Please, Let Me Finish! - The Relationship of Technology-Mediated Interruptions with Time Pressure and Task Accomplishment, the Mechanism Responsiveness and the Benefits of Mindfulness.

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Abstract

Technology-Mediated Interruptions are ubiquitous in the workplace today. Their effects on time pressure and task accomplishment are tested in this paper. Responsiveness is proposed as mediator of this relationship. A mindfulness intervention is tested as a potential moderator of the relationship between technology-mediated interruptions and responsiveness. A randomized field intervention study with daily measurements spanning fourteen days was conducted. In this study, 91 employees were randomly assigned to either a mindfulness intervention, or an active stress information control group. Results indicate that technology-mediated interruptions are positively associated with time pressure and negatively associated with task accomplishment. Responsiveness partially mediated the relationship between technology-mediated interruptions and task accomplishment. No significant intervention effect was found. However, if trait mindfulness is considered instead the hypothesized effect was confirmed.

Keywords: technology-mediated interruptions, mindfulness, intervention, responsiveness, time pressure, task accomplishment

Introduction

"Information overload is a symptom of our desire to not focus on what's important. It is a choice." --Brian Solis

Information and communication technology (ICT) has a sizable impact in shaping today's work environments. Workers can now rely on a number of sources to stay connected such as e-mail, text messaging and online collaboration tools. Also enterprise social networks and public social networks like Facebook, LinkedIn and Twitter become progressively more popular in a work context blurring the lines of transition between work and nonwork environments (van Zoonen, Verhoeven, & Vliegenthart, 2017). Furthermore, with the introduction of smartphones, it is also possible to access multiple sources of information simultaneously (van der Schuur, Baumgartner, Sumter, & Valkenburg, 2015). Companies can benefit from this and offer more flexibility where work can be done by for example offering telecommuting (Allen, 2012). Amongst other things, ICTs offer advantages by raising productivity and increasing perceptions of control over location and timing of work (Mazmanian, Orlikowski, & Yates, 2013).

However, ICTs are not free of disadvantages. Although most ICTs can be considered asynchronous communication, people are expected to respond timely to messages that are sent to them (Avrahami & Hudson, 2006). Together with the status of continuous connection this can lead to feeling pressured to respond quickly to ICT messages. This phenomenon is called workplace telepressure (Barber & Santuzzi, 2015). A problem with being highly responsive to ICT messages is that people respond even when they are engaged in a different task. In other words, a high degree of responsiveness at the wrong time might interrupt the ongoing work process (Avrahami & Hudson, 2006). So far, it has been demonstrated that work interruptions have negative effects on performance (Addas & Pinsonneault, 2018), and well-being (Baethge & Rigotti, 2013). More detailed, consequences of interruptions include on the job experiences time pressure and perceived task accomplishment. Time pressure is a job stressor that can be defined as the feeling of having too less time for all the things one has

to do (Parker & DeCotiis, 1983). Perceived task accomplishment is an employees subjective evaluation of progress towards goals (Fisher & Noble, 2004). The relationship between technology-mediated interruptions, responsiveness and these outcomes will be further explored in this paper.

A potential remedy for the negative effects of interruptions could be mindfulness, characterized by present-centered attention and awareness (Brown & Ryan, 2003). It has been shown that mindfulness can annotate the effects of work stress and increase well being and performance (Tetrick & Winslow, 2015). However, due to its mode of operation it is also highly plausible that the positive effects of mindfulness on attentional control and self-regulation could help to prevent or annotate technology-mediated interruptions during the interruption lag (Good et al., 2016). As the content is unknown, usually all messages need to be attended which causes a brief interruption that can itself be disruptive (Avrahami & Hudson, 2006). However, by increased attentional control or in other words "appropriately directing attention amid competing demands", responsiveness could be reduced in favor of the primary task. By not engaging in a secondary task or delaying it, the time that it takes to resume and complete the primary task could be reduced. This could be highly beneficial as the resumption lag is often regarded as the main cost of interruptions (Baethge & Rigotti, 2010). This second mode of mindfulness will be the focus of this study.

The objective of this present study is to elaborate and enlarge on the previously detailed lines of research. Firstly, this is done by expediting what is known about technology interruptions in the workplace and their effect on on-the-job experiences, in this case time pressure and task accomplishment. Secondly, the mode of action of a low-dose mindfulness self-training intervention that is tailored to the needs of employees is further explored (Hülsheger, Alberts, Feinholdt, & Lang, 2013; Hülsheger, Feinholdt, & Nübold, 2015). Uniquely, this intervention is tested as means to inoculate employees against the negative effects of work interruptions thereby furthering the insights of recovery literature. Lastly, responsiveness is investigated as a relatively novel mechanism that explains how employees deal with technology-mediated interruptions when at work (Sonnentag, Reinecke, Mata, & Vorderer, 2018). Considering the omnipresence of technological interruptions on the modern

workplace, responsiveness and what influences it could turn out to be the tipping of the scales between effective work processes and employee ill-being. Methodologically, the set-up of this study as a randomized field trial with event-sampling methodology, combined with a fourteen-day diary design can be beneficial. Data is gathered in a naturalistic setting and the likelihood of recall biases is reduced (Ohly, Sonnentag, Niessen, & Zapf, 2010; Reis, Gable, & Maniaci, 2013). Thereby, the mode of operation of the variables of interest can be investigated more thoroughly compared to regular set-ups involving only pre- and post-intervention measurements.

Theoretical Background

Technology-Mediated Interruptions

One problem arising from online messages, notifications or using multiple devices is a break in continuity in an employee's workflow. Interruptions in general are often defined as "incidents impeding or delaying organizational members as they attempt to make progress on work tasks" (Jett & George, 2003). They can be further divided into internally-motivated self-interruptions (Adler & Benbunan-Fich, 2013) and external interruptions that are caused by unintended and uncontrollable occurrences. The latter are the focus of this study, more specifically external interruptions that require the completion of a secondary task (Baethge & Rigotti, 2010). Baethge and Rigotti (2013) proposed an integrative framework of the interruption process following a single interruption: When being engaged in a primary task that is disrupted there is an interruption lag that is made up of the perception, interpretation, definition and preparation of an interrupting demand. Followingly, the cued secondary task is completed. After this, the primary task is not directly resumed, but is further delayed by the resumption lag, which is called "one of the main costs" of interruptions. On a cognitive level dealing with interruptions can be explained by the action regulation theory (ART, Hacker, 2003). It claims that, to carry out an action an appropriate goal must be set, an action plan needs to be developed or recalled, and the plan must be executed. During the execution, progress and outcomes are monitored. Work interruptions under this theory are regulation hindrances and function as stressors entailing costs (Baethge & Rigotti, 2013). This is the

case as, handling the interruption requires the creation of a new action plan while the old one is kept activated. Consequently, additional cognitive resources need to be mobilized (Hacker & Sachse, 2014). In real-work settings, multiple interruptions accumulate over the course of a working day. Therefore, the focus of this study lies on cumulative interruptions. Due to interactions between attentional demands and regulations, cumulative interruptions further increase the need for them (Baethge & Rigotti, 2013). The associated costs include deterioration of performance (Addas & Pinsonneault, 2018), and a decrease in overall well-being (Baethge & Rigotti, 2013).

One subclass of interruptions becoming more and more influential in the knowledge economy are interruptions by online messages or other technology-mediated interruptions (Chen & Karahanna, 2018; Sonnentag et al., 2018). A number of studies have explored the interrupting effects of e-mails (Addas & Pinsonneault, 2018), texting and social networks(Fox, Rosen, & Crawford, 2009).

