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Mindful work and mindful technology: Redressing digital distraction in knowledge work

Mohammad Hossein Jarrahi [a,*], Dorothy Lee Blyth [a,b], Cami Goray [c]

[a] University of North Carolina at Chapel Hill, United States of America
[b] SAS Institute Inc, Cary, NC, United States of America
[c] University of Michigan, United States of America

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ABSTRACT

Knowledge work today is characterized by frequent interruptions. Digital distraction plays an increasingly important role in this work context as workers' behavior and emotional state online spills into work practices, causing stress and productivity loss. This article discusses solutions to digital distraction by advancing the concepts of mindful work and mindful technology. In doing so, it first critiques the design of prevalent productivity tools (i.e., "block-and-avoid tools") that avoid the problem rather than remediating it. We argue that mindfulness is particularly applicable to handling digital distraction and propose a two-part framework for mindful work and mindful design through which workers can learn to work with technology — and their emotions — in more constructive ways. Lastly, we expand on our mindful work framework by proposing the concept of an intelligent personal assistant.

1. Introduction

Digital distraction is a large source of increased errors and stress levels in modern work, accumulating in the loss of billions of dollars in productivity each year. A recent study conducted by the Economist Intelligence Unit of the Economist Group estimates that 581 h per person are lost annually due to digital distractions (equivalent to 28% of work hours and a loss of $34,448 of productivity per person annually) (Olive, 2022). The effect of digital distraction and interruption is not limited to the individual level per se and can have a ripple effect by beseting group coordination and organizational performance (Addas & Pinsonneault, 2018a). Digital distraction is now a clear consequence of the digitization of work and a pervasive element of knowledge work.

The concept of digital distraction refers to activities that draw workers' attention away from primary tasks at hand and disrupt task completion momentarily (Farivar, Esmaeelinezhad, & Richardson, 2022). Knowledge work, which can be understood as work whose focus shifts away from routine and explicit knowledge to more conceptual, cultural, and documented types of knowledge, is increasingly made possible with the use of digital environments (Levy, 2016; Orlikowski, 2016). To manipulate digital content as the primary elements of their work, knowledge workers must engage in digital work practices, juggling projects that require extensive use of digital devices, applications, and platforms (Jarrahi, Nelson, & Thomson, 2017). Digital environments are not only a milieu of work, but also a milieu of entertainment and personal information management, and a gateway for searching for unlimited resources (Castells, 2011; Levy, 2016).

Digital environments also pose challenges to productive work. Most notably, digital distraction prevents knowledge workers from doing productive work because their focus can easily become derailed by other easily accessible and entertaining content (Mark, 2015). Repeated instances of digital distraction are associated with increased workload, lower and slower performance, and higher stress levels (Addas & Pinsonneault, 2018b). This is not an entirely new problem; Herbert Simon warned of the rise of the attention economy when he described the inverse relationship between information and attention: "The wealth of information means a dearth of something else: a scarcity of whatever it is that information consumes. What information consumes is rather obvious: it consumes the attention of its recipients" (Simon, 1971, 40).

Digital distraction is a pressing problem in today's society because in making technology more usable — which has become a large priority in today's organizations — designers have created systems that inadvertently challenge the user's self-control (Markowitz, Hancock, Bailenson, & Reeves, 2017). For example, a digital interface is disorienting because

* Corresponding author.
E-mail addresses: jarrahi@unc.edu (M.H. Jarrahi), dblyth@alumni.unc.edu (D.L. Blyth), cgoray@umich.edu (C. Goray).

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in one session, a worker can be engaged in an immersive experience, traveling to multiple digital spaces in a short amount of time while the physical body never leaves the chair. Application windows, browser tabs, and news feeds provide the infrastructure for multitasking by affording the user easy access to a panoply of applications, all of which enable perennial context switching (Afzali & Morrison, 2018). Little resistance prevents one's cursor (along with one's attention) from browsing the Internet mindlessly.

In this paper, we examine the causes of digital distraction and review tools and techniques that have attempted to solve the problem yet have possibly created other unintended consequences. These tools are designed to block content, websites, and applications, acting as a form of operant conditioning that punishes the user for their behavior. They do not necessarily support workers in learning about and reflecting on their behavior, which would in turn support them in building sustainable and healthier habits.

The research question underlying this article is how to address these shortcomings and design more effective technologies by building on the tenets of mindfulness. We first elaborate on and review related mindful technology and their design. We then propose a two-part conceptual framework for work rooted in the concept of mindfulness where humans can learn to work with technology — and their emotions — in more constructive ways. We present Mindful Work as a set of practices that enable workers to gain awareness of their emotional state. Following this framework, we detail five principles of Mindful Technology Design and apply them in the context of an intelligent personal assistant that helps workers develop healthier and self-sustaining habits. A theoretical contribution of this work is therefore building on principles and foundation of mindfulness to address digital distractions through mindful technology design.

2. Related work

2.1. Digital distraction

Digital distraction is a complex, multi-dimensional concept (Addas & Pinsonneault, 2018a; Taneja, Fiore, & Fischer, 2015). Spurred by both external (e.g., an email notification) and internal triggers (e.g., the "fear of missing out") that come from the interface, individual, and organization, these factors contribute to the costs of emotional labor, a process in which workers must regulate their emotions to perform their job (Morris & Feldman, 1996).

