins, Anna L. Cox, Jon Bird, and Cassie Cornish-Tresstail. 2014. Barriers to engagement with a personal informatics productivity tool. In *Proceedings of the 26th Australian Computer-Human Interaction Conference on Designing Futures: The Future of Design*.Association for Computing Machinery, New York, NY, 370–379. DOI: https://doi.org/10.1145/2686612.2686668

[42] Emily I. M. Collins, Anna L. Cox, Jon Bird, and Daniel Harrison. 2014. Social networking use and RescueTime: The issue of engagement. In *Proceedings of the 2014 ACM International Joint Conference on Pervasive and Ubiquitous Computing: Adjunct Publication*. Association for Computing Machinery, New York, NY, 687–690. DOI: https://doi.org/10.1145/2638728.2641322

[43] David Coyle, Gavin Doherty, Mark Matthews, and John Sharry. 2007. Computers in talk-based mental health interventions. *Interacting with Computers* 19, 4 (2007), 545–562. DOI: https://doi.org/10.1016/j.intcom.2007.02.001 Publisher: Oxford Academic.

[44] Alia J. Crum, Modupe Akinola, Ashley Martin, and Sean Fath. 2017. The role of stress mindset in shaping cognitive, emotional, and physiological responses to challenging and threatening stress. *Anxiety, Stress, & Coping* 30, 4 (2017), 379–395. DOI: https://doi.org/10.1080/10615806.2016.1275585

[45] Mary Czerwinski, Eric Horvitz, and Susan Wilhite. 2004. A diary study of task switching and interruptions. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, 175–182. DOI: https://doi.org/10.1145/985692.985715

[46] Charles Darrah. 2007. *Busier Than Ever!: Why American Families can't Slow Down*. Stanford University Press.

[47] Anjali Devakumar, Jay Modh, Bahador Saket, Eric P. S. Baumer, and Munmun De Choudhury. 2021. A review on strategies for data collection, reflection, and communication in eating disorder apps. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, 1–19. DOI: https://doi.org/10.1145/3411764.3445670

[48] Nancy G. Dodd and Daniel C. Ganster. 1996. The interactive effects of variety, autonomy, and feedback on attitudes and performance. *Journal of Organizational Behavior* 17, 4 (1996), 329–347. DOI: https://doi.org/10.1002/(SICI)1099-1379(199607)17:4⟨329::AID-JOB754⟩3.0.CO;2-B

[49] Gavin Doherty, David Coyle, and John Sharry. 2012. Engagement with online mental health interventions: An exploratory clinical study of a treatment for depression. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, 1421–1430. DOI: https://doi.org/10.1145/2207676.2208602

[50] Jamie Ducharme. [n. d.]. *The'Great Resignation' Is Finally Getting Companies to Take Burnout Seriously*. Time. Retrieved from https://time.com/6106656/workplace-burnout-pandemic/

[51] Marcus Eckert, David Ebert, Dirk Lehr, Bernhard Sieland, and Matthias Berking. 2016. Overcome procrastination: Enhancing emotion regulation skills reduce procrastination. *Learning and Individual Differences* 52 (2016), 10–18. DOI: https://doi.org/10.1016/j.lindif.2016.10.001

[52] Amy Edmondson. 1999. Psychological safety and learning behavior in work teams. *Administrative Science Quarterly* 44, 2 (1999), 350–383. DOI: https://doi.org/10.2307/2666999