Technology-mediated interruptions and time pressure. Technology-mediated interruptions are positively associated with time pressure. To begin with, a general observation is that interruptions increase the time it takes to complete the interrupted task (Monk, Boehm-Davis, Mason, & Trafton, 2004). The reason for this is twofold. Firstly, when interrupted one needs to employ cognitive regulations that are time consuming. This in in line with action regulation theory (Hacker, 2003). Secondly, dealing with an interruption implies a second task that needs to be attended to. This second task however small it may be needs time for completion. As these tasks are often not anticipated, they usually require additional time (Parke, Weinhardt, Brodsky, Tangirala, & DeVoe, 2018). Although individual interruptions only lead to small time loss, when aggregated over a wider timeframe, such as a workday their impact can become sizable (Baethge, Rigotti, & Roe, 2015). The consequence is that more tasks than anticipated need to be completed and that less time than planned is available for primary tasks. This can result in time pressure, the feeling of having too less time for all the things one has to do (Parker & DeCotiis, 1983). By means of a diary study assessing nurses, Baethge and Rigotti (2013) found a positive association between perceived workflow interruptions and the experience of time pressure. Moreover, a simulation study

with German university students by Mark and colleagues (2008) found a significant positive association between interruptions and perceived time pressure. Additionally, Sonnentag and colleagues (2018) found a significant positive association between technology-mediated interruptions and time pressure, using a diary design. Hence it is hypothesized that:

> *Hypothesis 1a: Perceived technology-mediated interruptions are positively related to time pressure. Employees who score low on interruptions have less time pressure than employees who score high on interruptions.*

Technology-mediated interruptions and task accomplishment. Perceived task accomplishment will be negatively affected by technology-mediated interruptions. Throughout a working day, employees judge how effectively they are working, as well as their progress towards assigned tasks or goals. The subjective experience arising from these everyday work situations can be referred to as the perceived task accomplishment (Fisher & Noble, 2004). When interrupted, the progress on the primary task is usually negatively affected (Trafton & Monk, 2007), as the time it takes to accomplish the task increases (Eyrolle & Cellier, 2000). Furthermore, additional time is needed to complete the secondary task. As described previously, additional interrupting tasks are often not accounted for when scheduling the time that is needed to complete primary tasks during the work day (Baethge et al., 2015; Parke et al., 2018). This could negatively affect an employee‘s evaluation of their work progress. Furthermore, resources are mobilized in order to deal with the increased workload caused by interrupting tasks; these resources are not infinite and will overtime be depleted (Hacker, 2003; Hockey, 1997). Therefore, interruptions that arise over a workday can lead to an increase in errors and a failure to complete the primary task (Pachler et al., 2018). Struggling to accomplish the tasks scheduled for the day, together with an increase in errors during the primary task will likely lead employees to be dissatisfied with their performance. In a five day diary study assessing the impact of technology-mediated interruptions on the workplace, Sonnentag (Sonnentag et al., 2018) found a negative association of interruptions caused by online messages with perceived task accomplishment. Additionally, also using a diary design Baethge and colleagues (2013) showed that

interruptions are negatively related to daily satisfaction with personal work performance. Therefore, it is hypothesized that:

> *Hypothesis 1b: Perceived technology-mediated interruptions are negatively related to perceived task accomplishment.*

The Mediating Role of Responsiveness

Being constantly connected and potentially available for communication leads to employees being preoccupied with ICT messages and a strong need to be responsive. Although ICT's are mainly asynchronous forms of communication, co-workers often expect an immediate answer more characteristically of synchronous communication (Barley, Meyerson, & Grodal, 2011). This on-the-job experience was synthesized by Barber and Santuzzi (2015) as workplace telepressure: "thinking about ICT messages accompanied by an overwhelming urge to respond". Although ICTs inherently provide employees with more control and autonomy, the pressure to answer immediately negates the benefits and calls for high responsiveness (Mazmanian et al., 2013). Responsiveness is considered high when emails and other online messages are responded with short latencies (Kalman, Scissors, Gill, & Gergle, 2013). A reason for the perceived importance of responsiveness is that responding fast to incoming messages serves a social function. In the absence of nonverbal cues that are usually available in synchronous communication, communicators online make use of chronemics. Chronemics are time-related information, such as the time of the day, pauses and conversational rhythms (Kalman et al., 2013). These cues are used for impression formation (Kalman & Rafaeli, 2011) and additionally can become normative in an organization leading to telepressure and in turn increased responsiveness (Barber & Santuzzi, 2015). Moreover, if one is frequently interrupted by online messages during the day, attention shifts to these messages increase their salience (Kalman & Ravid, 2015). Consequently, technology interruptions are associated with increased responsiveness (Sonnentag et al., 2018).

Adopting a deep level perspective towards the role of responsiveness during the interruption process, the interruption lag is of importance. During the interruption lag, it is possible to diminish the consequences of interruptions. By finishing the task or by leaving it

in a state that permits efficient recall, regulatory demands are reduced (Baethge & Rigotti, 2010). On the contrary, responsiveness calls for short response latencies analogous to a short interruption lag. If an employee decides to abandon their primary task in order to be responsive to online messages this is likely to lead to regulation hindrances resulting in psychological costs. Therefore, responsiveness can be seen as a mechanism that stands between interruptions and their consequences (Sonnentag et al., 2018). More specifically, responsiveness is likely to influence the on-the-job experienced time pressure in a way that increased responsiveness will lead to more time pressure. An experimental study by Bailey and colleagues (2006) showed that if a primary task is interrupted by a peripheral task participants perform the primary task 3% to 27% slower than if not interrupted. If the secondary task is presented between primary tasks there was no significant increase in task completion time. Additionally, in a field study Eyrolle and colleagues (2000) observed commercial telecommunication. While completing their routine work, employees had to process modifications to customer data in response to phone calls and letters. As employees cannot predict incoming modification requests, they can be seen as interruptions. In response to the interruption employees had the possibility to complete their primary task before dealing with the modification. However, this option was only used in 17% of the cases. In most cases, operators processed the interrupting task immediately leading to additional time and regulation costs. Therefore, it can be argued that the time consuming effect of an interruption depends upon whether a primary task is disrupted for it. In the case of online messages to which it is responded with short latencies, it can be seen as an immediate interaction with the interruption, thereby leading to costs, which can lead to time pressure. The inclusion of a direct link between responsiveness and time pressure improved the fit of Sonnentag's (2018) model which was used to specify how interruptions by online messages are related to affect states. The rationale for this was, that being responsive uses time resources. Therefore, it is hypothesized that:

> *Hypothesis 2a: The relationship between technology-mediated interruptions and time pressure is mediated by responsiveness.*

Additionally, aside from the direct negative association between technology-mediated interruptions and task accomplishment, it is expected that there will be an indirect negative relationship between technology-mediated interruptions and perceived task accomplishment via responsiveness. According to Sonnentag and colleagues (2018), being responsive to technology-mediated interruptions is not inherently bad. They argue for a multiple goal perspective regarding the secondary tasks. A different perspective is put forward by research on planning, in which it has been shown that employees use different types of planning to generate goals (Parke et al., 2018). According to Parke and colleagues (2018), employees that use time management planning (TMP, prioritizing tasks), the positive effects of planning are lessened when facing many interruptions throughout the workday. Additionally, if an employee uses contingent planning, he accounts for possible interruptions in the task process. This has been shown in a 2-week experience-sampling study. The experience of an employee using TMP can be illustrated by an example: if an employee who plans to write two pages of a report is interrupted by a colleague after writing only one page, he will have a decreased sense of task accomplishment, than if he would have been able to progress as planned (Beck, Scholer, & Hughes, 2017). Accordingly, this seemingly parsimonious strategy of goal generation (TMP) is assumed in this paper. To summarize, task accomplishment can be defined as the appraisal of progress towards goals (Fisher & Noble, 2004). For employees planning tasks ahead, delays in completion of planned tasks results in a comprised goal progress. (Parke et al., 2018). Upon this and the effect of responsiveness during the interruption lag, a negative effect of high responsiveness on task accomplishment can be predicted. Hence it is hypothesized that:

Hypothesis 2b: The relationship between technology-mediated interruptions and task accomplishment is mediated by responsiveness.