While emotional labor may be invisible, the health and productivity costs that result from it are evident. Research presents distraction as one major source of stress while workers fail to achieve their primary goals (Mark, Gudith, & Klocke, 2008). Workers often need to compensate for the time lost to digital distraction and interruption by working faster on their work-related tasks, potentially experiencing more stress (Farivar et al., 2022). Processing multiple streams of information may also impair cognitive control and impact the quality of work and stress on work (Ophir, Nass, & Wagner, 2009). Abundance of the information received over a rising number of channels can diminish one's sense of control over the situation and therefore result in higher levels of stress (Bhambri, 2021).

To further complicate the role of communications platforms on work behavior, the traditional social networking "culprits" of distraction (e.g., Facebook and TikTok) are becoming a growing part of knowledge workers' work routines (Jarrahi, Crowston, Bondar, & Katzy, 2017). Due to network effects, the social media sites have morphed into a digital "Third Space" that allows workers to communicate with people they otherwise would not have access to. Social networks have been sites of study for social boundary crossing (Skeels & Grudin, 2009), but are also interesting sites of what we call *attention boundary crossing* — where the mindful transforms into the mindless.

It should be noted that there are many organizational factors that contribute to digital distraction and interruption in addition to the design and configuration of a digital environment and the information/human availability it affords. Past research has studied the effect of organizational technologies on perceived workload and well-being (Addas & Pinsonneault, 2018b). For example, Mazmanian and Erickson (2014) found that mobile phones in the workplace contributed to workers feeling an obligation to be more accessible. Likewise, even those not tied to an organization (i.e., independent workers) have reason to be tied to their device (Sutherland, Jarrahi, Dunn, & Nelson, 2019). In short, not only is information more accessible, but so are people.

A major consequence of permeability of digital devices and digital media is the conflation of personal and professional spheres. Work interruptions spurred by digital devices can now easily find their way into workers' non-work domains and vice-versa (Chen & Karahanna, 2018). Digital distraction continues to span across both personal and professional spheres, in part due to the rise of remote work in past years. Ironically, a study done by the Owl Labs State of Remote Work (2022) revealed that although "two-thirds (62%) of workers feel more productive when working remotely … 77% of those that feel less productive at home say it's because there are more distractions." Their report findings suggest that both digital and non-digital distractions interrupt the workflow in a day. Examples of digital distractions in the personal sphere include scrolling through social media news feeds, reading and replying to messages from friends and family, selecting a song to play on Spotify, and watching the local TV news.

Past research has pointed to how digital technologies, especially social media, have made boundary management in this context more difficult (Siegert & Löwstedt, 2019). For example, Duxbury, Higgins, Smart, and Stevenson (2014) highlight some of the factors that complicate boundary management, including organizational expectations and norms, issues of self-control, and personal strategies to use technology. Lirio (2017) discusses some of the extra work that global managers need to embark on (called "boundary work") to manage the boundary between work and family time. In general, work interruptions and constant boundary work can have an overall negative effect (i.e., work exhaustion) (Chen & Karahanna, 2018).

2.2. Current solutions to digital distraction

In recent years, there has been a surge in time management strategies and tools ranging from books, Ted Talks, manuals, techniques, and tools that share the message that time sovereignty is achievable (Wajcman, 2019). Ironically, with all of this freedom, workers still want to feel like they have control. As more workers possess the flexibility to work anytime and anywhere, they must take on more responsibility to govern their own time (Jarrahi et al., 2021).

Next, we discuss non-technological and technological solutions to digital distraction. First, we critique a popular time management strategy: the Getting Things Done (GTD) method. Second, we discuss why technological tools like application blockers are deficient long-term solutions.

2.2.1. Getting things done (GTD) methodology

There is no shortage of strategies infiltrating the library aisles and Twitter feeds that involve blocking out chunks of time. The *Getting Things Done* methodology,[1] popularized with the hashtag #GTD, is the mantra of productivity consultant David Allen. In the world of GTD, control is achieved through developing meticulous workflows of activity (Allen, 2015). While the GDT method has been adopted by many, one of the many challenges of this methodology is an attempt to confine a messy and unpredictable world into neat boxes. Workers want to feel in control of their time and in control of their work, but the subversion to the checklist is heavily task-centric rather than human-centric (Wajcman, 2019).

[1] https://gettingthingsdone.com

As an example of these approaches, Cal Newport recommends in his *New York Times* and *Wall Street Journal* bestseller book *Digital Minimalism* to schedule uninterrupted work blocks (a type of commitment device in behavioral psychology) and quarantining tasks that don't boost productivity (Newport, 2019). Even the title of the book implies a call for asceticism because of technology decadence: consuming too much technology is self-indulgent and degrading, so minimize consumption. To challenge the assumptions of digital minimalism, we need to focus less on the amount of screen time, but the actual activity during the screen time.

