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# How Deep is your Work? The Day-to-Day Effects of Information and Communication Technology Use on Deep Work of Employees

*Completed Research Paper*

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## Abstract

*Prior empirical work provides contradictory findings on the consequences of information and communication technologies (ICT) use at work, indicating both positive and negative consequences for employees. Integrating insights from the deep work framework with flow literature and cognitive load theory, we build and test a dynamic theoretical model to explain these contradictory findings. We move the research perspectives of ICT use and deep work to a dynamic perspective and investigate day-to-day changes in ICT use and deep work on the within-person level. The results of our quantitative diary study (n=387) provide evidence that technical ICT use has a positive effect on deep work whereas social ICT use has an inverted U-shaped relationship with deep work. The effects of social and technical ICT use on deep work depend on workplace telepressure, work experience, and knowledge intensity of work.*

**Keywords**: ICT use, deep work, workplace telepressure, diary study

## Introduction

*"Writing is something I've always loved to do, but being ADHD, it's difficult to find ways to do it that allow me to* ***enter my zone of focus, without being constantly interrupted by something shiny****, the Internet, a text, or a cat. Then, about nineteen years ago, I discovered business travel. […] Armed with the right tools, I can turn almost any airplane into my own private writing studio, that allows me to* ***focus, block out all distractions****, and get words down on paper. Or in this case, on laptop."* (Peter Shankman (American Entrepreneur) on his blog "shankman.com", August 30, 2016, emphases added).

Digitization has diffused into every facet of people's private and working lives (Salo, Pirkkalainen, and Koskelainen 2019) making it even harder to work distraction-free and with full focus. Workplaces today require being connected to superiors, colleagues, and external stakeholders such as suppliers and customers sometimes 24 hours a day and 7 days a week. Job profiles are changing rapidly, and the technological permeation of working worlds has reached a new dimension and dynamic. New digital and mobile information and communication technologies (ICT) have served as a substantial enabler in this development. ICT are defined as “a collection of information, processing, storage, network, and communication technologies” (Ayyagari et al. 2011, A3).

On average knowledge workers spend more than 60% of their working time on electronic communication and internet searches, with 28% spent on e-mails (Chui et al. 2012). Working like this is often associated with rather undemanding, logistics-oriented tasks. Newport (2016) describes this as shallow work, which does not create much new value and is relatively easy to copy. To compensate for this state of mind, deep work is needed, defined as “professional activities performed in a state of distraction-free concentration that pushes your cognitive capabilities to their limit” (Newport 2016, p. 3). Practicing deep work is not easy in today’s digitized world and sometimes requires grand gestures such as that of Shankman (2016b), who not only uses his many business flights to experience times without distraction dedicated to work and even made a round-trip flight from the USA to Japan for the sole reason of writing concentrated and without distraction in order to complete a book manuscript.

Despite the pervasiveness and complex nature of ICT use at work and importance of ICT for organizational performance (e.g., Dos Santos and Sussman 2000) as well as the long tradition of research on technology acceptance (Davis, Bargozzi, and Warshaw 1992), previous IS research has also shown the negative effects of ICT use for employees (e.g., Ayyagari et al. 2011). Technostress research, for example, has shown that intrusive technology characteristics are dominant predictors of stressors such at work overload (Ayyagari et al., 2011). Research on technostress has mainly focused on the negative consequences of ICT use on the individual and concluded that it is predominantly harmful. Only recently, research started to explore the possibility that there might also be positive effects of these stressors (Benlian 2020). Yet, the understanding of how, when, and why ICT use at work influences employee outcomes remains incomplete and contradictory in several aspects, such as increasing vs. decreasing productivity (e.g., Dos Santos and Sussman 2000), positive vs. negative effects of interruptions (e.g., Chen and Karahanna 2018), the autonomy paradox at work (Mazmanian, Orlikowski, and Yales 2013), and better vs. worse job performance (e.g., Köffer, Orthbach, and Niehaves 2014). These studies clearly demonstrate that there are both negative and positive effects of ICT use, resulting in a somewhat paradoxical picture. Although the available literature discusses both opportunities and risks of ICT use for employees, none of these previous studies have explored the direct consequences of ICT use on the ability to concentrate in terms of deep work.

A possible explanation for the contradictory findings of outcomes of ICT use may be a nonlinear relationship between ICT use and individual performance outcomes hinting to a tipping point in the use of ICT. The positive effects of ICT use on deep work may turn into negative ones when the intensity of ICT usage is too high – an effect that is also known as the “too-much-of-a-good-thing” effect (Pierce and Aguinis 2013). However, it is conceivable both, that transparent information sharing and facilitated communication lead to employees being better able to concentrate on a complex task, or that the use of ICT distracts attention, making it difficult for employees to work deep (e.g., Csikszentmihalyi 2010; Gaillard 2008; Lee, Sheldon and Turban 2003; Newport 2016). All the more surprising that almost no studies investigated nonlinear relationships (e.g., inverted U-shaped relations) between ICT use and work-related outcomes. Based on the conflicting results from literature and the two scenarios above, we theorize and test the existence of a tipping point in the sense of the “too-much-of-a-good-thing” effect (Pierce and Aguinis 2013).

Another possible explanation for the conflicting findings might be that the intensity of ICT use changes from day to day. George and Jones’ (2000) state that “time can and should play a more important role because it can change the ontological description and meaning of a theoretical construct and of the relationships between constructs” (p. 657). Furthermore, as shown for social networking sites by Wenninger, Krasnova, and Buxmann (2019) it is likely that the use of ICT, depends on the activity and is the result of certain tasks in the work environment. Thus, the ICT use of employees varies depending on the tasks on a daily basis. Employee outcomes (like deep work) of ICT use can thus not be viewed as static, rather a dynamic perspective on ICT use and its outcomes is needed. Yet, most research about the consequences of ICT use at work derives from retrospective, cross-sectional studies examining only between-person differences at one point, demonstrating a need for longitudinal investigations that take a dynamic, within-person perspective to show how ICT use and its consequences reveal over time. Thus, both non-linear relationships and temporal aspects could play a role in disentangling the contradictory results.

Motivated by these research gaps, and the responsibility of IS researchers to understand the paradoxical consequences of ICT use (Salo et. al. 2019) for an “ICT-enabled Bright Society” (Lee 2016), our aim is to complement the hitherto understanding of the consequences of ICT use in organizations by focusing on deep work as an individual-level outcome. The research question we ask is: What consequences do the daily use of ICT have on the individual ability to concentrate intensively (deep work) at work? Furthermore, we want to answer the two related questions: i) how much ICT consumption is "performance-enhancing" in terms of "deep work" and ii) is there a point at which the individual run the risk of using too much ICT?

We designed a quantitative diary study and collected data from 82 participants who took part in our daily surveys and created 387 observations. Unlike prior research, we considered ICT use and deep work as daily varying constructs as daily work settings change from day to day (Ohly et al. 2010). This work contributes to current research most notably in four ways. First, we increase theoretical knowledge of deep work by transferring insights from cognitive load theory to the literature on deep work and theorize a dynamic effect of ICT use on deep work. Second, we broaden the construct of ICT use by disentangling the different effects of social and technical ICT use on deep work, thereby addressing the paradoxical findings of positive and negative effects of ICT us. Third, we introduce a previously overlooked level of analysis and investigate our hypotheses within persons and over time. Fourth, we provide more specific implications of the effects of ICT use on deep work, by examining cross-level boundary conditions of this within-person effect.