The Moderating Role of Mindfulness

Mindfulness can be defined as “attention to the experiences occurring in the present moment, in a non-judgemental or accepting way” (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006, p. 27). Inspired by buddhist tradition, mindfulness training firstly gained

importance as therapeutic tool managing chronic illnesses (Kabat-Zinn, 2006). Nowadays, it has also gained attention in the field of work and organizational psychology (Glomb, Duffy, Bono, & Yang, 2011). Various psychological benefits of mindfulness practice have been shown by a number of studies. Amongst other things, it improves sleep quality, job satisfaction, detachment from work, positive affect, self-efficacy and reduces distress, emotional exhaustion, as well as work-family conflict (Tetrick & Winslow, 2015).
It has been found that there are differences between individuals in how often they engage in states of mindfulness and that this difference can be considered a stable trait: trait mindfulness. However, the extent to which individuals are aware of and pay attention to stimuli that are happening in the moment (state mindfulness) can be considered a psychological state and varies from moment to moment (Glomb et al., 2011). Using a mindfulness intervention and the included continuous practice, state mindfulness can be increased (Hülsheger et al., 2015). In turn, with enough intensity, duration and frequency of practice the mode of state mindfulness can become more stable and leads to controlled attention in routine context (Jamieson & Tuckey, 2017). Additionally, evidence from neuroimaging studies suggests that mindfulness practice achieves this by changing underlying processes (Slagter, Davidson, & Lutz, 2011). Traditional mindfulness programs like Mindfulness-Based Stress Reduction are characterized by a relatively long duration (8 weeks) and involve group-training sessions and a coach (Kabat-Zinn, 1990). However self training interventions of much shorter duration have been proven beneficial as well (Hülsheger et al., 2013). For a working population, brief self-training interventions might be more prosperous, as they can be more easily integrated into daily routines (Moore, Gruber, Derose, & Malinowski, 2012).

Mindfulness reduces responsiveness by influencing attention. A brief self-training mindfulness intervention could reduce responsiveness to technology-mediated interruptions. During the interruption lag the primary task is often quickly abandoned in favor of short response latencies. However, a longer resumption lag would be beneficial, as regulatory processes resulting in costs could be diminished (Baethge & Rigotti, 2010). In an experimental study, Tams and colleagues (2015) found subjects with greater inhibitory deficit

to be more likely to experience negative effects of technology-mediated interruptions under conditions of high interruption salience. Furthermore, results of a correlational field study by Russell and colleagues (2017) suggest that low conscientiousness is related to more frequent email checking due to deficits in constraining attentional responses. According to Good's (2016) integrative framework relating mindfulness to workplace outcomes, mindfulness firstly positively affects attention. More accurately, attentional stability, control and efficiency. Attentional control means to "appropriately directing attention amid competing demands" (Ocasio, 2011). Mindfulness affects attentional control amongst other things by reducing attention to distracting information (Good et al., 2016). Results of a longitudinal randomized control group EEG study by Moore and colleagues (2012) suggest that mindfulness meditation alters the allocation of cognitive resources, improving self-regulation and attention. Other studies have found meditators to be less distractible by regular (Tang et al., 2007) and also emotional distractions (Allen, 2012). Mindfulness can be viewed as an effective emotion-regulation strategy (Hülsheger et al., 2013). As for example, meditators have been shown to accept unfair offers in prison games more often, choosing the economically right strategy instead of the emotionally and socially guided one (Kirk, Downar, & Montague, 2011).

As reacting highly responsive to online messages can be seen as socially motivated and acts as a social cue itself (Kalman et al., 2013), it is plausible that workers high in trait or state mindfulness are better able to resist this emotional response resulting in decreased responsiveness. All in all, instead of quickly shifting attention in favor of responsiveness, it is likely that high levels of mindfulness increase the tendency to stick to a primary task or prolong the interruption lag. Therefore, a third Hypothesis is proposed:

> *Hypothesis 3: A mindfulness intervention moderates the positive relationship between technology-mediated interruptions and responsiveness, such that the relation is weaker in the mindfulness intervention group compared to an active control group.*

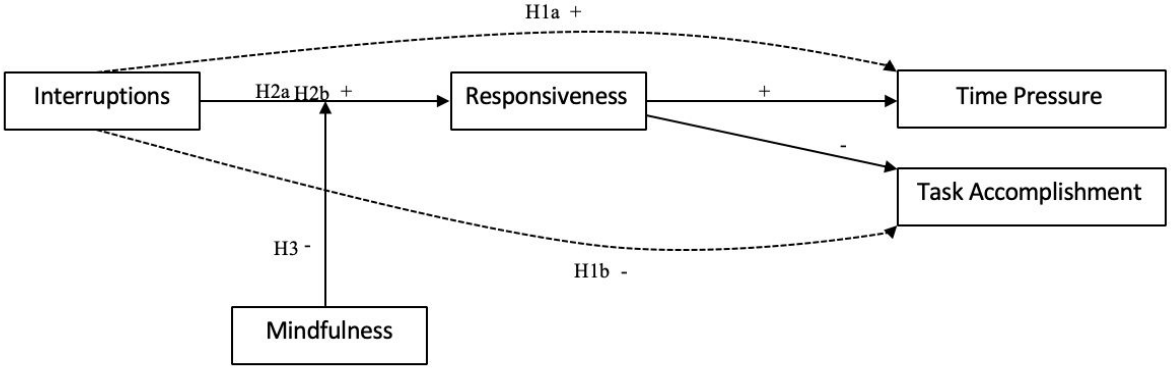

Figure 1. Model overview

Method

Study Design

The present study consists of a randomized field experiment combined with experience sampling methodology (ESM). Participants were randomly allocated to an intervention group or an active control condition. The data collection was based on an online diary survey spanning 14 work days. In order to investigate outcome variables that are dynamic, ongoing experiences over a certain period of time, a time-based design was chosen (Bolger, DeLongis, Kessler, & Schilling, 1989). In a recovery context, the variables of interest have been shown to be subject to daily fluctuations, therefore a fixed-time schedule can be viewed as suitable assessment approach (Sonnentag, Binnewies, & Mojza, 2008). In accordance with other day-level research, one measurement point in the afternoon was judged to be sufficient in order to recall experiences of the day (Sonnentag et al., 2008). Similarly to other diary based research a data collection period of two working weeks was chosen (Hülsheger et al., 2015). Especially in the field of work and organizational psychology, the diary study approach has several advantages. Firstly, it allows to gather data in a naturalistic setting (Reis et al., 2013). Secondly, diary designs can reduce retrospective

bias (Ohly et al., 2010). When a person is asked to describe an emotional experience that lies in the past, the answer is likely subject to state-congruent recall, whereby states similar to the state in the moment of recall have higher valence (Bower, 1981). This subjective aggregate of experience can be viewed as systematic measurement error that is solved by diary studies allowing an empirical aggregate of experience (Bolger, Davis, & Rafaeli, 2003; Ohly et al., 2010).

Sample and Procedure

Procedure. Participants were recruited via an anonymous link to the data collection software Soto developed by Maastricht University. After agreeing to participate, they had to provide an e-mail address to which all further study materials were sent. At this point they were randomly assigned to a self-training mindfulness intervention or a control group that received information about stress reduction. Followingly, they were sent a link to a general survey that was the same for both groups, as well as an e-mail containing group specific information. Over the next 14 days, participants received an e-mail containing material either for the self-training mindfulness intervention or the stress-info control group once a day at 8:00 am. E-mail invitations that lead to a daily survey were sent to the participants every day at 4:00 p.m.. This time was chosen in accordance with other day-level research and should limit interruptions to ongoing work caused by the study. It was judged that 4:00 p.m. should be towards the end of the work day for most participants (Sonnentag et al., 2018). Furthermore, participants were instructed to complete the survey at the end of their work-day. In order to not interrupt ongoing task accomplishment, the survey could be filled in until 2:00 am the next day. The daily surveys included a manipulation check that asked the participants to indicate how long they practiced mindfulness on the previous day.