One reason why the GTD method and the *Digital Minimalism* book has attracted so much attention is because in the digital environment, attention is treated as a commodity to be measured and monetized (Brynjolfsson and Oh 2013). In parallel reasoning, for people obsessed with productivity, time is treated as a commodity to be guarded and managed (Gregg, 2018). For example, one study by Erickson and Wajcman (2022) revealed that in 20 interviews with calendar software designers, almost all "[boasted] about how they manage their own personal productivity." They also found that Silicon Valley was reinforcing the notion of "time optimization" centered around efficiency and cost and urged readers to think critically about how time is quantified and how it should not be dictated by capitalism (Erickson & Wajcman, 2022). The desire to mechanize human thought and action to make people more reliable by tracking time drives the motivation in Silicon Valley to build intelligent digital assistants (Wajcman, 2019).

Some people are motivated to track their behavior and their time in order to become more self-aware or to change future behavior (Nagy, Eschrich, & Finn, 2021). In the context of the popularity of self-tracking as shown by the communities of people who do bullet journaling and quantified-selfers, the rise of this productivity agenda in the workplace makes sense because it appeals to many organization and people who are highly interested in tracking, storing, and retrieving information about themselves and the things that they have done (McEwen, 2018). People have long sought creative outlets for introspection and self-reflection.

2.2.2. *Pervasive design to address digital distraction*

Over the past few years, a variety of application and website-blocking applications have emerged, manifesting people's desire for self-restraint. In a meta-analysis of 367 apps and browser extensions designed to promote self-regulation, the most frequent characteristic found was blocking and removing distractions. The second most common was related to self-tracking (Lyngs et al., 2019). As an example of the blocking-and-removing characteristic, the productivity software Freedom[2] lets users block websites, applications, and the Internet. Two major technology companies, Apple and Google, have released their own versions of applications characterized by both blocking and self-tracking. Pianese, Errichiello, and Cunha (2022) also note the effects of remote work and reveal that organizations and managers use various remote work arrangements (RWAs) and surveillance of digital workers has risen drastically.

Despite their rise in popularity, Gregg (2018) observes that these applications employ "block-and-avoid" tactics that in the long run do not help the user; once the user stops using the application, they may return to their default habits.These tools manifest an "ethics of resignation" in that users subvert their control to the technology (Gregg, 2018). By relying on technology, people are acknowledging that they do not have the internal willpower to control their own behavior (Moore, 2018). This act of avoidance contradicts the importance of self-awareness. Like the GTD method, these block-and-avoid apps glorify restraint and abstinence. Gregg also describes how productivity tools and techniques promote asceticism, which is an extreme form of self-discipline and is characterized by self-punishment. The concept can be traced to the philosopher Michel Foucault, who defined the ascetic practices as codified around principles of self-restraint. In these terms, distraction is inherently bad, dangerous even to time management (Gregg, 2018).

In many cases, time management systems and productivity tools are an effective solution for helping one break down and organize tasks; however, distraction is both cognitive and affective (Paasonen, 2016). The solutions above do not consider a human's emotion regulation or self-awareness (an essential element of mindfulness). When one is mindfully aware, they are enabled to respond to situations more *reflectively* as opposed to *reflexively* (Bishop et al., 2004). Reacting reflexively means reacting automatically, whereas reacting reflectively means contemplating how one intends to react before reacting. These two types of reaction correspond to Daniel Kahnemen's dichotomy of modes of thought (Kahneman, 2011). Reacting reflexively corresponds to relying on System 1's ("the Automatic Mind") response, which is the system that relies on instinct and emotion. Likewise, reacting reflectively corresponds to relying on System 2's ("the Reflective Mind") response, which is the slower, more deliberate attentional system.

The fundamental problem that many of the GTD strategies and tools share is that they often forget that humans can experience feelings and can practice mindfulness, a uniquely human trait and capability that cannot be taught to machines. As such, the practice of mindfulness is a useful skill for addressing the problem of digital distraction at work.

3. Mindfulness

The practice of mindfulness, which is rooted in Hinduism religion and Buddhist tradition, experienced a renewed interest in the late 1970's when author and meditation teacher Jon Kabat-Zinn promoted the Mindfulness-Based Stress Reduction (MBSR) program (Trousselard, Steiler, Claverie, & Canini, 2014). Kabat-Zinn defines mindfulness as "paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally" (Zinn, 1994, p.4). In the following years, psychologists have attempted to formulate more specific definitions. For instance, Bishop et al. (2004) described mindfulness as a practice composed of two-stages: the first stage involving the self-regulation of attention and the second as adopting a particular orientation to experience.

Mindfulness has been linked to numerous health benefits, such as reduced risk for anxiety and depression, and increased prosocial behaviors (Hafenbrack et al., 2019; Shahbaz & Parker, 2022). Mindfulness may also help workers become more attuned to the feelings and needs of colleagues, helping cultivate a healthier, more meaningful relationship with work (Hafenbrack et al., 2019; Malinowski & Lim, 2015).

The concept of mindfulness can be understood based on three pillars: intention, attention, and action Stanford BeWell, 2019). Digital technology interferes with the process of mindfulness because it makes users forget what matters to them (intention), distracts them (attention), and keeps them from taking action (Stanford BeWell, 2019). People switch between content so quickly in the digital environment that it can be easy to become disconnected with the emotions that influence behavior (Magen, 2017). Additionally, humans have limited working memory and can only hold three to five meaningful items at once, impacting the ability to resume tasks in the "chain of distraction" (Iqbal & Horvitz, 2007). Moreover, emotional state plays a role in whether someone will become distracted. For example, when people are stressed and tired, their quality of attention suffers (Lyngs et al., 2019).