## Conceptual Background and Hypotheses

### *Deep Work*

Permanent access to the internet, parallel communication channels, social networks or the desire to complete several tasks at the same time could mean that deep concentration phases are rare for employees. In this context, Newport (2016) coined the term "deep work" as an antithesis to "shallow work". Whereas the later describes cognitively less challenging work activities that allow for constant distraction, deep work represents a state of intense concentration that is necessary for working on complex tasks (Newport 2016). Deep work involves intense concentration which is described "as the ability to mobilize and coordinate one's resources, to obtain and maintain an optimal state to perform efficiently and effectively" (Gaillard 2008, p. 59). Concentration levels can vary, however, so that low levels of concentration are needed for passive activities such as watching TV, medium levels for routine tasks, but full concentration for complex tasks that require the entire capacity of the mind to complete the task. Optimal concentration is achieved when, on the one hand, attention is focused on the task at hand and, on the other hand, the energetic state is optimal for processing the necessary information.

Particularly in knowledge work, there is a danger that this kind of intensive concentration will be neglected due to ubiquitous availability and other distractions, and therefore the feeling of meaningfulness will be lost. Often a large part of the working time is spent on shallow work and the constant checking of incoming e-mails ensures that worries and problems are the focus of attention. From a neurological perspective, a working day without intensive phases of concentration, which is primarily characterized by shallow work, is tiring and annoying (Newport 2016) while more time in concentration maximized performance, meaningfulness, satisfaction, and enjoyment (Newport 2016).

Deep work is a desirable state and therefore important to investigate from both a scientific and a business perspective. Newport (2016) postulates that knowledge workers have lost the ability to work in depth or have exchanged it for other (shallow) activities. This is mainly due to network tools, a comprehensive field of communication and information tools, which have led to fragmented attention, making an empirical investigation of how and to what extent deep work is influenced by ICT use indispensable.

### *Cognitive Load Theory and the Balance between Opportunities and Risks of ICT use*

Cognitive load theory is based on the well-known assumption that the human working memory is limited (Sweller, Merrienboe and Paas 1998). Cognitive load describes "the load that performing a particular task imposes on [an individual's] cognitive system" (Sweller et al. 1998, p. 266). This means that each task involves mental effort in the form of cognitive resources and skills (Sweller et al. 1998). High amounts of information that have to be processed by people, as well as cost or time constraints and high pressure to make decisions, therefore also generate a high level of cognitive load (Milkman, Chugh and Bazerman 2009). Ward et al. (2017) have shown that the mere presence of a smartphone at the workplace can lead to the demand of cognitive resources that are then no longer available for other tasks and can therefore end up in a reduction in performance. This effect is stronger the higher the user's dependence on the smartphone. Cognitive load theory was originally developed to describe what facilitates or hinders learning and how optimal performance can be achieved (Sweller et al. 1998). In deep work, similar cognitive processes are set in motion, since the content is usually not yet known and there are no automated processes or schemata for it.

## *The Dynamic Relationship between ICT Use and Deep Work*

Drawing on cognitive load theory, we propose that the consequences for deep work differ according to the function of ICT use. Wang et al. (2020) distinguish between two basic functions, which in turn are reflected in different work processes. On the one hand, ICT can be used as a tool to accomplish a certain task and thereby influence the user by actually affecting the task. These could include, for example, the word processing and calculation applications mentioned by the IP, or the use of specific databases. This process is described by Wang et al. (2020) as human-machine interaction. On the other hand, ICT can be used primarily as a communication medium and thus fulfils more of a social function, influencing the user by affecting the social exchange with other employees. These processes are referred to as ICT-mediated communication (Wang et al. 2020). Approaching Wang et al. (2020), we expect differences according to the different functions and therefore divide ICT use into Social ICT use if it is primarily used for social aspects of communication and information and Technical ICT use if it is primarily used for technical respectively task specific aspects such as for calculations, processing, editing or storage.

Furthermore, ICT use not only differs between persons but most important within-persons from day to day, not least as a function of both self-chosen and external changes, causing differences between working days. As digitization is an ongoing process changing work routines on a daily basis, we posit that temporal dynamics in the usage of ICT is of particular interest when aiming at understanding how digitization affects employees at work. As George and Jones (2000) suggest, one should ask about the duration of a construct as well as about its rate of change and why it is changing. "All constructs occur in and through time and any definition of a construct should specify its duration and if applicable, the way it is hypothesized to change from state to state over time" (George and Jones 2000, p. 668). Adopting a dynamic perspective enables to show that change in the constructs of interest (e.g., ICT use) and to explain differences in outcomes (e.g., deep work) beyond what can be explained by the observation of these constructs at one point in time.

ICT use has many positive effects on work-related aspects such as flexibility and autonomy (e.g., Mazmanian et al. 2013). The possibility of accessing company servers and thus important work material from home and then, for example, using the quiet evening hours at home to work on an important task, shows the positive benefits of technical ICT use. In addition, the use of various generic ICT applications, such as word processing, spreadsheet, or presentations programs, not only facilitates the work itself, but especially cognitively demanding activities that require a state of deep work (Newport 2016). Taking these positive aspects into account and applying the above stated temporal dynamics, we hence state that change in the intensity of technical ICT use has a positive relationship to changes in deep work time.

*Hypothesis 1. A change in technical ICT use is positively related to changes in deep work time: an increase (decline) in technical ICT use is associated with an increase (decline) in deep work time.*

Looking at the intensity of social ICT use, asynchronous communication, enabled through ICT, contributes to the employee's ability to decide when to react, e.g., to respond to a specific e-mail, and could therefore have a positive impact on deep work time. Some features of social ICT can also be influenced by the employee, such as turning off e-mail notifications, and thus reinforce the positive character of asynchronous work mode (e.g., Tétard 2000).

Drawing on cognitive load theory, we argue that at a certain level of social ICT use cognitive overload can come into play (e.g., Sweller et al. 1998). For example, when an employee normally "stays" at a certain level of social ICT use, i.e., is used to receive a certain number of e-mails and exchange information with other colleagues via social networks. If this habitual amount of social ICT use changes, e.g., from one day to the next, then there is a point at which the optimal level is reached. On the other hand, interruption due to social ICT use is another important aspect to consider. Studies have shown, that based to 15 minutes that an individual needs on average to concentrate on a task, a five-minute interruption, such as caused by writing an e-mail, thus creates a 20-minute distraction, which the employee can only avoid if he or she repeatedly exhorts self-discipline and develops strategies that help to consciously decide between sufficient "connectivity" and maintaining their own productive workflow (Markowetz et al. 2015).

Nevertheless, not all interruptions are equally damaging to deep work. Jett and George (2003) distinguish four different types of interruptions (intrusion, break, distraction, discrepancy) and show their negative as well as positive effects on various work-related aspects. While intrusion, defined as "an unexpected encounter initiated by another person that interrupts the flow and continuity of an individual's work and brings that work to a temporary halt" (Jett and George 2003, p.495) has a negative impact on a person who is in a state of total commitment to the task (deep work), on the other hand, intrusion can provide information that is crucial for the completion of the task at hand. It may therefore be that the interruption in this case results in a better subsequent deep work phase.