The self training mindfulness intervention. The mindfulness intervention used was a self-training intervention that was developed and tested by Hülsheger et. al. (2013, 2015) and was based on basic principles of Mindfulness-Based Stress Reduction (MBSR) (Kabat-Zinn, 1990) and Mindfulness-Based Cognitive Therapy (MBCT) (Segal, Teasdale, Williams, & Gemar, 2002). Like the aforementioned approaches the intervention used aimed at fostering

moment-to-moment non-judgemental awareness. Additionally, improving self-observation and cultivating a detached view of one's thoughts can be regarded as desired consequences (Fjorback, Arendt, Ørnbøl, Fink, & Walach, 2011). The present intervention consists of information texts, daily guided mindfulness meditations and exercises that participants are advised to integrate in their daily life. The guided mindfulness meditations included instructions for a Body Scan, Three-Minute Breathing Space, a Mindful Routine Activity exercise, and Loving Kindness Meditation exercises. The exercises were introduced one after another in the previously mentioned order and the recorded instructions used were the same as utilized by Hülsheger (2015). Additionally to the recorded instructions, participants received information texts when an exercise was introduced for the first time. On day five, participants were sent a brochure that summarized information about all previously introduced exercises and their backgrounds. Short descriptions of the exercises and a schedule of when they were performed can be found in Table 1.

Table 1. Daily schedule and description of exercises used in the mindfulness intervention

Day	Three-minute breathing space	Body scan	Loving kindness		Mindful routine activity
			Me	Friend	
0	X				
1		X			
2	X		X		
3	X			X	
4	X				X
5	X		X		
6		X			
7	X			X	
8	X		X		
9	X			X	
10		X			

11		X				X			
12		X							X
13		X						X	
14				X					

Three-Minute Breathing Space. Also sometimes described as mini-meditation encourages stepping out of automatic pilot functioning and establishing awareness to the present moment (Baer, 2014). The exercise is divided into three parts. In the first minute the participant focuses on internal experiences happening in the moment. During the second part attention is focused on the sensation of breathing. Lastly during the third minute this awareness is expanded to the body as a whole. During the whole exercise an attitude of non-judgemental perception is fostered. Thereby, the exercise is not only focused on relaxation but cultivates skill-full responding to situations rather than automatic reactions (Siegel, 2010).

Body Scan. Participants are guided to notice their bodily sensations from their toes moving upwards towards their head. However, they are instructed to experience them with openness and curiosity in contrast to changing them. When the mind wanders off during this process one should direct attention back to the body without criticizing oneself for losing focus. The body scan combines several mindfulness skills like present moment orientation, openness and a non-judgemental attitude (Kabat-Zinn, 1990).

Loving Kindness. Feelings of kindness towards self and other are central to the loving kindness exercise. Firstly, the loving kindness - Me exercise is introduced. After initially focusing on the sensation of breathing the participant is instructed to repeat positive sentiments towards himself. Examples of these include the sentences “may I be happy” or “may I be healthy and strong” (Baer, 2014). Following, during the loving kindness - friend exercise the participants are instructed to extent the sentimemens uttered during loving kindness - me to a person that is close to them. The loving kindness exercises differ from other mindfulness exercises in the way that feelings are created in contrast to non-judgmental moment to moment experience (Hutcherson, Seppala, & Gross, 2008).

Mindful Routine Activity. In this exercise, a routine activity from the subjects daily life is chosen. Examples of these activities include taking a shower, brushing teeth. Subsequently, the participant is instructed to perform this routine activity in a mindful manner with full attention. When distracting thoughts arise or the participant falls back in automatic functioning, attention should be directed towards the routine activity again.

The active control group. With the goal of reducing demand characteristics and clearing up treatment effects, an active-control condition was constructed. In order to be relevant, the control intervention needs to be structurally comparable to the mindfulness intervention expect for effects specific to mindfulness meditation (Davidson, 2010). Furthermore, to be useful as control condition the proposed intervention needs to consist of elements that can be judged to improve the same target variable (M. Allen et al., 2012). Therefore, information and instructions for behaviours that can reduce stress were provided to the participants. Among the non-specific characteristics of the intervention that were similar for both groups were the distribution of material via email, scheduling of material over fourteen days and evoking of positive expectations. Participants received emails providing information daily stressors and techniques for recovery from work. For example, techniques how to distract oneself from stressors and information about sports as recovery technique were provided. The participants were encouraged to implement the provided suggestions into their daily routines.

Sample. The initial sample for this study was drawn by a convenience mechanism from a wide range of organisations from Germany (Handcock & Gile, 2011). Further participants were instructed to forward the study information to people in their network that also fit the study requirements. This approach is called snowball sampling and is often used in work and organizational research (Wheeler, Shanine, Leon, & Whitman, 2014). 257 people were approached by the researches of whom 114 entered data collection. The resulting response rate was 44.36%. The use of snowball sampling however makes it difficult to estimate the actual response rate. Because participants were instructed to forward the link of

the study without being instructed to document the individuals they sent it to, the number of people approached in this manner is unknown to the researchers. Therefore, the actual response rate is likely lower (Hülsheger et al., 2015). The final sample included 91 participants of whom 39.6% were male and 60.4% female. Age ranged from 20 to 65 (M = 40.93, SD = 14.62). The average time spent working was 35.58 hours per week (SD = 11.73). As expected, the sample included a wide range of occupations.

Measures

Data collection consisted of two parts: a general survey and a diary part. First participants answered a general questionnaire that assessed demographic variables (e.g. age, gender, occupation, previous experience with relaxation techniques) and trait mindfulness. The general questionnaire was completed once before starting the intervention. The second part of data collection consisted of a daily survey that contained scales measuring technology-mediated interruptions, state mindfulness, responsiveness, time pressure and task accomplishment. The last diary survey included a measure of trait mindfulness like the general survey. All scales except the Mindfulness@Work scale by Hülsheger and Alberts (2019) that was available in a German version, were translated from English to German by means of forward translation (Degroot, Dannenburg, & Vanhell, 1994). First all items were translated from English by three bilingual native German speakers. Afterwards the most fitting translation out of the three was selected. This was done in order to guarantee that meaning and content of the items was not changed. All items of all scales were measured on a 5- point Likert scale ranging from 1 (I fully disagree) to 5 (I fully agree).

Technology-Mediated Interruptions. Interruptions perceived by the participants during their daily working hours were assessed with three items developed by Ten Brummelhuis, Bakker, Hetland & Keulemans (2012). However, instead of the original items an adapted version by Sonnentag et al (2018) was used in which the initial items were changed from “e-mails and phone calls” to “e-mails and other online messages”. Sample items are: “Today, incoming e-mails and other online messages kept me from doing my job.” and “Today, e-mails and other online messages disturbed me in doing my work.”.

Trait Mindfulness. For measuring trait mindfulness the 22- item mindfulness @ work scale by Hülsheger and Alberts (2019) was used. This scale was specifically designed for the working environment. Example items are: "In work meetings, I can easily focus on what it going on without starting to think about something else." and "I think some of the emotions I experience at work are bad or inappropriate and I should not feel them.".

State Mindfulness. Daily levels of state mindfulness were measured after work using the 7-item version of the mindfulness @ work scale that was assembled by Hülsheger and Alberts (2019).

Responsiveness. Participants responsiveness to online messages was assessed by using a three-item scale developed by Sonnentag et. al. (2018): The items contained for example: "Today, incoming e-mails and other online messages kept me from doing my job," and "Today, e-mails and other online messages disturbed me in doing my work.".

Time Pressure. Based on scales by Semmer (1984) and Zapf (1993), time pressure was assessed. The items were adapted by Sonnentag (2018) in order to reflect day-specific assessment. In total the scale contains four items. A sample item is: "When completing my tasks today, I was required to work fast".

Task Accomplishment. Assessment of task accomplishment on the daily level was done by using four items that reflect subjective goal progress and task related success (Ohly & Schmitt, 2015; Sonnentag et al., 2018). The items were formulated like this: "I completed my tasks successfully." and "I realized how well I am doing my work.".