Mindfulness has a strong presence in psychology literature and some business and organizational scholarship (Dane, 2010; Shahbaz & Parker, 2022). Several studies have documented the health and productivity benefits of a mindfulness intervention. For example, Liu, Zhang, Mark, Li, and Rau (2019) studied the effects of mindfulness meditation on stress, affect, and performance in an information multitasking environment. Biometric data, including participants' heart rate variability and EEG signals, served as proxies for stress. The results showed that a single

[2] https://freedom.to

mindfulness session can increase arousal and decrease stress. Similarly, organizational research has documented the positive impact of mindfulness-based interventions on workplace issues such as stress reduction, job satisfaction, employees performance and workers creative ability (Shahbaz & Parker, 2022). There is research that suggests that employees who practice mindfulness strategies are more engaged, focused, and productive at work (Pattnaik & Kesari, 2020). Especially in recent years, many organizations have taken notice of the importance of their employees well-being and have even begun implementing Mindfulness Training as part of their corporate strategies. Mindfulness training within organizations has also shown to improve workers' mindfulness skills, as well as their satisfaction with life, hope, and anxiety (Joelle, Ingram, Marc, Arnold, & Harding, 2016).

The following section identifies and defines four salient characteristics of mindfulness that are brought together to create the Mindful Work framework. Each characteristic is applied as a solution to factors of digital distractions.

3.1. Framework of mindful work

In addition to lowering stress, improving creativity, and increasing job satisfaction, mindfulness also has the potential to overcome digital distractions (Eduljee, Murphy, & Croteau, 2022). By acknowledging and reframing one's attention and attitude with digital noise using mindfulness practices, digital environments can be less distracting. By encapsulating the characteristics of the concept of Mindful Work using the current research on mindfulness, we offer a conceptual synthesis with a more concrete vision of how to design technology that supports mindful and meaningful use. Mindful Work, or "mindfulness at work," is a set of practices that guide knowledge workers to reflect on their attention, attitude, and action. For the purpose of this article, we define mindful work as being both a human capability and quality of noticing, but also an intentional practice of attentional training. Over time, mindfulness training may foster a greater sensitivity to context and perspective, in addition to cultivating a greater control of emotions (Teper, Segal, & Inzlicht, 2013).

Building from current research on mindfulness at work, we propose Mindful Work as encapsulated in five elements: *present-centered awareness, deliberate and intentional, non-judgemental, attitudes of openness and acceptance, and reflective-instead-of-reflexive action*. We borrow and expand on three axioms of mindfulness from Shapiro, Carlson, Astin, and Freedman (2006), who suggest the core mechanisms of mindfulness as: intentionally, attending with openness, and non-judgmentalness. In our framework, we place each element under a type of human information processing activity: attention, attitude, and action (see Table 1). *Attention* is a type of cognitive processing, *attitude* is a type of emotional processing, and *action* includes motor and cognitive processing. Each element is parsed into different applications of intention. (See Fig. 1.)

Table 1
Defining elements of mindful work.

Realm of Information Processing	Attention		Attitude		Action
Mindful Work Elements	Present- centered awareness	Deliberate and intentional	Non-judgmental	Attitudes of openness and acceptance	Reflective- instead-of- reflexive reaction
The Role of Intention	Intention: Choice of what to attend to		Intention: Choice of how to interpret stimuli		Intention: Choice of how to respond
Brief Definition for Each Element	Conscious awareness of what is happening in the present moment. Noticing what is occurring internally (i.e., thoughts, moods, emotions) and externally (i.e., the environment, physical sensations)	Directing attention in a deliberate manner. Focusing on the intended thing at the intended time.	Practicing self-compassion. Understanding what is in your control, and what is outside of it. Observing thoughts, feelings, and actions in context and in relation to other events.	Paying attention to stimuli in an open and accepting way "without imposing judgments, memories, or other self-relevant cognitive manipulations on them."	Staying in control of how to respond. Reacting reflexively (how to react before reacting) Creating a pause between the event and response.