Breaks, planned or unplanned, can occur when a person is tired or needs a short rest from their activity. Surfing the internet or exchanging ideas with others via video conferences could be possible breaks through social ICT use. Csikszentmihalyi (1975) has shown that such breaks are important to be able to work creatively again. Triggered by a newsletter with the latest publications, a scientist could, for example, learn about research results that contradict his findings and, in the best case, stimulate him to question himself and bring him into a cognitive process of attention (Jett and George 2003). However, the intensity of social ICT use that can lead to such interruptions and especially its change needs to be considered. Together with our explanations above on cognitive load, we assume that for ICT primarily used for social aspects there is an optimum from which the positive effect decreases again, and the negative effect takes over. Here, we assume that we might observe a "too-much-of-a-good-thing" effect (Pierce and Aguinis 2013), which describes that beneficial antecedents (e.g., social ICT use) lead to points at which the outcome might inflect. In line with this effect and the temporal dynamics, we expect that the change in social ICT use reaches an optimal point for the individual regarding the changes in deep work time. Accordingly, we hypothesize:

*Hypothesis 2. A change in social ICT use has an inverted U-shaped relationship to changes in deep work time, such that it has a) a positive linear effect and b) a negative quadratic effect on the change in deep work time.*

## *The Moderating Roles of Individual and Workplace Characteristics for Deep Work*

Individual differences as well as workplace characteristics have a large impact on employee behavior at work. When considering individual differences, we separate states and traits (Allport and Odbert, 1936). A state is dynamic and describes the actual condition of mind and mood of an individual that might change over time and depending on the given situation, such as day-to-day changes in deep work depending on ICT use. A trait, in turn, describes a consistent personal characteristic, which influences the behavior of a person over time and across different situations. Traits are, thus, stable (Allport and Odbert, 1936). To provide a more nuanced understanding on the effects of social and technical ICT use on deep work, we investigate workplace telepressure and work experience as individual characteristics as well as knowledge intensity as a workplace characteristic as potential boundary conditions of the relationship between daily ICT use and daily deep work. Workplace telepressure, work experience, and knowledge intensity are considered stable.

## *The Moderating Role of Workplace Telepressure*

Social norms of ICT use behavior are important. Peer influences on individual decision making are widely documented in social psychology (Dijkstra, Lindenberg, and Veenstra 2008) and in management (Trevino and Victor 1992). People tend to adopt the behavior of relevant others from their social environment (Bandura 1977). Behaviors are particularly adopted from people individuals identify with (Bandura 1977). When it comes to the use of technology, the behavior of peers might generate a subjectively perceived norm.

A case in point is workplace telepressure, "the combination of preoccupation and urge to immediately respond to work-related ICT messages" (Barber and Santuzzi 2015, p. 172). Based on its definition workplace telepressure is strongly related to the social aspects of ICT use, so we expect it to influence the relationship between social ICT use and deep work time. In fact, the use of e-mail and other asynchronous means of communication allows employees to be more flexible, allowing them to have longer periods of uninterrupted working time. With workplace telepressure this intended advantage can be negated (e.g., Barber and Santuzzi 2015; Van Laethem et al. 2018). Employees who experience a high level of workplace telepressure feel the need to respond immediately to asynchronous communication, which tempts them to prefer social interaction via communication technologies to other work processes. Hence, other important work or even break times could be neglected or interrupted (e.g., Chen and Karahanna 2018; Sonnentag et al. 2018). On the other hand, as shown above, these interruptions could also have positive effects on the deep work time. We therefore expect workplace telepressure to have an impact on the relationship between social ICT use and deep work time. Thus, the slopes of the inverted-U-shaped relationship are steeper for individuals who have a higher level of workplace telepressure than for individuals with a lower level. Stated differently, given the increased stress levels from workplace telepressure, we expect a more dramatic inverted U-shaped relationship than that in Hypothesis 2, that is, we predict a faster decline of the (within-person) change in deep work time when the change in social ICT use becomes too large, as the collaboration benefits from social ICT use are more clearly outweighed by the disadvantages of cognitive overload. We hence hypothesize:

*Hypothesis 3. Workplace telepressure moderates the relationship between changes in social ICT use and changes in deep work time such that it steepens the curve: the inverted U-shaped relationship is stronger for individuals facing more workplace telepressure than for individuals facing less workplace telepressure.*

For individuals with high workplace telepressure, it is difficult to focus on other things when they receive a message from someone (Barber and Santuzzi 2015). In relation to the positive effect of technical ICT use on deep work time, we therefore assume that workplace telepressure will mitigate this. Employees with low workplace telepressure (e.g., employees who can work deeply for a long time without feeling the urge to check for incoming messages or answer them immediately) should feel the positive effect of the change in technical ICT use on the change in deep work time more strongly. In other words, employees who feel a very strong urge to respond the moment they receive a request from someone, and thus may leave notifications on, are more likely to feel less of the deep work-enhancing effect, thus showing a weaker link between changes in technical ICT use and changes in deep work time than those employees with less workplace telepressure. In sum, we argue that workplace telepressure negatively moderates the strength of the (within-person) effect of changes in technical ICT use at work on change in deep work time. Accordingly, we hypothesize:

*Hypothesis 4. Workplace telepressure moderates the relationship between changes in technical ICT use and changes in deep work time such that the positive effect is weaker for individuals facing more workplace telepressure than for individuals facing less workplace telepressure.*

### *The Moderating Role of Work Experience*

The longer a person works in their job, the more experience they gain. Work experience, defined as time the employees have been in their profession regardless of employer (McDaniel, Schmidt, and Hunter 1988) has positive properties, such as on work performance (e.g., Quinones, Ford, and Teachout 1995). We draw on cognitive load theory, to theorize the potential distracting consequences that ICT use can have for deep work. How and when distraction affects a person's concentration while working on a task is shown by studies of cognitive interference, which look at how memory and attention work (Jett and George 2003). It is important, for example, whether the information that a person needs to complete a task is stored in long-term memory. The more skilled a person is, the more likely the information they need is already stored in long-term memory and the more available working memory and attention will be for dealing with potential distractions (Edwards and Gronlund 1998). As a result, a person with more work experience is less likely to be disturbed by distracting stimuli in completing the task than a person with less work experience. The processing of new or unknown tasks, on the other hand, depends almost exclusively on working memory and is therefore more prone to the effects of distractions.

The more work experiences an individual has, the more familiar they are with their task at hand and the more room their mind has to deal with distractions. Someone who is relatively new to their job may be more easily distracted and reaches cognitive overload more easily. Hence, we deduce that employees with little work experience may be distracted more by using social ICT, thus experiencing a more dramatic inverted U-shaped relationship with a faster decline of the change in deep work time when the change in social ICT use becomes too large and cognitive overload is reached. Hence, we hypothesize that work experience strengthens the positive (within-person) effect by flattening the curve the more work experiences a person has:

*Hypothesis 5. Work experience moderates the relationship between changes in social ICT use and changes in deep work time such that it flattens the curve: the inverted U-shaped relationship is weaker for individuals with more work experience than for individuals with less work experience.*

### *The Moderating Role of Knowledge Intensity*

In the context of using ICT for work, the term knowledge worker, coined by Drucker (e.g., 1999) is particularly interesting. Davenport's (2005) describes knowledge workers to "have high degrees of expertise, education, or experience, and the primary purpose of their jobs involves the creation, distribution, or application of knowledge" (p.10). One of the main characteristics of the knowledge worker is that thinking is the basis of their activity. Although basically all jobs involve a mixture of physical, social, and mental work, for knowledge workers it is mainly the handling of problems that are not routine and therefore require non-linear and creative thinking (Reinhardt et al. 2011). The use of IT is represents a central part of knowledge workers' work processes. Managers and knowledge workers are dependent on the use of ICT in an increasingly complex world of work, as they are helpful for gathering information and making decisions necessary for their jobs (e.g., Tétard 2000). Therefore, we assume that the more knowledge-intensive a workplace is, the more it is dependent on technical ICT use that supports the worker in completing his or her tasks with thinking, i.e. in a state of deep work. Thus, we argue that knowledge intensity positively moderates the strength of the (within-person) effect of changes in technical ICT use on changes in deep work time. We hence hypothesize:

*Hypotheses 6. Knowledge intensity moderates the relationship between changes in technical ICT use and changes in deep work time such that the positive effect is stronger for individuals with more knowledge-intense jobs than for individuals with less knowledge-intense jobs.*

Figure 1 provides an overview of our conceptual model. The two levels represent the distinction between states (measured five times; within-person at day-level) and traits (measured once; between-person at person-level).