Statistical Analysis

The collected data is hierarchically structured. It contains day-level data (Level 1: state mindfulness, technology-mediated interruptions, responsiveness, time pressure, task accomplishment) that is nested within persons (Level 2: trait mindfulness, intervention group) (Ohly et al., 2010). Therefore, hierarchical linear modeling was chosen as the most fitting analysis strategy. Hierarchical linear modeling is applicable for the analysis of longitudinal data also if time is not a variable of interest (J. B. Vancouver, Thompson, & Williams, 2001; Jeffrey B. Vancouver, Thompson, Tischner, & Putka, 2002). Additionally, it is robust to

participant loss and well suited for investigating work characteristics and outcomes that are measured on multiple data-collection points (Schonfeld & Rindskopf, 2007). All predictor and mediator data was centered around the person mean. Centering day-level data in this way removes between-person variance from the variables. As the data did not show violations against multi level assumptions, different models were tested against each other. A significant chi-square test of the difference between maximum likelihood statics of two models, thereby indicates a better model fit. For Level 1 data random intercept, fixed slope models were calculated and compared to unconditional random intercept model. A proposed mediation effect in Hypotheses 2a and 2b was tested utilizing Baron and Kenny's analytical procedure (Baron & Kenny, 1986). According to this approach (1) the predictor must be related to the dependent variable (path c), (2) the predictor must be related to the mediator (path a), and (3) the mediator must be related to the dependent variable to establish mediation (path b, path c') (Baethge & Rigotti, 2013; Frazier, Tix, & Barron, 2004). Lastly, in order to test for an interaction effect of the level 2 predictor intervention on the relationship between technology interruptions and responsiveness, a random slope model including an interaction term was computed. Subsequently, it was compared to a random intercept, fixed slope model.

Results

Means, standard deviations, Cronbach's α, intra-class correlations and intercorrelations at the day- and person-level are displayed in Table 2. In order to compute the person-level intercorrelations, level 1 data was combined and averaged to the person level. Additionally, Cronbach's α were calculated per scale for every day and then averaged. The reliability analysis showed high internal consistency for all scales (α=.78-.88), except for time pressure (α=.34) (Cortina, 1993). Lastly, to decompose the variance ICCs were calculated using unconditional random coefficient models (Ployhart & Bliese, 2006). The ICCs show that responsiveness, time pressure and task accomplishment all have a proportion of variation explained by between-person variation, as well as within-person variation (cf. Table 2). For example, 46% of the variation of responsiveness can be explained by between-person variance, while 54% is due to within-person variation. Therefore, multilevel

modeling can be seen as appropriate analysis strategy, as a trait and state structure of constructs can be inferred.

Table 2. *Summary of means, standard deviations, intercorrelations, ICC's and Cronbach's alpha reliabilities*

Variable	*M*	SD	ICC	1	2	3	4	5	6
Person Level									
1. Trait Mindfulness	5,22	.70	-	α =.88					
Day Level									
2. Perc. Interruptions	1.93	.73	-	-.33**	α=.87	.42**	.21**	-.35**	-.26**
3. Responsiveness	2.06	.78	.46	-.42**	.71**	α=.90	.07	-.28**	-.3**
4. Time Pressure	2.9	.75	.35	.03	-.29**	.13	α=.34	-.2**	-.06
5.Work Performance	3.66	.70	.31	.27*	.34**	-.27**	-.13	α=.78	.34**
6. State Mindfulness	3.91	.59	-	.67**	-.45**	-.45**	- .18	.46**	α=.78

N = 91 Data below the diagonal show correlations at the between-person level, with day-level measurements being aggregated to the person level. Data above the diagonal show correlations at the within-person level. Cronbach's α is shown on the diagonal.
* $p < 0.05$, ** $p < 0.01$

Hypothesis Testing

Technology-mediated interruptions and time pressure. Hypothesis 1a proposes that technology-mediated interruptions are positively related to time pressure. Therefore, a direct relationship between the constructs was tested. The results can be found in Table 3. To begin with, a null model (unconditional random intercept model) was created. Subsequently, technology-mediated interruptions were included as predictor in a random intercept, fixed slope model. The model fit improved significantly (difference of-2*log= 15.92, df=l,p <.001). It was found that technology-mediated interruptions were a significant, positive predictor of time pressure (estimate = 0.27, t = 4.04,p < .001.) Hypothesis 1a was fully supported.

Table 3. *Multilevel Models Predicting Time Pressure from Technology-Mediated Interruptions.*

	Null Model			Model 1		
	Estimate	*SE*	*t*	*Estimate*	*SE*	*t*
Fixed Effects						
Intercept	2.88	.08	36.18***	2.88	.08	36.19***
Perc. Interruptions				.27	.07	4.04***
Random Effects						
Residual	.62	.05		0.59	.04	
Intercept	.39	.08		0.40	.08	
-2*LL	1128.77			1112.85		
Δ -2*LL				15.92***		

Note. Models are random intercept, fixed slope models. $N = 91$ at the person level

$p < 0.05$, ** $p < 0.01$, ***$p < .001$ (two-tailed)

Δ. = difference; SE = standard error; LL = log likelihood.

Technology-mediated interruptions and task accomplishment. Hypothesis 1b stated that technology-mediated interruptions are negatively related to perceived task accomplishment. This direct relationship was again tested by firstly calculating an unconditional random intercept model. The results can be found in Table 4. After including technology-mediated interruptions as a predictor of task accomplishment the model fit significantly increased (difference of-2*log= 46.25, df=l,p <.001). The estimate suggests a significantly negative association between technology-mediated interruptions and perceived task accomplishment (estimate = -0.33, t = -7.03,p < .001). In other words, Hypothesis 1b was fully supported.

Table 4. *Multilevel Models Predicting Perceived Task Accomplishment from Technology-Mediated Interruptions.*

	Null Model			Model 1		
	Estimate	*SE*	*t*	*Estimate*	*SE*	*t*
Fixed Effects						
Intercept	3.67	.07	49.39***	3.66	.07	49.42***
Perc. Interruptions.				-.33	.05	-7.03***
Random Effects						
Residual	.33	.03		.29	.02	
Intercept	.39	.07		.40	.07	
-2*LL	912.45			866.20		
Δ -2*LL				46.25***		

Note. Models are random intercept, fixed slope models. $N = 91$ at the person level

$p < 0.05$, ** $p < 0.01$, ***$p < .001$ (two-tailed)

Δ. = difference; SE = standard error; LL = log likelihood.

The mediating role of responsiveness. A mediation model is investigated in the second set of hypotheses. Hypothesis 2a states that the relationship between technology-mediated interruptions and time pressure is mediated by responsiveness. The Baron and Kenny method was used to investigate this (Baron & Kenny, 1986). The first prerequisite condition of the aforementioned method dictates that technology-mediated interruptions must be a predictor of time pressure. This is the total effect model also called path c and establishes that there is an effect that is potentially mediated. The outcome is analogous to Hypothesis 1a and was significant. In order to test if step 2 is given, technology-mediated interruptions were added to a model as a predictor of responsiveness. Establishing path a, it demonstrates that the causal variable is correlated with the mediator. Compared to the null model of responsiveness, model fit increased significantly (difference of-2*log= 65.61, df=l,p <.001). This confirms step 2 as it showed that technology-mediated

interruptions were significantly related to responsiveness (estimate = .05, t = 8.5,p < .001). In order to confirm the mediation effect, both technology-mediated interruptions and responsiveness were added to a random intercept, fixed slope model as predictors in Step 3/4. Firstly, this was done to show that the mediator affects the outcome variable while controlling for the causal variable (path b). Secondly, the same model can be used to estimate and test path c'. Full mediation is established if the effect of technology interruptions on time pressure controlling for responsiveness is no longer significant. The model was compared to the null model of time pressure. Although the model fit significantly increased (difference of-2*log= 20.42, df=2,p <.001), a mediation effect could not be confirmed, as responsiveness did not significantly predict time pressure in the presence of technology-mediated interruptions (estimate = .05, t = 8.5,*p* = 0.63). Therefore, Hypothesis 2a was not supported.