[53] Laura L. Ellingson. 2009. *Engaging Crystallization in Qualitative Research: An Introduction*. SAGE.
[54] Daniel Epstein, Felicia Cordeiro, Elizabeth Bales, James Fogarty, and Sean Munson. 2014. Taming data complexity in lifelogs: Exploring visual cuts of personal informatics data. In *Proceedings of the 2014 Conference on Designing Interactive Systems*. Association for Computing Machinery, New York, NY, 667–676. DOI: https://doi.org/10.1145/2598510.2598558
[55] Daniel A. Epstein, Daniel Avrahami, and Jacob T. Biehl. 2016. Taking 5: Work-breaks, productivity, and opportunities for personal informatics for knowledge workers. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, 673–684. DOI: https://doi.org/10.1145/2858036.2858066
[56] Kristina Fenn and Majella Byrne. 2013. The key principles of cognitive behavioural therapy. *InnovAiT: Education and Inspiration for General Practice* 6, 9 (2013), 579–585. DOI: https://doi.org/10.1177/1755738012471029
[57] Kathleen Kara Fitzpatrick, Alison Darcy, and Molly Vierhile. 2017. Delivering cognitive behavior therapy to young adults with symptoms of depression and anxiety using a fully automated conversational agent (Woebot): A randomized controlled trial. *JMIR Mental Health* 4, 2 (2017), e19. DOI: https://doi.org/10.2196/mental.7785 Company: JMIR Mental Health Distributor: JMIR Mental Health Institution: JMIR Mental Health Label: JMIR Mental Health Publisher: JMIR Publications Inc., Toronto, Canada.
[58] Bj Fogg. 2009. A behavior model for persuasive design. In *Proceedings of the 4th International Conference on Persuasive Technology*. ACM, Claremont California, 1–7. DOI: https://doi.org/10.1145/1541948.1541999
[59] Nicole Forsgren, Margaret-Anne Storey, Chandra Maddila, Tom Zimmermann, Brian Houck, and Jenna Butler. 2021. The SPACE of developer productivity: There's more to it than you think. *ACM Queue: Tomorrow's Computing Today* 19, 1 (2021), 20–48.
[60] Freedom.to. [n. d.]. Freedom: Internet, App and Website Blocker. Retrieved from https://freedom.to
[61] Al Gini. 1998. Work, identity and self: How we are formed by the work we do. *Journal of Business Ethics* 17, 7 (1998), 707–714.
[62] Daniela Girardi, Filippo Lanubile, Nicole Novielli, and Alexander Serebrenik. 2021. Emotions and perceived productivity of software developers at the workplace. *IEEE Transactions on Software Engineering* (2021), 1–1. DOI: https://doi.org/10.1109/TSE.2021.3087906 Conference Name: IEEE Transactions on Software Engineering.
[63] Ingunn Ýr Guðbrandsdóttir and Guðmundur Valur Oddsson. 2022. Productivity in an organizational setting: A systematic view of the causalities at work. *Administrative Sciences* 12, 3 (2022), 90. DOI: https://doi.org/10.3390/admsci12030090
[64] Hayley Guillou, Kevin Chow, Thomas Fritz, and Joanna McGrenere. 2020. Is your time well spent? Reflecting on knowledge work more holistically. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, Honolulu, HI, 1–9. DOI: https://doi.org/10.1145/3313831.3376586
[65] Barbara Göbl, Helmut Hlavacs, Jessica Hofer, Isabelle Müller, Hélen Müllner, Claudia Schubert, Halina Helene Spallek, Charlotte Rybka, and Manuel Sprung. 2015. MindSpace: A cognitive behavioral therapy game for treating anxiety disorders in children. In *Proceedings of the Entertainment Computing*.Konstantinos Chorianopoulos, Monica Divitini, Jannicke Baalsrud Hauge, Letizia Jaccheri, and Rainer Malaka (Eds.), Lecture Notes in Computer Science, Springer International Publishing, Cham, 463–468. DOI: https://doi.org/10.1007/978-3-319-24589-8_41
[66] Mohsen Haghbin, Adam McCaffrey, and Timothy A. Pychyl. 2012. The complexity of the relation between fear of failure and procrastination. *Journal of Rational-Emotive & Cognitive-Behavior Therapy* 30, 4 (2012), 249–263. DOI: https://doi.org/10.1007/s10942-012-0153-9
[67] Aleesha Hamid, Rabiah Arshad, and Suleman Shahid. [2022]. What are you thinking?: Using CBT and storytelling to improve mental health among college students. In *Proceedings of the CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, 1–16. DOI: https://doi.org/10.1145/3491102.3517603
[68] Celeste Headlee. 2020. *Do Nothing: How to Break Away from Overworking, Overdoing, and Underliving*. Harmony.
[69] Esther Howe, Jina Suh, Mehrab Bin Morshed, Daniel McDuff, Kael Rowan, Javier Hernandez, Marah Ihab Abdin, Gonzalo Ramos, Tracy Tran, and Mary P Czerwinski. [n. d.]. Design of digital workplace stress-reduction intervention systems: Effects of intervention type and timing. In *Proceedings of the CHI Conference on Human Factors in Computing Systems*. ACM, 1–16. DOI: https://doi.org/10.1145/3491102.3502027
[70] Ian Andrew James and Stephen Barton. 2004. CHANGING CORE BELIEFS WITH THE CONTINUUM TECHNIQUE. *Behavioural and Cognitive Psychotherapy* 32, 4 (2004), 431–442. DOI: https://doi.org/10.1017/S1352465804001614
[71] Jodi Kantor, Arya Sundaram, Aliza Aufrichtig, and Rumsey Taylor. 2022. The rise of the worker productivity score. *The New York Times* (2022).
[72] Harmanpreet Kaur, Daniel McDuff, Alex C. Williams, Jaime Teevan, and Shamsi T. Iqbal. 2022. "I didn't know I looked angry": Characterizing observed emotion and reported affect at work. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*. 1–18.
[73] Harmanpreet Kaur, Alex C. Williams, Daniel McDuff, Mary Czerwinski, Jaime Teevan, and Shamsi T. Iqbal. 2020. Optimizing for happiness and productivity: Modeling opportune moments for transitions and breaks at work. In

Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, 1–15. DOI: https://doi.org/10.1145/3313831.3376817

[74] Jasmine I. Kerr, Mara Naegelin, Raphael P. Weibel, Andrea Ferrario, Roberto La Marca, Florian von Wangenheim, Christoph Hoelscher, and Victor R. Schinazi. 2020. The effects of acute work stress and appraisal on psychobiological stress responses in a group office environment. *Psychoneuroendocrinology* 121 (2020), 104837. DOI: https://doi.org/10.1016/j.psyneuen.2020.104837

[75] Young-Ho Kim, Eun Kyoung Choe, Bongshin Lee, and Jinwook Seo. 2019. Understanding personal productivity: How knowledge workers define, evaluate, and reflect on their productivity. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, 1–12. DOI: https://doi.org/10.1145/3290605.3300845

[76] Young-Ho Kim, Jae Ho Jeon, Eun Kyoung Choe, Bongshin Lee, KwonHyun Kim, and Jinwook Seo. 2016. TimeAware: Leveraging framing effects to enhance personal productivity. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, 272–283. DOI: https://doi.org/10.1145/2858036.2858428

[77] Young-Ho Kim, Jae Ho Jeon, Bongshin Lee, Eun Kyoung Choe, and Jinwook Seo. 2017. OmniTrack: A flexible self-tracking approach leveraging semi-automated tracking. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 1, 3 (2017), 67:1–67:28. DOI: https://doi.org/10.1145/3130930

[78] Predrag Klasnja, Sunny Consolvo, and Wanda Pratt. 2011. How to evaluate technologies for health behavior change in HCI research. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, Vancouver BC Canada, 3063–3072. DOI: https://doi.org/10.1145/1978942.1979396

[79] Kenneth A. Kobak, James C. Mundt, and Betsy Kennard. 2015. Integrating technology into cognitive behavior therapy for adolescent depression: A pilot study. *Annals of General Psychiatry* 14, 1 (2015), 37. DOI: https://doi.org/10.1186/s12991-015-0077-8

[80] Geza Kovacs, Drew Mylander Gregory, Zilin Ma, Zhengxuan Wu, Golrokh Emami, Jacob Ray, and Michael S. Bernstein. 2019. Conservation of procrastination: Do productivity interventions save time or just redistribute it?. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, Glasgow, Scotland Uk, 1–12. DOI: https://doi.org/10.1145/3290605.3300560