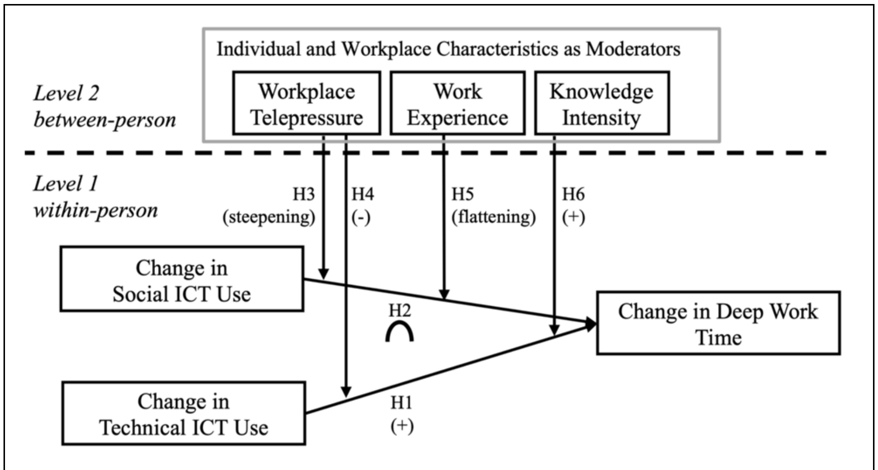


**Figure 1. Conceptual Model**

## Study design, procedure, and sample

We designed and ran a diary study to examine the temporal dynamics in deep work time of employees as well as to isolate the interplay of traits and states on deep work. Diary studies offer some decisive advantages for analyzing research questions that explicitly or implicitly consider a change over time.

Diary studies are used to measure real phenomena changing over time (e.g., Addas and Pinsonneault 2018; Ohly et al. 2010) and consider within-person effects. Furthermore, diary studies are not so prone to retrospective biases, as participants are asked about certain events and their experiences on the same day (Ohly et al. 2010). As we consider the prevalence of ICT use as well as its consequences on deep work for the individual to vary from day to day, we conducted a five-day diary study over the course of one working week. This way, we can capture changes in and correlations of employees' work-related states that change over a working week. We account for common-method bias by methodologically separating the measurement of the predictor variable and the criterion variable (Podsakoff et al. 2003) by using different response formats. Moreover, the repeated measurements enhance causality of the hypothesized effects.

We conducted the study in November 2019 in two phases via the online survey tool Unipark. Before the first day of the relevant work week, participants were asked to take part in a survey on their demographics and various stable factors (traits), such as workplace telepressure. This first survey also asked for the willingness to participate in the diary study. In a second step, participants were then asked to answer the same version of our online survey on five consecutive days (one working week). Here, the participants had to report daily on their ICT use and their deep work time together with some control variables. To ensure that the entered data covered the entire working day, the survey link was provided in the afternoon and participants were instructed to complete the survey after the end of their working day. To link a person's measurements both to the first survey and over the course of the week, while maintaining anonymity, each participant had to enter a personal code. To increase the willingness to participate, 4 x €50 gift vouchers were raffled off among all participants who took part on all five days.

162 employees took part in the first survey covering their demographics and stable factors. 108 participants started to take part in the daily surveys but subsequently dropped out over the course of the week. Therefore, we included only those 82 participants who took part in our daily surveys on at least four days and created 387 observations. With 46 participants (56.1%), female employees were slightly overrepresented. The employees were between 19 and 61 years old (mean=39.6; SD=13.22). With regards to education, 48.8% of the participants have a professional qualification, while 28.05% have a university degree and 7.32% have a PhD as their highest degree.

## Measures

We measured all variables of the daily surveys at the end of the workday. We employed established scales whenever possible to ensure adequate reliability and validity; work overload and workplace telepressure are two examples (e.g., Ahuja et al. 2007; Barber and Santuzzi, 2015). Finally, we developed a new measure for deep work based on Newport's (2016) framework. All items were in German. As usual in diary studies, some scales were shortened or adapted, and single items were used to not overburden the participants and to encourage them to continue participating (Ohly et al., 2010).

### *Deep Work Time*

The measurement of our dependent variable is based on the definition of deep work by Newport (2016). It was assessed asking the participants about their deep work time: "Please indicate here how many hours you were able to concentrate on cognitively demanding tasks during your working day without distraction." The answer possibilities ranged from 1=less than 1 hour, 2=up to 2 hours, 3=up to 3 hours and 4=up to 4 hours to 5=more than 4 hours.

### *Social and Technical ICT Use*

Based on the configuration of ICT use, we have asked for the intensity and function of each ICT category. The participants were asked to "Please indicate how you have used the following information and communication technologies (ICT) during working time today. Please note that ICT is a collection of information, processing, storage, network and communication technologies." In a matrix with seven categories ((1) MT: Mobile technologies, such as cell phone, pager, laptop; (2) NT: Network technologies, such as internet and intranet; (3) CommT: Communication technologies, such as e-mail and voicemail; (4) EDT: Enterprise and Database technologies, such as SAP® and Oracle® applications; (5) GAT: Generic application technologies, such as word processing, spreadsheet and presentation; (6) CollT: Collaborative technologies, such as instant messaging, video conferencing and teleconferencing; (7) OT: Other work specific technologies), they were then asked: "How often have you used the following ICT today?" (intensity) and "What have you mainly used the following ICT for today?" (function). While the former could be answered on a 5-point Likert scale from "1=not at all" to "5=very often", for the latter the participants could answer as follows: 1=For information, 2=For communication, 3=For processing or editing, 4=For storage, 5=For calculation, 6=For something else, and 7=Not at all.

We split the variable ICT use into social and technical ICT use based on Wang et al. (2020) and the answers about the main function of ICT use. Whenever "information" or "communication" was indicated as the main function (1 or 2 according to the scale above), we counted this ICT category as social ICT use. In the case of "processing or editing", "storage" and "calculation", as the main function (3, 4 or 5 according to the scale above), the corresponding ICT category was assigned to technical ICT use. This was done analogously for all seven ICT categories and led to the fact that mobile, network, communication and collaborative technologies (MT, NT, CommT, CollT) formed the social ICT use variable whereas enterprise and database, generic application and other work specific technologies (EDT, GAT, OT) formed the technical ICT use variable. The new variables were calculated by adding the intensity values of the individual categories.

### *Workplace Telepressure*

We assessed the stable (person-level) variable workplace telepressure with six items according to the measure developed by Barber and Santuzzi (2015). They defined workplace telepressure "as a combination of preoccupation with fast response times and the strong urge to respond to asynchronous work-related messages" (2015, p. 174). Therefore, three items each ask for preoccupation and urge on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). One sample item for preoccupation is: "I can concentrate better on other tasks once I've responded to my messages". One sample item for urge is: "I have an overwhelming feeling to respond right at that moment when I receive a request from someone". The internal consistency of the six questions can be considered high with a Cronbach's alpha of 0.84.