Hypothesis 2b similarly suggests, that the relationship between technology-mediated interruptions and task accomplishment is mediated by responsiveness. Step 1 was again the same as Hypothesis 1b and was found to be significant. Step 2 was the same as for Hypothesis 2a and also showed a significant association. In comparison to the null model of perceived task accomplishment, model fit increased significantly in step 3 (difference of-2*log= 58.86, df=2,p <.001). It was confirmed that responsiveness is a significant mediator of the relationship between technology-mediated interruptions and perceived task accomplishment (estimate = -.12, t =-2.92,p < 0.01). However as technology-mediated interruptions remain a significant predictor in the presence of responsiveness (estimate = -.27, t = -5.27,p < .001), only partial mediation is found. Therefore, Hypothesis 2b was partially supported. The analyses are displayed in more detail in Table 5.

Table 5 *Multilevel Estimates of the Mediation Effect of Responsiveness on the Relation between Perceived Interruptions and Time Pressure and the Mediation Effect of Responsiveness on the Relation between Perceived Interruptions and Perceived Task Accomplishment.*

	Time Pressure						Task Accomplishment					
	Step 1			Step 2			Step 3/4			Step 1			Step 2			Step 3/4		
Variable	*Estimate*	*SE*	*t*	*Estimate*	*SE*	*t*	*Estimate*	*SE*	*t*	*Estimate*	*SE*	*t*	*Estimate*	*SE*	*t*	*Estimate*	*SE*	*t*
Fixed Effects																		
Intercept	2.88	.08	36.19***	2.03	.08	24,46***	2.88	.08	36.36***	3.66	.07	49.42***	2.03	.08	24,46***	3.67	.074	49.59
Perc. Interruptions	.27	.07	4.04***	.05	.06	8.5***	.29	.07	3.88***	-.33	.05	-7.03***	.05	.06	8.5***	-.27	.05	-5.27***
Responsiveness							-.03	.06	-0.48							-.12	.04	-2.92** [a]
Random Effects																		
Residual	0.59	.04		.45	.03		.59	.04		.29	.02		.45	.03		.28	.02	
Intercept	0.40	.08		.48	.09		.39	.08		.40	.07		.48	.09		.4	.07	
- 2*LL	1112.85			1040.18			1108.35			866.20			1040.18			853.58		
Δ -2*LL	15.92***			65.61***			20.42***			46.25***			65.61***			58.86***		

Note. Models are random intercept, fixed slope models. $N = 91$ at the person level. Step 1: Perceived interruptions predict Time pressure / perceived task accomplishment (path c). Step 2: Perceived interruptions predict responsiveness (path a). Step 3/4: Mediation model; Perceived interruptions predict time pressure / perceived task accomplishment in the presence of responsiveness (path b, path c'). $p < 0.05$, ** $p < 0.01$, ***$p < .001$ (two-tailed) Δ. = difference; SE = standard error; LL = log likelihood. [a] = partial mediation effect

The role of mindfulness for responsiveness. Hypothesis 3 proposes that a mindfulness intervention moderates the positive relationship between technology-mediated interruptions and responsiveness. A growth curve analysis testing an intervention effect on the pattern of state mindfulness over the course of 14 days was conducted as a manipulation check. An unconditional random intercept model (Null Model) was compared to a random intercept, fixed slope model (Model 1). No significant difference in likelihood ratio was found (-2*LL = 1.09, df = 1, p = .30). Thereafter, Model 1 was compared to a random intercept, random slope model with an interaction term of day and intervention (Model 2). Again no significant difference in likelihood ratio was demonstrated (-2*LL = -39.86, df = 3, p = 1). Thus, the analysis did not show significant results (cf. Table 6, Figure 1.). Nevertheless, the planned statistical analyses and supplementary analyses were conducted. Firstly, an unconditional random intercept model for responsiveness was constructed. Secondly, technology-mediated interruptions were included as a predictor in a random intercept, fixed slope model (Model 1). Subsequently, a random intercept, random slope model (Model 2) including an interaction term of technology-mediated interruptions and intervention (coded as 0 = control group; 1 = intervention group) was computed and compared to the previous model. Although, the model fit significantly increased (difference of-2*log= 10.14, df=2,p <.01), a moderation effect could not be confirmed, as the interaction effect was not found to be significant (estimate = .05, t = .75,p=0,75). Therefore, Hypothesis 3 was not supported. More details about this analysis can be found in Table 7.

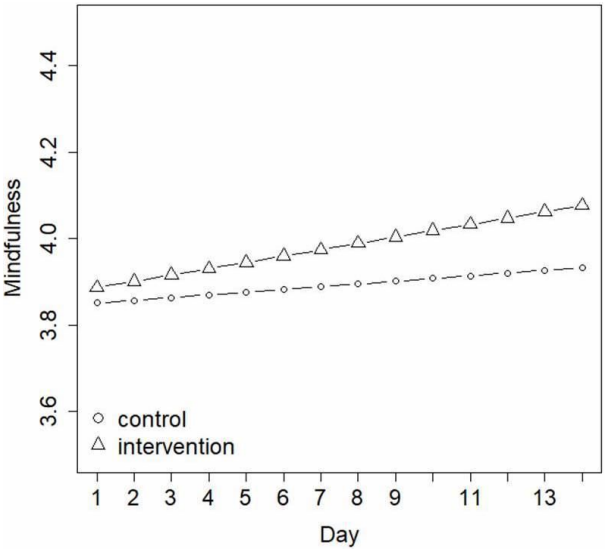

Figure 2. Growth Curve Analysis of daily levels of mindfulness for control and intervention group.

Table 6. *Growth Curve Model of The Changes in Daily Mindfulness Over Time*

	Null Model			Model 1			Model 3		
Parameter	Estimate	*SE*	*t*	Estimate	*SE*	*t*	Estimate	*SE*	*t*
Fixed Effects									
Intercept	0.00	0.18	0.0	-0.03	0.03	-0.74	-0.01	0.04	-0.13
Day				0.00	0.00	1.04	0.00	0.01	0.30
I				0.00	0.04	0.04	-0.05	0.06	-0.73
Day x I							0.01	0.01	0.76
Random Effects									
Residual	0.14	0.01		0.14	0.01		0.15	0.01	-0.13
Intercept	0.00	0.00		0.00	0.00		0.00	0.00	
-2*LL	366.368			365.278			405.123		
Δ-2*LL				1.09			-39.86		

Note. $N = 91$. I = Intervention * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$ (two-tailed).
Δ = difference; *SE* = standard error; LL = log likelihood.

Table 7. *Multilevel Models Predicting Responsiveness by Technology Interruptions and a Mindfulness Intervention.*

Variable	Model 1			Model 2			Model 3		
	Estimate	*SE*	*t*	*Estimate*	*SE*	*t*	*Estimate*	*SE*	*t*
Intercept	2.03	.08	-24,37***	1.97	.12	16.88***	1,98	.12	16.91***
Perc. Interruptions				.5	.06	8.49***	.47	.11	4.14***
Intervention				.5	.17	.7	.11	.17	.49
Perc.Interruptions xIntervention							.05	.16	.75
-2*LL	1105.8			1039.7			1029,56		
Δ -2*LL				66.1***			10.14**		

Note. A random slope was specified in Model 2. N = 91 at the person level. Model 1 was compared to the null model; Model 2 compared to Model 1 to estimate respective model fit increase. $p < 0.05$, ** $p < 0.01$, ***$p < .001$ (two-tailed)

Δ. = difference; SE = standard error; LL = log likelihood.