[81] Geza Kovacs, Zhengxuan Wu, and Michael S. Bernstein. [n. d.]. Not now, ask later: Users weaken their behavior change regimen over time, but expect to re-strengthen it imminently. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, 1–14. DOI: https://doi.org/10.1145/3411764.3445695

[82] Kostadin Kushlev and Elizabeth Dunn. 2015. Checking email less frequently reduces stress. *Computers in Human Behavior* 43 (2015). DOI: https://doi.org/10.1016/j.chb.2014.11.005

[83] Gilly Leshed and Phoebe Sengers. 2011. "I lie to myself that i have freedom in my own schedule": Productivity tools and experiences of busyness. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, 905–914. DOI: https://doi.org/10.1145/1978942.1979077

[84] Yuhan Luo, Bongshin Lee, Donghee Yvette Wohn, Amanda L. Rebar, David E. Conroy, and Eun Kyoung Choe. 2018. Time for break: Understanding information workers' sedentary behavior through a break prompting system. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, Montreal QC Canada, 1–14. DOI: https://doi.org/10.1145/3173574.3173701

[85] Yuliya Lutchyn, Paul Johns, Asta Roseway, and Mary Czerwinski. 2015. MoodTracker: Monitoring collective emotions in the workplace. In *Proceedings of the 2015 International Conference on Affective Computing and Intelligent Interaction*. 295–301. DOI: https://doi.org/10.1109/ACII.2015.7344586 ISSN: 2156-8111.

[86] Gloria Mark, Mary Czerwinski, and Shamsi Iqbal. 2018. Effects of individual differences in blocking workplace distractions. (Feb. 2018). Retrieved from https://www.microsoft.com/en-us/research/publication/effects-individual-differences-blocking-workplace-distractions/

[87] Gloria Mark, Mary Czerwinski, Shamsi Iqbal, and Paul Johns. 2016. Workplace indicators of mood: Behavioral and cognitive correlates of mood among information workers. In *Proceedings of the 6th International Conference on Digital Health Conference*. Association for Computing Machinery, New York, NY, 29–36. DOI: https://doi.org/10.1145/2896338.2896360

[88] Gloria Mark, Daniela Gudith, and Ulrich Klocke. 2008. The cost of interrupted work: More speed and stress. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, 107–110. DOI: https://doi.org/10.1145/1357054.1357072

[89] 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. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, 1717–1728. DOI: https://doi.org/10.1145/2858036.2858262

[90] Gloria Mark, Stephen Voida, and Armand Cardello. 2012. "A pace not dictated by electrons": An empirical study of work without email. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, 555–564. DOI: https://doi.org/10.1145/2207676.2207754

[91] Gloria Mark, Yiran Wang, and Melissa Niiya. 2014. Stress and multitasking in everyday college life: An empirical study of online activity. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, 41–50. DOI: https://doi.org/10.1145/2556288.2557361

[92] Nick Martin. 2020. Against productivity in a pandemic. *The New Republic* (2020).

[93] Jim McCambridge, John Witton, and Diana R. Elbourne. 2014. Systematic review of the hawthorne effect: New concepts are needed to study research participation effects. *Journal of Clinical Epidemiology* 67, 3 (2014), 267–277. DOI: https://doi.org/10.1016/j.jclinepi.2013.08.015

[94] Greg McKeown. 2020. *Essentialism: The Disciplined Pursuit of Less*. Currency.

[95] Andre Meyer, Gail Murphy, Thomas Zimmermann, and Thomas Fritz. 2017. Design recommendations for self-monitoring in the workplace: Studies in software development. *Proceedings of the ACM on Human-Computer Interaction* 1 (2017), 1–24. DOI: https://doi.org/10.1145/3134714

[96] Rebecca Murphy, Suzanne Straebler, Zafra Cooper, and Christopher G. Fairburn. 2010. Cognitive behavioral therapy for eating disorders. *The Psychiatric Clinics of North America* 33, 3 (2010), 611–627. DOI: https://doi.org/10.1016/j.psc.2010.04.004

[97] Sebastian C. Müller and Thomas Fritz. 2015. Stuck and frustrated or in flow and happy: Sensing developers' emotions and progress. In *Proceedings of the 2015 IEEE/ACM 37th IEEE International Conference on Software Engineering*. 688–699. DOI: https://doi.org/10.1109/ICSE.2015.334 ISSN: 1558-1225.