### *Knowledge Intensity*

Based on the definition of knowledge worker from above, which indicates a high level of education as one main characteristic, we formed the variable knowledge intensity as an index of education and job position of the respondents. The higher this index, the higher the knowledge intensity of the work and the more likely the respondent is a knowledge worker. The variable education includes 1=no professional qualification, 2=professional qualification, 3=university degree, and 4=PhD. The job position variable ranges from 1=employee (without management responsibility) to 4=higher management.

### *Work Experience*

Participants were asked to provide information about their work experience. As pointed out by Quinones, Ford, and Teachout (1995) in their review the most familiar measurement of work experience is time-based including job tenure (e.g., years in the job). We therefore defined work experience following McDaniel, Schmidt, and Hunter (1988) as years they have been in their profession regardless of employer. The following response categories could be selected: 1=Less than 1 year; 2=1-5 years, 3=6-10 years; 4=11-15 years; 5=16-20 years; 6=More than 21 years.

### *Control Variables*

We included the control variables work overload, work emotional exhaustion, working time, and additional working time into all our analyses.

## Analysis

The data from diary studies are described in two levels (see Figure 1). Level 1 describes the daily variables (within-person), while level 2 includes the stable personal variables (between-person) (Ohly et al. 2010). Due to our interest in explaining changes in deep work time, we decided to use fixed effects panel regression models in STATA. This approach is well suited for explaining changes in outcome variables over time and account for time-invariant unobserved heterogeneity. Hence, it's not about whether someone uses a lot or little ICT compared to others, but whether someone uses more ICT compared to himself (within-person), e.g., compared to the previous day, and how an increase affects the change in deep work time. Following this approach, we align our analytic technique with the hypothesized constructs and choose fixed effects, as suggested by Certo, Winthers, and Semadani (2017). The advantage of the chosen fixed effects panel model is that it refers to the variation within the subject (e.g., within each person) over time (e.g., one work week). Instead, it neglects variations between subjects (e.g., different persons) at a given time. However, since interaction effects with time-constant variables can easily be specified in the fixed effects panel model, this is not a problem. We standardized all control and predictor variables and used robust standard errors.

We tested for multicollinearity, which gives us the variance inflation factor (VIF) for all our used predictor variables. As a widely accepted rule of thumb, a variable whose VIF value is greater than 10 indicates multicollinearity. The VIF for all our variables were well below 10 ranging from 1.08 to 1.88. To test for the percentage of variance due to differences between respective within individuals, we calculated the interclass correlation coefficient for all variables.

## Results

Table 1 summarizes descriptive statistics, pairwise correlations and within-person variances for all variables.

| | Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Working Time | 1 | | | | | | | | | | |
| 2 | Additional Working Time | 0.047 | 1 | | | | | | | | | |
| 3 | Work Overload | 0.123** | 0.137*** | 1 | | | | | | | | |
| 4 | Emotional Exhaustion | 0.115** | 0.157*** | 0.657*** | 1 | | | | | | | |
| 5 | ICT Use | 0.168*** | 0.111** | 0.173*** | 0.066 | 1 | | | | | | |
| 6 | Social ICT Use | 0.194*** | 0.144*** | 0.159*** | 0.089* | 0.888*** | 1 | | | | | |
| 7 | Technical ICT Use | 0.066 | 0.021 | 0.124** | 0.009 | 0.768*** | 0.387*** | 1 | | | | |
| 8 | Workplace Telepressure | -0.105** | 0.061 | 0.257*** | 0.203*** | 0.179*** | 0.121** | 0.189*** | 1 | | | |
| 9 | Knowledge Intensity | 0.245*** | 0.174*** | 0.107** | 0.125** | 0.084* | 0.118** | 0.004 | 0.052 | 1 | | |
| 10 | Work Experience | 0.032 | 0.103** | -0.043 | -0.019 | -0.032 | -0.129** | 0.116** | -0.116** | 0.289*** | 1 | |
| 11 | Deep Work Time | 0.066 | -0.044 | -0.002 | -0.055 | 0.189*** | 0.156*** | 0.162*** | -0.087* | -0.211*** | -0.024 | 1 |
| | **Mean** | 504.47 | 10.35 | 2.93 | 2.67 | 15.58 | 9.81 | 5.77 | 2.72 | 3.81 | 3.84 | 3.14 |
| | **Standard Deviation** | 107.40 | 29.00 | 1.54 | 1.65 | 5.11 | 3.56 | 2.55 | 0.92 | 1.30 | 1.94 | 1.33 |
| | **Minimum** | 90 | 0 | 1 | 1 | 7 | 4 | 3 | 1 | 2 | 1 | 1 |
| | **Maximum** | 900 | 420 | 7 | 7 | 35 | 20 | 14 | 4.67 | 8 | 6 | 5 |
| | **Within-Person Variance in %** | 56.97 | 65.14 | 51.03 | 51.39 | 28.54 | 29.58 | 33.62 | 0 | 0 | 0 | 42.65 |

Note. N=387 (82 participants over 4 to 5 days). *** p<0.01, ** p<0.05, * p<0.10

**Table 1. Descriptive Statistics, Pairwise Correlations and Percentage of Within-Person Variances**

Three findings appear particularly noteworthy. First, the average deep work time per day and person is about three hours. Second, all the ICT use variables have a positive and significant correlation with the deep work time variable. In addition, workplace telepressure also shows a weak but significant negative correlation to deep work. Third, the percentage of within-person variance of all variables measured at level 1 ranged from 29.58% to 65.14%. According to this, daily fluctuations in the variables at level 1 cause a considerable part of the total variance.

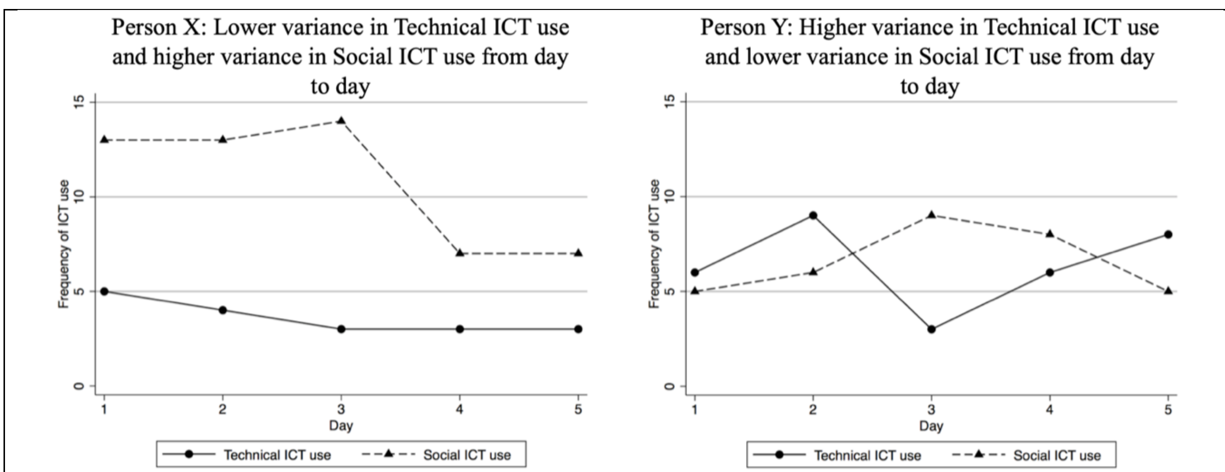


**Figure 2. Two examples for within-person variance of ICT use over time**

To better illustrate the variance within persons, Figure 2 shows the exemplary patterns of social and technical ICT use over the 5 days of our diary study for two of our participants. While the variance of technical ICT use is relatively low in Person X's case as it does not vary every day, social ICT use shows a higher variance with day-to-day variations. For Person Y it is the other way around (the variance of social ICT use is lower than that of technical ICT use), but the values for both types of ICT use vary every day. From these curves it is easy to see that there are differences between persons, as one might expect, but most important that there are significant differences within a person over the course of a week. This in turn shows that it is useful to look at the changes in variables over time, as we have postulated in our hypotheses.