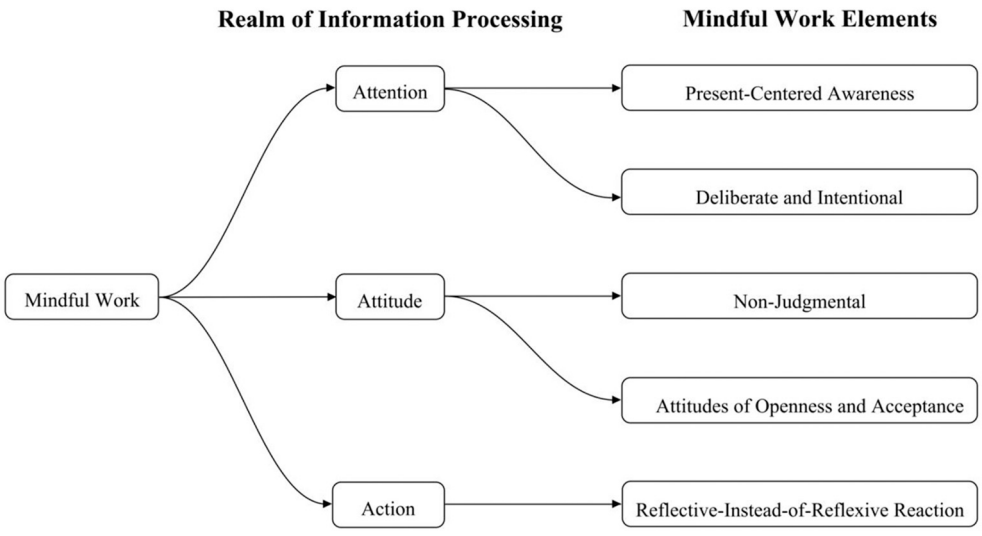

Fig. 1. Mindful work framework.

3.1.1. Present-centered awareness

Mindfulness emphasizes bringing one's attention to experience what is occurring in the present moment (Baer, 2003). If one is ruminating about the past or obsessively anticipating the future, they are not practicing mindfulness (Hyland, Andrew Lee, & Mills, 2015).

As an example, for digital nomads, a community of hypermobile knowledge workers who mix work and travel, carving out time for reflection is important for improving one's self and for developing a philosophy of work and life. Digital nomads reflect through meditation, or what is called "regenerative disconnection" (Kolb & Collins, 2011), which requires disconnecting from information streams in order to meditate on their status and goals (Jarrahi, Philips, Sutherland, Sawyer, & Erickson, 2019). Through the process, they reflect on their current state and their intention.

3.1.2. Deliberate and intentional

Mindfulness is closely linked with intentional processes where attention is being directed in a deliberate manner. In other words, mindfulness is an intentional state of meta-awareness of both internal and external stimuli (Holas & Jankowski, 2013). If workers reflect on the intentionality of each daily activity, they will not only feel more in control of how they spend their time but also appreciate the small moments. Practicing mindfulness can also train them to reflect on how their activities align with their values and personal goals.

Contrastingly, workers can also proceed through their workday without intention. Content appearing on their screen can drive their activity, rather than the other way around. For instance, engaging with a plethora of social media posts via reaction icons can suggest that they may be avoiding what they originally want to or must complete.

3.1.3. Non-judgmental

A central pillar of mindfulness practices is raising present-centered awareness of actions and attentions without making judgments about them. This non-judgmental awareness breaks the cycle of one unpleasant experience or thought leading to another because of "the judgmental thought heightening the unpleasantness of the feeling" and instead focuses on each thought and feeling in the attentional field "as is" (Bishop et al., p. 234). This approach is particularly relevant to the design and implementation of digital technology as technology is increasingly assuming the role of "a judging deity," deciding what is considered right or wrong from a supra-human perspective (Gregg, 2018). Digital tools and applications in this respect are thought of as external judges that "continuously" and "objectively" monitor one's behavior, offering verdicts as well as corrective actions.

3.1.4. Openness and acceptance

Mindfulness is an open and receptive attitude to experience (Holas & Jankowski, 2013). The Buddhist conceptualization of mindfulness is not only attentional, but also attitudinal, meaning that mindfulness is imbued with an attitude of open-minded curiosity and intention of kindness and compassion (Gunaratana, 2010). Mindfulness involves paying attention to stimuli in an open and accepting way, "without imposing judgments, memories, or other self-relevant cognitive manipulations on them" (Glomb, Duffy, Bono, & Yang, 2012, p. 119). An example of this principle in practice is observing thoughts in a non-normative way: by detaching from one's thoughts, people are less likely to ruminate. As explicitly outlined in the Mindful Work table, openness and acceptance means that workers have a choice in how they interpret stimuli; in this case, emotions being internal stimuli. By naming and accepting why they may have visited those websites or possibly what emotional state could have influenced her behavior, workers can not only be more self-compassionate but also be more open-minded to changing their work strategy.

Being truly accepting of behavior means that technology use should always be put in situational context. As such, using social media at work is not inherently a detrimental thing. In fact, browsing social media during micro-moments at work can be a method for recharging and replenishing one's energy (Epstein, Avrahami, & Biehl, 2016). What mindfulness offers to this discussion is the evaluation of context in deciphering whether an experience is meaningful to an individual. Lukoff, Yu, Kientz, and Hiniker (2018) pose a similar question about smartphone use in their study by asking: "*What makes smartphone use meaningful or meaningless?*". In short, Mindful Work honors attention management through contemplation of the purpose of the activity rather than only fixating on time management.

3.1.5. Reflective-instead-of-reflexive reaction

Awareness enables humans to respond to situations more *reflectively* (i.e., contemplating how one intends to react before reacting) as opposed to *reactively* (i.e., automatically) (Bishop et al., 2004). Again, while there is a lack of friction in the digital environment, mindfulness as a strategy provides that mental friction. For example, people may open Twitter as an instinctive reaction to wanting to avoid the rest of a client's email. Guidance from the Mindful Work framework suggests that they pause and take a moment to deliberately reflect on their intention before opening social media. A worker could reflexively ask themselves what may have triggered their consequent action: *Did they intend to search for something on Twitter? Were they hoping for a respite from work? What were their intentions?* Each of the pillars of Mindful Work are deeply connected; in this instance, the reflective action is related to desired intention.