[98] Cal Newport. 2021. The frustration with productivity culture. *The New Yorker* (2021).

[99] Cal Newport. 2022. It's time to embrace slow productivity. *The New Yorker* (2022).

[100] Jenny Odell. 2019. *How to Do Nothing: Resisting the Attention Economy*. Melville House.

[101] Irismar Reis De Oliveira. 2012. *Standard and Innovative Strategies in Cognitive Behavior Therapy*. BoD – Books on Demand.

[102] Helga Guðrún Óskarsdóttir, Guðmundur Valur Oddsson, Jón Þór Sturluson, and Rögnvaldur Jóhann Sæmundsson. 2022. Towards a holistic framework of knowledge worker productivity. *Administrative Sciences* 12, 2 (2022), 50. DOI: https://doi.org/10.3390/admsci12020050

[103] Pablo Paredes, Ran Giald-Bachrach, Mary Czerwinski, Asta Roseway, Kael Rowan, and Javier Hernandez. 2014. PopTherapy: Coping with stress through pop-culture. In *Proceedings of the 8th International Conference on Pervasive Computing Technologies for Healthcare*. ICST. DOI: https://doi.org/10.4108/icst.pervasivehealth.2014.255070

[104] Martin Pielot and Luz Rello. 2017. Productive, anxious, lonely: 24 hours without push notifications. In *Proceedings of the 19th International Conference on Human-Computer Interaction with Mobile Devices and Services*. ACM, Vienna Austria, 1–11. DOI: https://doi.org/10.1145/3098279.3098526

[105] Jesse Prinz. 2005. Are emotions feelings? *Journal of Consciousness Studies* 12, 8-9 (Jan. 2005), 9–25.

[106] James O. Prochaska and Wayne F. Velicer. 1997. The transtheoretical model of health behavior change. *American Journal of Health Promotion* 12, 1 (1997), 38–48. DOI: https://doi.org/10.4278/0890-1171-12.1.38 Publisher: SAGE Publications Inc.

[107] Judith Proudfoot, Janine Clarke, Mary-Rose Birch, Alexis E. Whitton, Gordon Parker, Vijaya Manicavasagar, Virginia Harrison, Helen Christensen, and Dusan Hadzi-Pavlovic. 2013. Impact of a mobile phone and web program on symptom and functional outcomes for people with mild-to-moderate depression, anxiety and stress: A randomised controlled trial. *BMC Psychiatry* 13, 1 (2013), 312. DOI: https://doi.org/10.1186/1471-244X-13-312

[108] Timothy A. Pychyl and Fuschia M. Sirois. 2016. Chapter 8 - procrastination, emotion regulation, and well-being. In *Proceedings of the Procrastination, Health, and Well-Being*. Fuschia M. Sirois and Timothy A. Pychyl (Eds.), Academic Press, San Diego, 163–188. DOI: https://doi.org/10.1016/B978-0-12-802862-9.00008-6

[109] Yuri W. Ramírez and David A. Nembhard. 2004. Measuring knowledge worker productivity: A taxonomy. *Journal of Intellectual Capital* 5, 4 (2004), 602–628. DOI: https://doi.org/10.1108/14691930410567040

[110] Kara Rennert and Evangelos Karapanos. 2013. Faceit: Supporting reflection upon social anxiety events with lifelogging. In *Proceedings of the CHI'13 Extended Abstracts on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, 457–462. DOI: https://doi.org/10.1145/2468356.2468437

[111] Katherine M. Richardson and Hannah R. Rothstein. 2008. Effects of occupational stress management intervention programs: A meta-analysis. *Journal of Occupational Health Psychology* 13, 1 (2008), 69.

[112] Wilmar B. Schaufeli and Esther R. Greenglass. 2001. Introduction to special issue on burnout and health. *Psychology & Health* 16, 5 (2001), 501–510. DOI: https://doi.org/10.1080/08870440108405523; arXiv:https://doi.org/10.1080/08870440108405523 PMID: 22804495.