As shown in Table 2, Model 1, changes in the control variables working time, additional working time, and work overload did not significantly predict changes in deep work time. Emotional exhaustion, however, has a significantly negative impact on deep work in that the higher the change in emotional exhaustion, the more negative the change in deep work. Model 2 already indicates that the change of ICT Use is significantly and positive related to deep work time changes.

| | Deep Work Time | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Model 1** | **Model 2** | **Model 3** | **Model 4** | **Model 5** | **Model 6** | **Model 7** | **Model 8** |
| **Constant** | 3.137 *** | 3.137 *** | 3.137 *** | 3.2859 *** | 3.2155 *** | 3.3094 *** | 3.2712 *** | 3.2333 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0636) | (0.0632) | (0.0619) | (0.0649) | (0.0576) |
| **Control Variables (Level 1)** | | | | | | | | |
| Working Time | 0.1013 | 0.1051 | 0.1053 | 0.1039 | 0.1 | 0.1084 | 0.1016 | 0.1036 |
| | (0.0859) | (0.0785) | (0.0785) | (0.0759) | (0.0727) | (0.0763) | (0.0808) | (0.0772) |
| Additional Working Time | -0.0136 | -0.0251 | -0.0238 | -0.0203 | -0.0147 | -0.0165 | -0.0212 | -0.0133 |
| | (0.0415) | (0.0408) | (0.0424) | (0.0432) | (0.0456) | (0.0457) | (0.0438) | (0.0480) |
| Work Overload | -0.0121 | -0.0179 | -0.0225 | -0.0242 | 0.0228 | -0.016 | -0.017 | 0.0305 |
| | (0.0822) | (0.0799) | (0.0788) | (0.0770) | (0.0802) | (0.0760) | (0.0807) | (0.0826) |
| Emotional Exhaustion | -0.1839 * | -0.1818 * | -0.1751 * | -0.1553 | -0.181 * | -0.1432 | -0.1698 * | -0.1774 * |
| | (0.0963) | (0.0923) | (0.0940) | (0.0942) | (0.0966) | (0.0964) | (0.0955) | (0.0988) |
| **Main Effects (Level 1)** | | | | | | | | |
| ICT Use | | 0.3281 *** | | | | | | |
| | | (0.0988) | | | | | | |
| Social ICT Use | | | 0.1897 | 0.2439 ** | 0.2784 ** | 0.2625 ** | 0.234 ** | 0.2836 *** |
| | | | (0.1198) | (0.1148) | (0.1099) | (0.1089) | (0.1129) | (0.1044) |
| Technical ICT Use | | | 0.2057 * | 0.2403 ** | 0.1877 * | 0.2373 ** | 0.2398 ** | 0.194 ** |
| | | | (0.1044) | (0.1052) | (0.0979) | (0.1024) | (0.0994) | (0.0965) |
| Social ICT Use (squared) | | | | -0.1493 ** | -0.0983 | -0.1611 ** | -0.1353 ** | -0.1011 |
| | | | | (0.0637) | (0.0635) | (0.0651) | (0.0650) | (0.0656) |
| **Cross–Level Moderating Effects** | | | | | | | | |
| Workplace Telepressure x Social ICT Use | | | | | -0.0186 | | | -0.0068 ** |
| | | | | | (0.1271) | | | (0.1189) |
| Workplace Telepressure x Social ICT Use (squared) | | | | | -0.1741 ** | | | -0.1615 ** |
| | | | | | (0.0717) | | | (0.0757) |
| Workplace Telepressure x Technical ICT Use | | | | | 0.2082 * | | | 0.1705 |
| | | | | | (0.1203) | | | (0.1081) |
| Knowledge Intensity x Technical ICT Use | | | | | | | 0.1893 ** | 0.1665 * |
| | | | | | | | (0.0923) | (0.0840) |
| Work Experiencec x Social ICT Use | | | | | | -0.1436 | | -0.133 |
| | | | | | | (0.1144) | | (0.1116) |
| Work Experiencec x Social ICT Use (squared) | | | | | | 0.1617 ** | | 0.151 ** |
| | | | | | | (0.0790) | | (0.0717) |
| **Level 1 N (Total observations)** | 387 | 387 | 387 | 387 | 387 | 387 | 387 | 387 |
| **Level 2 N (Participants)** | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 |
| **Days (min)** | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **Days (max)** | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| **F** | 2.0564 * | 4.5135 *** | 3.8254 *** | 4.7576 *** | 3.9145 *** | 6.3494 *** | 5.2456 *** | 5.7773 *** |
| **R-Squared (within)** | 0.0305 | 0.0709 | 0.0719 | 0.0883 | 0.1153 | 0.105 | 0.1 | 0.1378 |

Note. Standardized coefficient estimates from fixed effects panel estimator reported. Robust standard errors reported in parentheses. ***p < .01. **p < .05. *p < .10.

**Table 2. Fixed effects panel regression analyses**

Our Hypothesis 1 predicts that changes of technical ICT Use are positively related to changes of deep work time. Model 3 in Table 2 indicates this positive relationship revealing a positive coefficient for technical ICT use ($ß = .21$, $p < .1$). This means that if technical ICT use changes by one standard deviation, then deep work time changes by 0.21 units indicating that an increase in technical ICT use of 44.19\% is associated with a 6.56\% increase in deep work time. Therefore, the results support Hypothesis 1. Hypothesis 2 predicts that in contrast to technical ICT use, the change in social ICT use does not have a linear positive effect on deep work time but an inverted U-shaped relationship with changes in deep work time. To test whether such a relationship exists, the coefficient of the quadratic term must be significant and for an inverted U-shaped relationship negative (Haans, Pieters, and He 2016). Model 4 shows this relationship (ß = -.15, $p < .05$). In addition, we show that the slope is significant and sufficiently steep on both sides (-1.634544; 2.865721) and that the turning point is well located within this data range (.82). This means that the peak of the inverted U-shaped curve lies at a change in social ICT use of 0.82. If the change is greater, social ICT use has a negative impact on change in deep work time. In sum, the results support our Hypothesis 2.

Hypothesis 3 states that workplace telepressure moderates the inverted U-shaped relationship between changes in social ICT use and deep work time. A steepening (or flattening) of an inverted U-shaped relationship does only depend on the coefficient of the interaction term that must be significant and negative to support our hypothesis (Haans et al. 2016). Model 5 in Table 2 shows that the expected coefficient (ß = -.17, $p < .05$). Thus, Hypotheses 3 was supported. In addition, we plotted the moderating effect of workplace telepressure according to procedures by Aiken and West (1991) as shown in Figure 3. In line with our Hypothesis 3, the inverted U-shaped relationship between changes in social ICT use and deep work time is stronger for individuals facing more workplace telepressure (1 s.d. above the mean) than for individuals facing less workplace telepressure (1 s.d. below the mean). Interestingly, for people with low workplace telepressure, this seems to result in a shape-flip of the curve, suggesting positive changes in deep work time with increasing changes in social ICT use. The value of workplace telepressure at which the shape-flip occurs is at -.56 of the standardized variables according to calculations by Haans et al. (2016).