3.1.6. Time scale of mindful work

Due to the fact that the Mindful Work framework is not task or session-based, the five elements of Mindful Work are most applicable if the rhythm of work is analyzed comprehensively. The concept of digital distraction does not refer to one frame in time; rather, it refers to the ripple effect of interactions and emotions that cascade into both online and offline life. For example, a worker might realize that distractions have pulled their attention away from their original task and, as a result, when they reflect, might feel anxious and even guilty. If this cycle repeats daily, there begins to be a sense of cumulative emotional toll. Some workers seek out the feeling of *flow*, or the phenomenon of becoming completely absorbed in their work, or they seek a break and desire to become lost in social media. Other times, they engage because they are avoiding something else. Again, intentionality plays a role in the meaning of the experience. It is sometimes the after-effects reflective experience that tarnishes the meaning of the initial experience.

3.2. Mindful design

In the following section, we introduce the Mindful Design framework, which is grounded in the tenets of the Mindful Work framework but proposes the role that technology can play in supporting mindfulness. In doing so, we go one step further from current conceptualizations and applications of mindfulness practices (e.g., Berthon & Pitt, 2019), and discuss how mindfulness ideals can be embedded and instantiated within design. We use digital distraction as a prime example to illustrate a common problem in the workplace that Mindful Design may address.

The table below outlines the relationship between each design manifestation and their relation to the Mindful Work attributes defined earlier in the article.

Many of the design manifestations mentioned above can be materialized through an intelligent personal assistant (IPA). The technology could ask questions that support mindful behavior, including those related to directing attention (e.g., *"What are you doing?", "Why are you doing it?"*), fostering a constructive and introspective attitude (e.g., "*How do you feel about it?*", "*What can I do to support myself?*"), and contributing towards more self-aware actions (e.g., "*How do my actions relate to and/or trigger previous habits?*").

It is important to highlight that not all digital interruptions and distractions are destructive. For example, Addas and Pinsonneault

(2018b) highlight congruent interruptions as those that may offer relevant information to core tasks at hand. Questions towards more self-aware actions can help workers distinguish between congruent and incongruent distractions in practice.

3.2.1. Mindful design as a solution to digital distraction

Digital distraction is one component of the knowledge work environment millions around the world face today. As workers integrate and weave mindfulness practices into their work life (e.g., when faced with a digital distraction), we argue that they can work more productively and without judgment.

A primary reason why mindfulness can serve as a relevant solution to digital distraction is because it embraces acknowledgement and acceptance, contrary to applications that aim to deny or fight those feelings through "block-and-avoid" tactics. Following this practice, people are not judgmental of their behaviors. As David Levy notes, a mindful design embraces attention not only in relation to task focus (i.e., the ability to remain focused on the task at hand), but also in relation to self-awareness and self-observation. Self-awareness is the ability to observe one's feelings, the relationship between mind and body, and repeating patterns of helpful and unhelpful behaviors (Levy, 2016).

Another reason why these five Design Manifestation elements are a better alternative than traditional "block-and-avoid" tactics is because they force users to pause and face their feelings head-on, rather than avoiding them. By asking questions such as "*What am I doing?" and "How can I support myself?",* the proposed Mindful Design framework provides users continuous analysis and reflection of work practices embedded in their daily routine.

Digital technology provides affordances for embedding and integrating mindfulness into everyday life and has even proven to be more effective than traditional practices (i.e., meditation and education) (Niedderer, 2017). With design ultimately being as influential as it is when it comes to user's behaviors, we propose embedding Mindful Design principles into technology as a solution to digital distraction in order to alleviate workers' pain points in the workplace. Our solution proposes incorporating mindfulness practices in the daily lives of knowledge workers via a digital sphere. In an application context, Mindful Design may come in the form of a chatbot that asks the person these questions before or after they complete a specific task (which could be pre-determined by the individual or organization). It should be noted that Mindful Design does not have to be limited to a chatbot; rather, its principles can be integrated and built into any application.

3.2.2. The intelligent personal assistant as a representation of mindful design

To illustrate the Mindful Work framework and its application in Mindful Design, we suggest a technical solution — human-technology symbiosis — as one example of a path towards more mindful work. In this scenario, technology can be perceived as an intelligent personal assistant (IPA). Much of the literature related to mindfulness has antagonized technology or placed the responsibility of managing digital distraction solely on the human. If artificial intelligence (AI) can augment humans' interactions with the world, then it can also augment their awareness surrounding their digital experiences and emotions.

To discover those patterns of behavior and gain a greater understanding of ourselves, we suggest recruiting artificial intelligence as an ally. People and machines could complement each other: one is curious and sensitive to changes around them and is constantly interpreting the world around them, the other is capable of sustaining attention for long periods of time (Norman, 2017). The symbiosis is made by human and technology cooperating, not competing (Jarrahi, Askay, Eshraghi, & Smith, 2022). AI does not — and will not ever — have the ability to feel emotions in the same way that humans can receive and interpret them. It can, however, use data to help humans be more in touch with their own. If we envision technology as less of a tool and more as a partner that can help us become more aware, we avoid fooling ourselves into thinking that digital distraction is a quick fix.