$p < 0.05$, ** $p < 0.01$, ***$p < .001$ (two-tailed)

Supplementary results. Substantiated through findings by Hülsheger and colleagues (2013), state mindfulness and trait mindfulness can be seen as interrelated and function in a similar way. Trait mindfulness refers to a high natural capacity of being mindful, while inducing high state mindfulness is dependent on continuous regular meditation practice over time. However, there is no substantiated estimate of the right duration and length of mindfulness training (Moore et al., 2012). Although, not significant the plot of the growth curve displayed in Figure 2 exhibits a steeper increase for the mindfulness training group than the control group. It could be that more training was needed to significantly increase state mindfulness. Therefore, a supplementary analysis was conducted using a conceptualization of mindfulness that is not dependent on training effects but is similar in function: trait

mindfulness (Glomb et al., 2011). It was investigated if trait mindfulness moderates the relationship between technology-mediated interruptions and responsiveness. Results of this analysis are displayed in Table 8. Firstly, an unconditional random intercept model, including the dependent variable responsiveness was computed. It was compared to a random intercept, fixed slope model (Model 1) including the predictors technology-mediated interruptions and trait mindfulness. This comparison resulted in a significant difference in likelihood ratio (difference of-2*log= 81.43, df=2,p <.001). Followingly, Model 1 was compared to a random intercept, random slope model with an added interaction term of technology-mediated interruptions and trait mindfulness (Model 2). The model fit significantly increased between Model 1 and Model 2 (difference of-2*log= 16.72, df=2,p <.001). Also, the interaction effect turned out to be significant (estimate = -.32, t = -2.7,p >.05). This shows that for employees low on trait mindfulness, the positive relationship of technology-mediated interruptions and responsiveness was stronger than for employees with high levels of trait mindfulness. Thus, considering trait mindfulness instead of a mindfulness intervention, Hypothesis 3 can be supported.

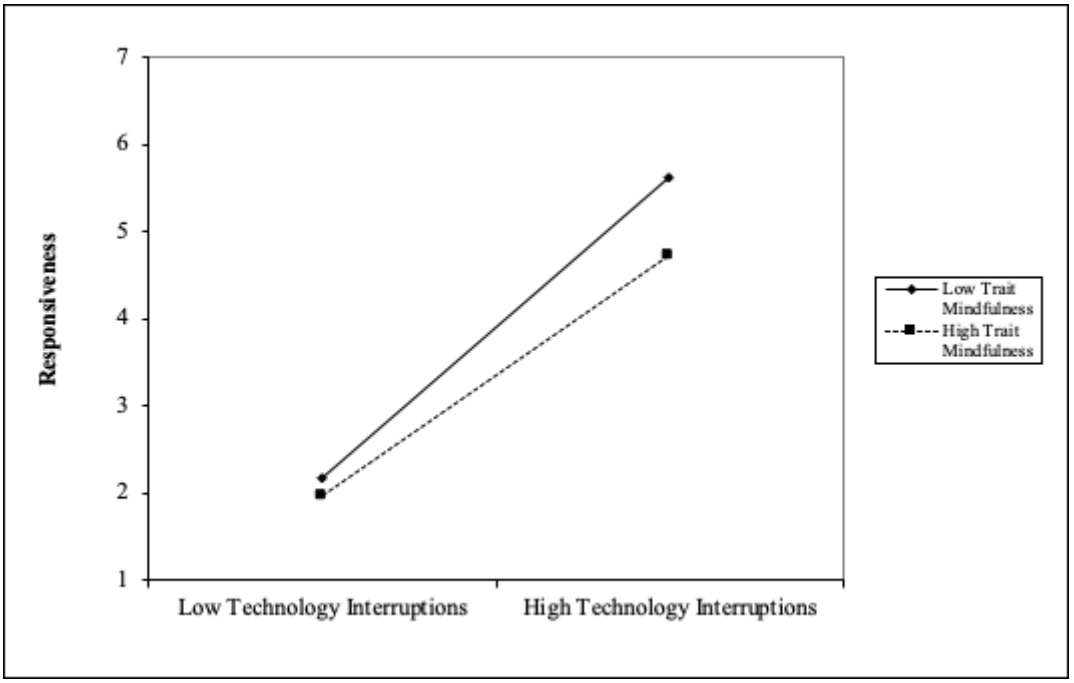

Figure 3. Moderation effect of trait mindfulness on the relation between technology interruptions and responsiveness.

Table 8. *Multilevel Models Predicting Responsiveness by Technology Interruptions and Trait Mindfulness.*

Variable	Null Model			Model 1			Model 2		
	Estimate	*SE*	*t*	*Estimate*	*SE*	*t*	*Estimate*	*SE*	*t*
Intercept	2.03	.08	24.37***	3.92	.46	8.48***	3.93	.46	8.5***
Perc. Interruptions				.5	.06	8.5***	1.72	.42	3.84***
Trait Mindfulness				-.54	.13	-4.15***	-.55	.13	-4.17***
Perc.Interruptions xTrait Mindfulness							-.32	.12	-2.7***
-2*LL	1105.78			1024,35			1007,63		
Δ -2*LL				81.43***			16.72***		

Note. A random slope was specified in Model 2. N = 91 at the person level. Model 1 was compared to the null model; Model 2 compared to Model 1 to estimate respective model fit increase. $p < 0.05$, ** $p < 0.01$, ***$p < .001$ (two-tailed)

Δ. = difference; SE = standard error; LL = log likelihood.

Discussion

The introduction of information and communication technology to the workplace, despite its benefits, is accompanied by an increase in technology-mediated interruptions (Chen & Karahanna, 2018). At the same time, it is established that interruptions at work can have a variety of negative effects including worse well-being, creating a dilemma for employees and employers alike (Baethge & Rigotti, 2013). Responsiveness is investigated as a possible mechanism of the relationship between technology-mediated interruptions and task

accomplishment (Sonnentag et al., 2018). A mindfulness intervention could potentially influence the relationship between technology-mediated interruptions and responsiveness and therefore turn out to be a potential remedy against the negative effects of interruptions. Choosing what task to complete, affords attentional control (Baethge et al., 2015). According to Good (2016) mindfulness practice has an effect on an attention which subsequently increases self-regulation and reduces automaticity. Therefore, this daily-survey study set out to a) further explore the negative association of interruptions on on-the-job experiences: time pressure and task accomplishment b) shed light on a mechanism of incorporating interruptions into daily work: responsiveness and c) test the effectiveness of a low-dose mindfulness self-training intervention in order to inoculate employes against the negative effects of technology-mediated interruptions. The findings of this study were mixed, supporting some, but not all hypotheses.

Firstly, the number of technology-mediated interruptions experienced during the workday were associated with higher time pressure. Secondly, a direct negative relationship of technology-mediated interruptions with perceived task accomplishment was found. These findings are in line with the action regulation theory (Hacker, 2003). They support the notion of interruptions as regulation hindrances and work stressors, related to less satisfaction with job performance. This is in line with similar findings by Baethge et. al. (2013) and Sonnentag and colleagues (2018).

The relationship between technology-mediated interruptions and time pressure was not mediated by responsiveness. Although, both responsiveness and time pressure were significantly related to technology-mediated interruptions. We assumed that time pressure is related to responsiveness, as being responsive demands time resources (Sonnentag et al., 2018) and negates interruption lag benefits, leading to increased regulatory demands and in turn costs (Baethge & Rigotti, 2010). Unexpectedly, this within-person relationship was not demonstrated. However, this result is in line with finding results by Sonnentag and colleagues (2018) who also did not demonstrate a relationship of time pressure at the within-person level. But, as they found a between-person effect of responsiveness on time pressure the relationship between the constructs seems to be futile ground for further investigation.

Thirdly, we found that responsiveness partially mediates the relationship between technology-mediated interruptions and task accomplishment. The demonstrated relationship between responsiveness and task accomplishment was negative. This is in contrast to findings by Sonnentag and colleagues (2018). They found a positive association of responsiveness to task accomplishment. Regarding contribution to the technology-mediated interruption literature, responsiveness was interpreted as the mechanism connecting interruptions to positive effects (Waldhauser, 2019). The findings of this study do not substantiate this. Rather they reinstate a stressor perspective on interruptions, in line with action regulation theory (Baethge & Rigotti, 2013). According to Sonnentag and colleagues (2018), it is possible to make progress towards secondary goals by short response latencies to online messages (Vitak, Crouse, & LaRose, 2011). This multiple goal perspective is in accordance with the workplace telepressure literature (Barber & Santuzzi, 2015). Although contradictory, we conclude that both findings and theoretical explanations are deepening the understanding of technology-mediated interruptions at work. As a consequence, respective boundary conditions need to be identified. Apart from this, our results demonstrate that the relatively novel concept responsiveness is an important mechanism explaining the stressor-strain relationship of technology-mediated interruptions.

