Changing Forms of Stress as an Outcome of a Digitalised Work

Inaugural-Dissertation

zur Erlangung des Doktorgrades der Philosophie

der Ludwig-Maximilians-Universität

München

vorgelegt von

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aus

München

2020

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Tag der mündlichen Prüfung: 3. Juli 2020

Abstract

Nowadays, digitalisation is a highly significant topic that affects many aspects of our lives, from the way we work to our social interactions and communication. Alongside positive opportunities, digitalisation also involves risks and can evoke negative reactions such as anxiety. The positive aspects tend to be most frequently discussed. However, in order to take full advantage of digitalisation's benefits, it is necessary to also examine negative factors to buffer or avoid their consequences. The aim of this dissertation is to investigate stressors related to digitalisation (Information and Communication Technology (ICT)-specific demands). In addition to that, the consequences of those ICT-specific demands on well-being and productivity are examined and interventions to eliminate or reduce these negative consequences are studied. Specifically, the following research questions are addressed:

Research Question 1: What demands are related to digitalisation?

Research Question 2: What consequences do ICT-specific demands have for well-being?

Research Question 3: What can be done to buffer negative consequences of ICT-specific demands?

As an introduction to the context of this dissertation, Chapter 1 addresses digitalisation and its general effects on how we work, communicate, and live. In addition to presenting this dissertation's research questions, Chapter 1 includes a definition of the term digitalisation, describes previous developments related to digitalisation, and presents examples of technologies and business models that are made possible by digitalisation. In addition, positive and negative effects of digitalisation on society, the work environment, well-being, and the way we communicate and interact with each other are summarised on a general level.

Narrowing the focus to the risks of negative consequences for stress and well-being identified in the first chapter, Chapter 2 presents the theoretical background

for the research questions by introducing various theoretical stress models. It can be inferred from this chapter that digitalisation comes along with new stressors and demands as well as new resources and opportunities for coping and intervention strategies, which will also be discussed in the following chapters.

Chapters 3 and 4 can be seen as an integration of the first two chapters and address the first research question concerning demands related to digitalisation. In Chapter 3, two existing concepts describing new forms of ICT-specific and therefore digitalisation-related demands and new forms of stress are presented: (1) technostress creators are defined as factors related to ICT use that trigger a specific form of stress known as technostress while (2) telepressure describes the perceived pressure to immediately respond to work-related messages. Given the ongoing nature of digitalisation-related developments and in light of the weaknesses and limitations of previous constructs, it is necessary to update existing constructs and develop new ones. Chapter 4 therefore introduces a qualitative study seeking to conceptualise digitalisation anxiety. In addition to the positive opportunities, digitalisation also entails risks and can evoke negative reactions such as anxiety. In order to analyse the psychological causes of this so-called digitalisation anxiety, 26 interviews were conducted, from which it emerged that the digitalisation megatrend not only evokes anxiety with regard to individual or organisational changes, but especially concerning societal aspects. Based on the results, interventions are proposed to support organisations, teams, and individuals in coping with digitalisation anxiety triggers. This could help to improve individuals' feelings and experiences surrounding digitalisation. In order to be able to also quantitatively assess the newly developed digitalisation anxiety construct, the development and validation of a corresponding scale are presented in Chapter 4 as well: Items derived from the qualitative interviews were further reviewed and adjusted in order to compile a scale. The 35-item Digitalisation Anxiety Scale (DAS) was found to be reliable and valid in the conducted studies and exhibited correlations with behavioural indicators. The DAS was then used

to measure digitalisation anxiety in the further studies reported on in Chapters 5 and 6.

Chapter 5 addresses the consequences of new, ICT-specific demands for employees and their well-being. In this context, ICT-specific demands are defined as all factors related to digitalisation that can arise in the work context and are associated with effort or negative feelings on the part of the employees. In examining the effects, particular focus was placed on well-being, although subjective performance assessments were also analysed. A research model was developed based on previous theories, models, and existing empirical results and is introduced in Chapter 6. The hypotheses derived from this research model primarily focus on the main effect of the ICT-specific demands on well-being and productivity, as well as the possible influence of third variables, such as detachment (the ability to switch off from work) and technostress inhibitors (factors that prevent technostress from occurring). Examining the latter makes it possible to draw conclusions about potential underlying mechanisms. To test these hypotheses, four studies were conducted, the first three of which focused on particular ICT-specific demands (Study 5: telepressure, Study 6: technostress creators, Study 7: digitalisation anxiety). Study 8 examined the full research model. Across the four studies, it could be shown that the three investigated types of ICT-specific demands negatively influence various well-being indicators (more stress, poorer quality of sleep, less engagement and satisfaction, less commitment). However, the results were not clear with regard to the effects of the assumed third variables. Detachment had a mediating effect on the relationship between the ICT-specific demand telepressure and the two dependent variables stress and sleep quality. Nevertheless, no mediating effect for detachment was found in Study 8 examining the holistic research model. The hypothesised moderating effect of technostress inhibitors on well-being could not be shown for all ICT-specific demands as predictors: it was predominantly found for positive well-being indicators and (self-rated) performance as dependent variables. Significant moderation effects of technostress inhibitors were found for the relation between technostress creators

and engagement, commitment, and detachment as well as for the relation between digitalisation anxiety and (self-rated) performance. The ambiguous empirical findings on the effects of these third variables should therefore be examined further in future studies.