In an applied setting, the IPA can incorporate Mindful Design manifestations outlined in Table 2 to help the user with their mindfulness practice and become more aware of their actions or behaviors throughout a workday. For instance, the IPA can be programmed to ask a person about their intention (e.g., "*Why am I doing [this action]?*") after a trigger event has occurred, prompting the user to pause and self-reflect. The IPA can also perform periodic check-ins about the user's current emotional and physical well-being. Through this Mindful Design approach, the IPA does not make moral judgments about how the user *should* be feeling; rather, its goal is to simply help the user become more aware of their own feelings and thoughts throughout their work process. With time and consistent interaction with the IPA, the user can strengthen their mindfulness approach within their workplace setting.

Both sides of this human-IPA partnership hold value and provide several affordances to the relationship. The IPA offers personalization through storing users' data, with each person's digital footprint as unique as their genetic code. The IPA offers personalization through user access (i.e., access to the trail of websites that a person visits, which can help the IPA connect patterns of online behavior with the user's emotional patterns). In this scenario, there is a two-way flow of feedback that enhances mutual learning where the IPA learns from humans by observing their personal context and conversely, humans learn from the IPA. Instead of being wholly dependent on this technology, workers work with and alongside the technology to train themselves in mindfulness practices. The question of whether the symbiosis will be just another reliance on technology is a valid and concerning topic. In human-technology symbiosis, users would take on the role as active learners, rather than technology like information dashboards (e.g., Apple's ScreenTime), which treats users as passive recipients of information. In other words, agency is given to humans in human-technology symbiosis.

Recent research has suggested that mindfulness training can be enhanced through a conversational chatbot. Williams, Kaur, Mark, and Thompson (2018) found that a conversational bot aided knowledge workers in detaching from and reattaching to work. The bot used a "pull" rather than a "push" model of interaction; in the "pull" model, the users initiate the conversation with the bot, rather than the information being "pushed" to them. The proposed IPA borrows from Williams et al.'s (2018) work by using emotion-centric dialogue that is personalized for the person (e.g., *"How are you feeling about [the task?]", "What can I do to support myself?"),* a method that demonstrates improvements in sustained productivity.

The IPA of Mindful Work provides the resistance needed to convert the habit of performing a reactive action into a reflective action by prompting a moment of contemplation, as described in the reflective instead of reflexive pillar in Mindful Work and Mindful Design. In this way, it helps the user perform the next action with intention. When the IPA asks a person *"Why are you doing [the task]?",* the intention is *not* to apply normative judgment of what is or is not distracting, but rather to aid user awareness of their behavior and to identify patterns of digital activity and their corresponding consequences of their mental state.

3.3. Implications for research and practice

3.3.1. Research directions

Knowledge work is increasingly mediated by digital technology. Organizations are adopting new digital regimes such as algorithmic management at an accelerated pace, which can in turn transform, but also complicate, how work is performed as well as its boundary with personal life — adversely impacting the attitudes, emotions, and behaviors of workers (Gagné, Parent-Rocheleau, Bujold, Gaudet, & Lirio, 2022). This article presents mindfulness as a potential solution to some of the unintended consequences of digitization.

Mindfulness is not a monolithic but a rather eclectic concept. For that reason, it has been hard to capture and operationalize it in scientific

Table 2
Link between elements of mindful work and mindful design.

Mindful Work Attribute	Present- centered awareness	Deliberate and intentional	Non-judgmental	Attitudes of openness and acceptance	Reflective-instead-of-reflexive reaction
	Attention		Attitude		Action
Design Manifestation	*Asks "What are you doing?"*	*Asks "Why are you doing it?"*	*Asks "How do you feel about it?"*	*Asks "What can I do to support myself?"*	*"How does my action relate to and/or trigger previous habits?"*
	E.g., Technology design helps the user prioritize tasks by asking them about their goals for the day and what they are doing in the present moment.	E.g., Technology learns from past interactions with the user. The feedback loop helps the technology capture and predict the user's intent. The technology learns when to intervene and ask the user why they are doing an action.	E.g., Technology design helps the user flesh out their feeling of the current task without a judgmental perspective. Throughout the day, technology chatbot asks the user about how they feel when they are working on a task. It does not apply moral judgments about how the user *should* be feeling.	E.g., Technology design helps train the user to be more resilient and self-compassionate through reinforcing principles of a growth mindset.	E.g, Technology design helps support self-reflection and behavior change. Technology helps the user identify triggers that spurred past habits so that when the user recognizes them, they take more thoughtful action.

research and more importantly in the design of technologies. Mindfulness as a concept offers promising alternative directions in the design and management of information systems; however, it needs further conceptual advancement, theory building, and empirical testing when it comes to information systems deployment as most research to date has been directed at the design and evaluation of mindfulness interventions in the workplace (Johnson, Park, & Chaudhuri, 2020). The Mindful Work framework and Mindful Design principles presented in this article are some steps towards this goal; however, future research is needed to empirically verify and refine these ideas and ideals. An effective operationalization of such research designs may direct attention to situated practices of workers in their daily personal and work routines and how they integrate and interact with digital technologies. For example, a situated approach could leverage digital diary approaches to capture contextual dynamics around the key questions of what activities with which participants engage, why they engage in those activities and how they reflect upon those situated activities (Jarrahi, Goray, Zirker, & Zhang, 2021).