Lastly, we did not find that a brief self-training intervention moderates the relationship between technology-mediated interruptions and responsiveness. Although, a slight upward trend of state mindfulness over the course of the study was visible, the growth curve analysis conducted as a manipulation check was not significant. In other words, the intervention did not have an effect on daily mindfulness levels. This is in contrast to other studies that were able to demonstrate an effect of similar brief-mindfulness self-training interventions (Hülsheger et al., 2013, 2015). Although, there are no agreed standards regarding the length of self-training interventions (Moore et al., 2012), continuous, prolonged training is regarded as necessary for effective mindfulness interventions (Hülsheger et al., 2015). Subjects in the mindfulness group reported that they practiced on average 9 minutes per day. However, only 66% percent of all possible questionnaires were filled in, aggravating the assumption of continuous practice. Following this notion, Hülsheger and colleagues

(2013) only included data of the second workweek into their analysis of a 10-day mindfulness intervention. For a neuroimaging study by Moore and colleagues (2012), participants were required to practice 10 minutes a day for 16-weeks to ensure a significant effect.

In order to test if mindfulness is a relevant construct influencing the relationship between technology-mediated interruptions and responsiveness, we conducted a supplementary analysis including trait mindfulness. Trait mindfulness is not dependent on continuous practice (Glomb et al., 2011) and is similar in function to state mindfulness (Hülsheger et al., 2013). We found that trait mindfulness significantly moderates the relationship between technology-mediated interruptions and responsiveness. Participants high in trait mindfulness showed reduced responsiveness under conditions of high technology-mediated interruptions compared to low trait mindfulness. Finding an intervention effect of mindfulness in a diary study combined with a field experiment could have provided insights into the causal nature of relationships of the constructs (Hülsheger et al., 2013). Nonetheless, showing that trait mindfulness is an influential concept is valuable. Therefore, further exploration of the effect of mindfulness in warranted.

Limitations

The present study possesses several characteristics that allow for relevant contribution to existing literature. Firstly, data was collected in the natural work environment of the participants. Conclusions drawn from studies set up in this way are therefore highly applicable to the actual situations employees face during work days (Sonnentag et al., 2008). In this regard, they have advantages in comparison to experimental studies that emphasize controllability over complexity (Ohly et al., 2010). Secondly, assessing the variables daily in the evening over the course of two weeks captured daily fluctuation in the constructs while not interrupting the participant. Especially for research focused on work interruptions, this can be essential (cf. Sonnentag (2018)). Lastly, the inclusion of an active control group answers one of the main critique points regarding mindfulness intervention studies. Namely, that a complete understanding of the mechanisms or active ingredients of mindfulness is not possible without a suitable control condition (MacCoon et al., 2012).

However, we are aware that the contribution of this research is influenced by limitations. Firstly, the concept of online messages might be too broad. The participants were only asked about "e-mails and other online messages", not taking into account that different types of online communication tools might have differing affordances and effects. Therefore, regarding the predictor interruptions some degree of complexity might have been lost. Another limitation concerns the data collection exclusively via self-report measures, as this entails the possibility for common method bias (Podsakoff & Organ, 1986). Variance attributed to the measurement method rather than the constructs threatens the validity of the conclusions (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Next, it was challenging to investigate the relationship of interruptions and responsiveness with time pressure, as the scale used showed low reliability (α=.34). The low α value of time pressure could be due to poor inter-relatedness between items, the low number of questions or heterogeneous constructs. An α value this low is usually not considered an acceptable internal consistency value (Tavakol & Dennick, 2011). As the items were translated into German, it is possible that participants misunderstood the meaning and interpreted them in a different way than initially intended (Degroot et al., 1994). Using only one of the items for the statistical analysis did not change results. Moreover, one of the most important shortcomings of this research was low power. To start with, the power to detect cross-level interaction effects in multilevel designs with low sample size at Level 1 can be regarded as low (Mathieu, Aguinis, Culpepper, & Chen, 2012). 91 participants in the final sample are a sufficient sample size for multilevel modeling (Maas & Hox, 2005). However, as only a relatively low percentage of total possible questionnaires were completed by the participants (66%) the sample size at Level 1 can be regarded as low. According to Ohly (2010) and colleagues special means are required to motivate participation in diary studies and increase completion rates. That lack of incentives provided by the present study is possibly related to the low power obtained. Another potential limitation concerns the construction of the active control group. As the stress information intervention used was self constructed, it is not validated as structurally equivalent. The consequence is, that it cannot be guaranteed that group differences reflect mindfulness as the mechanism of interest (MacCoon et al., 2012).

Suggestions for Future Research

Further experimental investigations are needed to estimate the relationship between the studied variables in more detail. Further studies might take a more fine grained look at interruptions, for example by including different types of interruptions or by further specifying online interruptions. The former would have the effect of painting a clearer picture of what kind of ICTs interrupt employees, while the second would advance the knowledge on the effect of ICTs in the workplace. Additionally, different characteristics of interruption including complexity (simple, complex) and time demand (frequency, duration) could be considered (Baethge et al., 2015). Also, different methods assessing the impact of interruptions could be tested. For example, Akbar and colleagues (2019) assessed stress in response to e-mail interruptions using thermal imaging. Innovative methods like this could lead to valuable insights, while further reducing the possibility for common-method bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Next, as responsiveness only partially mediated the relationship between technology-mediated interruptions and task accomplishment other indirect effects could be examined and tested empirically. Additionally, future research could identify possible boundary conditions of this relationship, for example daily-planning approaches (Parke et al., 2018). Finally, the brief self-training mindfulness intervention developed by Hülsheger and colleagues (2013, 2015) should be tested again in the context of interruptions. The plot of the growth curve analysis, as well as the significant interaction effect of trait mindfulness point towards the relevance and potential effectiveness of a public health low dose mindfulness intervention. If the study were to be replicated, limitations present in this research should be considered. Most importantly, higher study compliance should be archived possibly by offering incentives (Ohly et al., 2010).

Practical Implications

The findings of this study advance the understanding of the role of online messages in employees' daily working life. They paint a different picture than recent findings by Sonnentag (2018) who suggests that responsiveness to interruptions can lead to positive

on-the-job experiences. In contrast to this, findings of the study support the stressor perspective on interruptions (Baethge et al., 2015). To summarize, this study finds that interruptions through e-mail and online messages are negatively associated with the employee's on the job experiences. As a consequence, practitioners and employers should aim for an elimination or reduction of at least unnecessary technology-mediated interruptions at work. Reducing the negative impact of interruptions is desirable for the individual and the organization alike. One way that seems promising is changing the social norm within an organization. Generally, as technology-mediated interruptions are a social phenomenon, dealing with them on an organizational or team level could prove to be most effective. A change in response norm could lessen the pressure to respond (Barber & Santuzzi, 2015). For example, if non-response times, as well as communication hours would be introduced, important tasks could be scheduled during times with limited interruptions. Also, other employees would not expect a reply during those times and would probably not depend on information that another person is expected to deliver immediately.

Conclusion

All in all, this study contributes to a more fine-grained perspective on interruptions at work. For many employees technology-mediated interruption belong to a typical workday. The evidence from this study suggests that they are in fact related to increased time pressure and reduced task accomplishment. Further, responsiveness is found to be a relevant mechanism connecting technology-interruptions to reduced task accomplishment. The brief self-training mindfulness intervention was not shown to have an effect on this relationship. However, trait mindfulness was shown to significantly reduce the relationship between technology-mediated interruptions and responsiveness. Given the omnipresence of information and communication technology in contemporary workplaces the present findings underline the need for effective interruption-reducing strategies. Using a field study and within-person approach this study furthers the understanding of how these strategies should be adapted.

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