To avoid focusing solely on the negative consequences of ICT-specific demands, Chapter 6 also addresses new ways for interventions targeting digitalisation-related stress and improving well-being. In addition, the question of what can be done to buffer negative consequences of ICT-specific demands is attempted to answer. Following an overview of existing stress management interventions and their effectiveness, a longitudinal intervention study testing the effectiveness of several app-based interventions is presented. In this study, three different intervention types (meditative, cognitive-behavioural, and informational) were tested. Significant improvements in well-being compared to a control group were observed in both the meditative and cognitive-behavioural intervention groups over the study period. However, because the positive effects could not be confirmed for all of the examined variables, and a deterioration in well-being was even evident in the informational intervention group, further in-depth studies are necessary.

Chapter 7 provides a concluding discussion, that summarises the results of all studies with regard to the three research questions. Additionally, the limitations of the studies are outlined and potential hints for future research are derived. Finally, the strengths of this work are highlighted, and theoretical and practical implications based on the full set of conducted studies are identified.

Zusammenfassung

Die Digitalisierung als aktueller Megatrend beeinflusst viele Aspekte unseres Lebens, von der Art und Weise, wie wir arbeiten, bis hin zu unseren sozialen Interaktionen und unserer Kommunikation. Die Digitalisierung birgt dabei neben positiven Chancen und Möglichkeiten auch Risiken und kann zudem negative Reaktionen wie Stress oder Angst mit sich bringen. Obwohl im Allgemeinen meist positive Aspekte der Digitalisierung diskutiert werden, müssen auch damit zusammenhängende nachteilige Aspekte untersucht werden, um mögliche negative Konsequenzen abmildern oder vermeiden und die positiven Chancen nutzen zu können. Ziel dieser Dissertation ist daher die Untersuchung von Stressfaktoren und Anforderungen in Zusammenhang mit der Digitalisierung im Arbeitskontext und deren Auswirkungen auf das Wohlbefinden und die Produktivität von Arbeitnehmern. Darüber hinaus sollen Interventionen untersucht werden, die negative Auswirkungen von digitalisierungsbedingten Anforderungen auf das Wohlbefinden vermeiden können. In der Arbeit werden daher die folgenden Forschungsfragen behandelt:

Forschungsfrage 1: Welche Anforderungen und Stressoren ergeben sich aus der Digitalisierung?

Forschungsfrage 2: Welche Auswirkungen haben digitalisierungsbedingte Anforderungen auf das Wohlbefinden?

Forschungsfrage 3: Was kann getan werden, um negative Auswirkungen digitalisierungsbedingter Anforderungen abzumildern?

Als Einleitung und um den Kontext dieser Arbeit vorzustellen wird in Kapitel 1 die Digitalisierung und ihre generellen Auswirkungen darauf, wie wir arbeiten, kommunizieren und leben, thematisiert. Neben der Vorstellung der behandelten Forschungsfragen beinhaltet dieses Kapitel auch eine Definition des Digitalisierungsbegriffes, die bisherigen Entwicklungen im Rahmen der Digitalisierung werden dargestellt und es werden beispielhafte Technologien und Geschäftsmodelle,

die durch die Digitalisierung ermöglicht werden, vorgestellt. Zudem werden auf einer generellen Ebene sowohl positive als auch negative Auswirkungen der Digitalisierung auf die Gesellschaft, das Arbeitsumfeld, das Wohlbefinden und die Art und Weise, wie wir miteinander kommunizieren und interagieren, aufgezeigt.

Aufgrund der im ersten Kapitel identifizierten Risiken negativer Konsequenzen für Stress und Wohlbefinden wird in Kapitel 2 der theoretische Hintergrund der Forschungsfragen behandelt und es werden verschiedene theoretische Stressmodelle sowie bisherige empirische Befunde zu diesen Theorien vorgestellt. Aus diesem Kapitel ergibt sich, dass die Digitalisierung sowohl neue Stressoren und Anforderungen als auch neue Ressourcen und Möglichkeiten für Coping- und Interventionsstrategien mit sich bringt, worauf auch in den weiteren Kapiteln weiter eingegangen wird.