This article proposes a mindfulness at work framework focused primarily at the individual worker level as it emphasizes how one individual becomes aware of, interprets, and reacts to stimuli. One research area of interest is to investigate how the Mindful Work framework can be applied structurally at the organizational and team levels, as mindfulness at those higher levels may entail different contextual dynamics. One research design supported by this paper is a comparative study between workers using the principles of the Mindful Work framework which are imposed by their team or company, versus workers who have not been instructed to follow mindfulness practices because of their own interests (be independent workers or employees affiliated with an organization). A comparative study as such could both reveal new findings within the framework, as well as investigate its use at the organizational-level.

3.3.2. Practical directions

Much of today's management is still driven by efficiency-centric goals at both personal and organizational levels. These strategies have a long history in organizations that traces back to the Scientific Movement when management researchers became preoccupied with quantifying actions to improve worker efficiency (O'Neill, 2017). Today, we see a similar story at the organizational level; for example, workers in Amazon's fulfillment centers must wear wristbands that track their productivity by calculating their time to complete tasks. Workers who continuously do not meet expectations are let go (Dzieza, 2020). More companies are using Microsoft Workplace Analytics which tracks how long teams spend on email and how frequently they switch between applications. These approaches can raise the productivity and efficiency level in the short term but may have a toll on effectiveness in the long term, increasing emotional labor. At the personal level, self-regulation strategies (e.g., GTD methodology) can be counterproductive by guiding the worker into a vicious cycle of guilt and unachieved goals. These are often reified in the mindset behind the design of "block-and-avoid" technologies.

The *Mindful Work* framework that we advance in this article instead focuses on non-judgmental awareness about one's actions and the self-regulation of emotions and attention. This framework directs attention from fixation with strict time management and productivity optimization towards contemplation of the purpose, openness, acceptance, and management of one's emotion by raising self-awareness. Mindful work is particularly helpful in a digital world marked by constant flow of information, distraction, and disruption, and can be nurtured at both individual and organizational levels. To date, despite all the interest, mindfulness-centered practices as part of professional development training for employees are in their infancy (Johnson et al., 2020). There is still a need for systematic training programs for workers with particular focuses on digital distraction and ways that mindful work can help them tackle affiliated challenges of digital environments.

In this article, we also discussed two common design approaches relative to (1) social and communication tools that undergird our information landscape and (2) common productivity technologies. The concept of mindful design advanced in this article dispenses several of the underlying design choices behind these tools.The design of information communication tools are often based on the attention economy, meaning the business model of applications and media are geared towards hooking users' attention by using psychological tricks (e.g., gamification). Strategies presented in this article under the umbrella of mindful technology can potentially help developers and users of digital technologies to arrive at a more ethically-balanced state where the financial interests of social media companies and the advertisers are balanced against the interest and welfare of their users. The current state of these systems is unsustainable and myopic as Berthon and Pitt (2019) note: "Business models [of these applications] are designed to make us mindless" (p. 36).

Productivity applications often feature endless optimization in one's time management based on universal strategies and best practices (e.g., the GTD methodology or the Pomodoro technique). We argue the design

of these systems can be enriched and complemented with less judgmental and more present-centered ideals presented here in the form of mindful technology, which encourages training of "attentional muscles" of users and their sense of control rather than ceding control to the application.

4. Conclusion

This paper can be interpreted as a call-to-action for integrating mindfulness into digital work practices. We must interrogate what design features exacerbate digital distraction while also imagining work norms and best practices that can best support more mindful usage of technology. As previously outlined, the Getting Things Done (GTD) methodology concentrates on the centrality of the task, yet the study by Williams et al. (2018) suggests focusing on the task may not be the most conducive for work. While there is nothing wrong with meticulously planning tasks, there is a benefit for workers to pause and contemplate their relation to their current surroundings and emotions.

The ethos of the GTD and similar methodologies is embodied in the material design of many self-control applications on the market, particularly those that block functionality. Awareness is a perennial theme of study; however, it is typically found between human beings. We suggest that technology design should be made aware of the humans' patterns (with the human being aware of their own behaviors and emotions), instead of blocking them. Our proposed Mindful Work practice integrates the roles of present-centered awareness in work, non-judgmental attitudes, reflective instead of reflexive reactions, intentions, and attitudes of openness and acceptance.

Digital distraction is caused by a network of semiotic and material actors that reinforce habits. Many factors, such as the material design of technology, institutional pressures from work culture, and societal obsession with status and improvement are difficult to challenge, let alone define. However, there are theoretical frameworks in design that touch on the issue. Mindful Work can complement burgeoning design movements like slow design, reflective design, value-sensitive design, and calm technology. It can be augmented by the organizational studies from behavioral sciences. Together, they can make sense of our increasingly information- and stimuli-rich lives.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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