[113] Anya Skatova, Ben Bedwell, Victoria Shipp, Yitong Huang, Alexandra Young, Tom Rodden, and Emma Bertenshaw. 2016. The role of ICT in office work breaks. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing*

Systems. Association for Computing Machinery, New York, NY, 3049–3060. DOI: https://doi.org/10.1145/2858036.2858443

[114] The Future Forum team. 2022. Future Forum Pulse Summer Snapshot.

[115] Jaime Teevan. 21. Let's Redefine "Productivity" for the Hybrid Era. Retrieved from https://hbr.org/2021/09/lets-redefine-productivity-for-the-hybrid-era

[116] Jaime Teevan, Brent Hecht, Sonia Jaffe, Nancy Baym, Rachel Bergmann, Matt Brodsky, Bill Buxton, Jenna Butler, Adam Coleman, Mary Czerwinski, et al. 2021. The new future of work: Research from microsoft into the pandemic's impact on work practices. *Retrieved March* 4 (2021), 2022.

[117] Vincent W.-S. Tseng, Matthew L. Lee, Laurent Denoue, and Daniel Avrahami. 2019. Overcoming distractions during transitions from break to work using a conversational website-blocking system. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, 1–13. DOI: https://doi.org/10.1145/3290605.3300697

[118] Steven Walfish. 2006. A review of statistical outlier methods. *Pharmaceutical Technology* 30, 11 (2006), 82.

[119] Shuo Wang, Ya Zhou, Shi Yu, Li-Wen Ran, Xiang-Ping Liu, and Yu-Fei Chen. 2017. Acceptance and commitment therapy and cognitive–behavioral therapy as treatments for academic procrastination: A randomized controlled group session. *Research on Social Work Practice* 27, 1 (2017), 48–58. DOI: https://doi.org/10.1177/1049731515577890 Publisher: SAGE Publications Inc.

[120] Ariane G. Wepfer, Tammy D. Allen, Rebecca Brauchli, Gregor J. Jenny, and Georg F. Bauer. 2018. Work-life boundaries and well-being: Does work-to-life integration impair well-being through lack of recovery? *Journal of Business and Psychology* 33, 6 (2018), 727–740. DOI: https://doi.org/10.1007/s10869-017-9520-y

[121] Steve Whittaker, Vaiva Kalnikaite, Victoria Hollis, and Andrew Guydish. 2016. 'Don't waste my time': Use of time information improves focus. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, 1729–1738. DOI: https://doi.org/10.1145/2858036.2858193

[122] Alex C. Williams, Harmanpreet Kaur, Gloria Mark, Anne Loomis Thompson, Shamsi T. Iqbal, and Jaime Teevan. 2018. Supporting workplace detachment and reattachment with conversational intelligence. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, Montreal QC, Canada, 1–13. DOI: https://doi.org/10.1145/3173574.3173662

[123] Jacob O. Wobbrock and Julie A. Kientz. 2016. Research contributions in human-computer interaction. *Interactions* 23, 3 (2016), 38–44. DOI: https://doi.org/10.1145/2907069

[124] Michael J. A. Wohl, Timothy A. Pychyl, and Shannon H. Bennett. 2010. I forgive myself, now I can study: How self-forgiveness for procrastinating can reduce future procrastination. *Personality and Individual Differences* 48, 7 (2010), 803–808. DOI: https://doi.org/10.1016/j.paid.2010.01.029

[125] Jesse H. Wright, Jesse J. Owen, Derek Richards, Tracy D. Eells, Thomas Richardson, Gregory K. Brown, Marna Barrett, Mary Ann Rasku, Geneva Polser, and Michael E. Thase. 2019. Computer-assisted cognitive-behavior therapy for depression: A systematic review and meta-analysis. *The Journal of Clinical Psychiatry* 80, 2 (2019), 3573. DOI: https://doi.org/10.4088/JCP.18r12188

Received 17 July 2022; revised 13 March 2023; accepted 19 May 2023