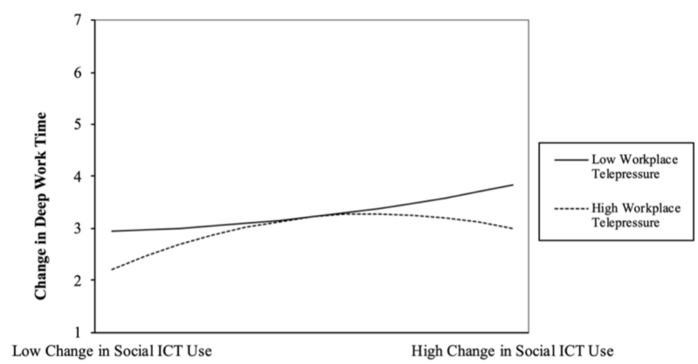


**Figure 3. Cross-level interaction effect for social ICT use and workplace telepressure on deep work time**

Hypothesis 4 posited that workplace telepressure would negatively moderate the relationship between changes in technical ICT use and deep work time. Support for this hypothesis would be obtained by a negative coefficient of the cross-level interaction term between technical ICT use and workplace telepressure. Contrary to our theoretical expectations, Model 5 in Table 2 indicate a positive relationship (ß = .21, $p < .1$), which suggests that the positive effect of change in technical ICT use is stronger for individuals facing more workplace telepressure than for individuals facing less workplace telepressure. Therefore, the results do not support Hypothesis 4.

Hypothesis 5 states that work experience moderates the inverted U-shaped relationship between changes in social ICT use and deep work time. Support for this hypothesis would be obtained by showing that the interaction term of work experience and the squared social ICT use is significant and positive (Haans et al. 2016) as Model 6 in Table 2 does (ß = .16, $p < .05$). We plotted the interaction effect of work experience according to procedures by Aiken and West (1991). In line with our Hypothesis 5, Figure 4 indicates that the inverted U-shaped relationship between changes in social ICT use and deep work time is flattening for individuals facing more work experience (1 s.d. above the mean) than for individuals facing less work experience (1 s.d. below the mean). Interestingly, for people with high work experience, there is no longer an inverted U-shaped relationship but a straight line, suggesting only positive effects of changes in social ICT use for this group. Thus, Hypotheses 5 was supported.

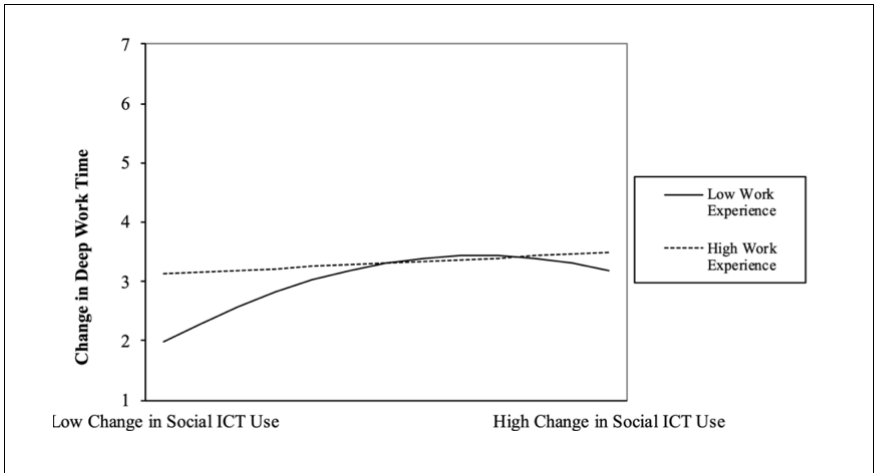


**Figure 4. Cross-level interaction effect for social ICT use and work experience on deep work time**

Hypothesis 6 predicted that knowledge intensity would interact with technical ICT use such that the relationship between changes in technical ICT use and deep work time would be stronger for employees who have more rather than less knowledge-intense jobs. As shown in Table 2 Model 7, the cross-level interaction effect between knowledge intensity and technical ICT use on deep work is positive and significant (ß=.19, p<0.1). Thus, Hypothesis 6 was supported. As shown in Figure 5, we further explored this moderation by plotting the simple slopes at one standard deviation above and below the mean for knowledge intensity.

Model 8 in Table 2 summarizes all interactions at a glance and confirms the results for all hypotheses except Hypothesis 4, where the moderating effect of workplace teleessure is no longer significant.

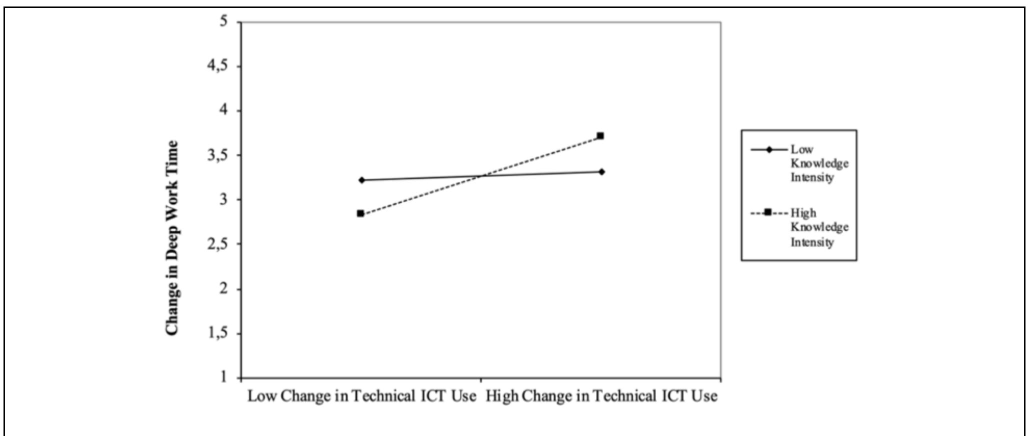


**Figure 5. Cross-level interaction effect for technical ICT use and knowledge intensity on deep work time**

## Discussion

The digitization of the individual is a progressive process that has gathered pace rapidly in recent years. Although both positive and negative effects of ICT use have been investigated, there are still contradictory findings regarding the different outcomes of ICT use at work and the deep work implications of ICT use have not yet been adequately examined. The mixed results of previous studies on work-related consequences of ICT use thus demonstrate the paradoxical situation and make Newport's (2016) implicit hypothesis that the constant use of ICT leads to a loss of deep work appear at least questionable.

The aim of our research was to promote an understanding of how employees experience daily ICT use at work and how positive and negative effects of ICT use on deep work can be observed when considering temporal effects. We provide evidence that ICT use has different effects depending on the purpose for which it is used. While daily technical ICT use has a positive effect on daily deep work time (H1), daily social ICT use has an inverted U-shaped relationship with daily deep work time (H2), indicating there is an optimal daily use of social ICT use for enhancing daily deep work time. We also found that the inverse U-shaped relationship between daily social ICT use and daily deep work time is steeper when workplace telepressure is higher compared to when workplace telepressure is lower (H3). Regarding our research question we can now confirm that there seems to be a point at which the "performance-enhancing" effect of daily social ICT use starts to decrease such that the individual runs the risk of using too much social ICT. In contrast, work experience flattens this curvilinear relationship between daily social ICT use and daily deep work time such that only employees with less work experience feel the negative impact of daily social ICT use (H5). Furthermore, provide evidence that the relationship between daily technical ICT use and daily deep work time is stronger when knowledge intensity is high (H6).

### *Theoretical and Empirical Contributions*

Our research contributes to the interdisciplinary field of research on ICT use and its outcomes for employees at work. First, we provide a rationale for the paradoxical studies on ICT use. While previous studies have shown the dark or bright side of ICT use as well as paradoxical insights regarding its different outcomes, we disentangle the contradictory consequences of ICT use on deep work. Our quantitative diary study showed that the ICT use of the participants varies and can change from day to day. Thereby the findings recognize that a person's stress mechanism, which is often negatively interpreted in the literature (e.g., Ayyagari et al. 2011; Barber and Santuzzi 2015; Kushlev and Dunn 2015), does not necessarily lead to techno-stress and self-inflicted distraction, but can also contribute to an optimal arousal and thus to the exploitation of the individual's performance potential. We were also able to show that different ICT is used for different purposes. We thereby show that social ICT use has a greater potential for risks in terms of deep work.

Second, we integrate insights from cognitive load theory (Sweller et al. 1998) and the "too-much-of-a-good-thing effect" (Pierce and Aguinis 2013) to explain the paradoxical effects of ICT use on concentration and to extend the considerations by a non-linear perspective. By applying them in a new context (i.e., deep work), we connect the strands of literature. In relation to the use of social ICT and deep work, the cognitive load is too much when social pressure in the form of workplace telepressure becomes too high or the work experience is still very low and therefore the working memory is already more occupied. It is therefore conceivable that ICT use of a more technical nature may well have positive consequences for companies and individuals, but that ICT used primarily for social aspects do not have unlimited positive effects on individuals and their work-related outcomes such as deep work.

Third, we classify ICT into categories and thereby create a differentiation that many other studies lack. ICT use is often aggregated and undifferentiated by asking participant about their overall perceptions and use of ICT (e.g., Ayyagari et al. 2011). However, as we have shown, the consequences of ICT use can vary considerably depending on the type of ICT, i.e., what ICT is used for. In addition, by asking for both the intensity and the purposes of use, we met Wang et al.'s (2020) call for an appropriate approach to better understand ICT use. In line with Wang et al. (2020), we have differentiated according to the main functions of ICT use, as the impact on work-related aspects will differ accordingly. Furthermore, our differentiation between technical and social ICT use has not only shown that the former has a linear positive impact on deep work time and the latter follows a non-linear inverted U-shaped pattern, but also that the impact of changes in social ICT use on changes in deep work time is moderated by workplace telepressure. Regarding the two different ICT uses (social vs. technical), we have also revealed knowledge intensity and work experience as two further moderators. We have thereby highlighted that ICT use should be considered from the perspective of both the intensity and the function of this use. This allows for unique insights that would not be possible from a one-dimensional perspective (Wang et al. 2020).

Fourth, our study makes a methodological contribution. We are among the first to implement a quantitative diary study to account for dynamic processes within individuals. From this, it can be better deduced when and why ICT use affects the deep work time of the individual. A static model, as often used in this context, would not have been able to show the significant variations in ICT use and its consequences within persons from one day to another. By using the diary study, we answered the call for using longitudinal designs (Benlian 2020) and we were able to look through a "magnifying glass" to gain a deeper understanding of the micro-foundations of daily ICT use and its work-related consequences on daily deep work time.

### *Managerial Implications*

Regarding practice, the results of the analysis must be viewed on the one hand from the personal perspective of an individual that uses ICT for work and on the other hand from a broader organizational point of view.

From the personal perspective, it would be advisable for individuals to be aware of both the risks and the opportunities of ICT use for deep work, such as primarily the personal limits of ICT use. In particular, the results showed that the consequences of ICT use differ according to its function. Accordingly, it is important for every user to recognize this differentiation, to reflect on his or her own use and to take appropriate actions. ICT use varies between persons and within persons (e.g., from day to day). The "right" level of ICT use is therefore not clearly determinable, but very individual. However, we have shown that there is a point at which the change in social ICT use does not lead to any further positive change in deep work time and that this process is also intensified by social pressure (workplace telepressure). Identifying this point for oneself may not be easy, but it could be a good way to increase effective deep work time and thus achieve higher work performance. As we have shown, work experience has a positive impact on the inverted U-shaped relationship between changes in social ICT use and deep work time leading to the conclusion that the longer a person is working in a specific job the more it profits from the positive consequences of social ICT use and the less it suffers from the negative ones.

From an organizational perspective, decision makers are advised to question their own expectations regarding the appreciation of work outcomes by deliberating our results. Superiors have greater visibility in the organization and serve as reference points. Their influence as role models is grounded in their social position within the organization due to formal hierarchy, professional reputation, age, or informal leadership. Evidence shows that the normative pressure generated by the behavioral patterns of supervisors have a stronger effect on individual's response behaviour to work-related messages than behavioural norms set by colleagues (Derks et al. 2015). Against the background of these findings, it is worthwhile for managers to ask themselves if constant availability and the immediate answering of e-mails by their employees are more valuable than a good suggestion, a conscientiously developed concept or a solid calculation prepared in a state of deep work? On the other hand, the results have shown that the use of technical ICT promotes deep work, and this applies to knowledge intensive jobs. Managers should be aware of these differences and make the right ICT applications available for knowledge-intensive jobs and, in case of doubt, train employees to use them. According to these results, managers should help employees to manage their ICT use to both strengthen the positive and reduce the negative consequences at work for deep work.

### *Limitations*

Our research is not without limitations. Although common, we assessed the data on the diary study with self-reported measures only. Therefore, we cannot exclude the possibility of common-method bias. However, we account for that by methodologically separating the measurement of the predictor variable and the criterion variable (Podsakoff et al. 2003) by using different response formats. In addition, we have implemented further recommendations by Podsakoff et al. (2003) to reduce social desirability by protecting the anonymity of respondents and indicating to them that there are no right or wrong answers. Another possible limitation was that the scales we used were shorter than the original ones. As asking participants to respond to the same questions repeatedly over a period of time can challenge their commitment, so it is recommended that daily evaluations should be as short as possible each day and is rather common to use shortened or adapted scales as well as single items (Ohly et al., 2010). Besides, research has proven that single items do not cause issues in terms of predictive validity and that single-item measures are as valid as multi-item measures (Bergkvist and Rossiter, 2007). As "there is no known categorization of ICTs that effectively organizes different technologies in a mutually exclusive and collectively exhaustive fashion" (Ayyagari et al. 2011, p. 851), our categorization of the different ICT could be limited. Although, we tried to control for the diversity of ICT use we might have not included all the functionalities and properties of ICT, so that new insights can possibly be gained by extending these. We encourage IS scholars to refine our design and create even narrower or different categories and thus review our classification.

### *Conclusion*

Our study represents an important step toward a better understanding of the outcomes of daily ICT use on deep work. We have shown that an integrative approach, the joint consideration of the positive and negative consequences of ICT use in relation to deep work at an individual level is needed.

If we look back to Peter from the vignette, who boarded the plane in search of intense concentration in a hyper-networked world. Noticeable he still uses his laptop and a word processing program, thus uses ICT. As we have shown ICT use and deep work do not necessarily conflict with each other, as one might have assumed at the beginning, but they complement each other in a meaningful way. Thanks to the results of the present study, these phases of concentration become more predictable, as they can be the result of personal choices in the use of ICT but are also determined by external factors such as social pressure.

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