In den beiden Kapiteln 3 und 4 wird die Frage behandelt, welche Anforderungen und Stressoren sich aus der Digitalisierung ergeben. In Kapitel 3 werden dafür zwei bereits existierende Konzepte vorgestellt, die mit der Digitalisierung zusammenhängende Anforderungen sowie neue Formen von Stress beschreiben: (1) Technostress Creators sind Faktoren in Zusammenhang mit der Nutzung von Informations- und Kommunikationstechnologien, die Stress auslösen, den so genannten Technostress, und (2) Telepressure beschreibt den empfundenen Druck, sofort auf arbeitsbezogene Nachrichten antworten zu müssen. Wegen der immer weiter fortschreitenden Entwicklungen durch die Digitalisierung und auch aufgrund von Schwächen bisheriger Konstrukte ist es notwendig, existierende Konstrukte zu aktualisieren und auch neue Konstrukte zu entwickeln. In Kapitel 4 wird daher zunächst eine qualitative Studie zur Konzeptualisierung von Digitalisierungsangst vorgestellt. Neben den positiven Möglichkeiten und Chancen bringt die Digitalisierung auch Risiken und negative Reaktionen wie Angst mit sich. Um die psychologischen Ursachen dieser so genannten Digitalisierungsangst zu analysieren, wurden 26 Interviews durchgeführt, aus denen sich ergab, dass der Megatrend zur Digitalisierung nicht nur Angst in Bezug auf individuelle oder organisationale Veränderungen, sondern auch im Hinblick auf

gesellschaftliche Aspekte mit sich bringt. Basierend auf den Ergebnissen werden in Kapitel 4 zudem Interventionen vorgeschlagen, die Organisationen, Teams und Individuen dabei helfen können, mit den Auslösern von digitaler Angst umzugehen, um die Gefühle und Erfahrungen von Individuen in Bezug auf die Digitalisierung zu verbessern. Um Digitalisierungsangst als neu entwickeltes Konzept auch quantitativ messen zu können, wird in Kapitel 4 die Entwicklung und Validierung einer entsprechenden Skala vorgestellt. Nachdem aus den qualitativen Interviews Items abgeleitet wurden, wurden diese im Rahmen mehrerer Schritte weiter überprüft und angepasst und daraus eine Skala zusammengestellt. Die Digitalisierungsangst-Skala (Digitalisation Anxiety Scale, DAS) mit ihren 35 Items erwies sich in den durchgeführten Studien als reliabel und valide und es konnten auch Zusammenhänge mit Verhaltensindikatoren gezeigt werden. Die Skala wurde auch in den weiterführenden Studien zur Messung von Digitalisierungsangst und zur weiteren Untersuchung der Konsequenzen von Digitalisierungsangst in den Kapiteln 5 und 6 eingesetzt.

Kapitel 5 dreht sich um die Frage, welche Konsequenzen neue, mit der Digitalisierung zusammenhängende Anforderungen auf Arbeitnehmer haben. Als Anforderungen werden in diesem Kontext alle mit der Digitalisierung zusammenhängende Faktoren angesehen, die im Arbeitskontext auftreten können und von Seiten der Arbeitnehmer mit Anstrengung, Aufwand, oder negativen Gefühlen verbunden sind. Der Fokus bei der Untersuchung der Auswirkungen wurde insbesondere auf das Wohlbefinden gelegt, wobei auch subjektive Produktivitätseinschätzungen analysiert wurden. Basierend auf bisherigen Theorien und Modellen sowie existierenden empirischen Ergebnissen wurde ein Forschungsmodell aufgestellt, welches in Kapitel 5 vorgestellt wird. Die daraus abgeleiteten Hypothesen beziehen sich vor allem auf die Haupteffekte der Anforderungen auf das Wohlbefinden und die Produktivität sowie auf den möglichen Einfluss von Drittvariablen wie Detachment (die Fähigkeit, von der Arbeit abschalten zu können) sowie Technostress Inhibitors (Faktoren, die das Entstehen von

Technostress verhindern können) auf diesen Zusammenhang, woraus auch Schlüsse auf mögliche Wirkmechanismen gezogen werden können. Um diese Hypothesen zu überprüfen, wurden insgesamt vier Studien durchgeführt, wobei bei den ersten Studien der Fokus jeweils auf einer bestimmten digitalisierungsbedingten Anforderung lag (Studie 5: Telepressure, Studie 6: Technostress Creators, Studie 7: Digitalisierungsangst) und in Studie 8 das gesamte Forschungsmodell überprüft wurde. Hierbei konnte über die verschiedenen Studien hinweg gezeigt werden, dass sich die drei verschiedenen Arten von digitalisierungsbedingten Anforderungen negativ auf unterschiedliche Indikatoren für Wohlbefinden auswirken (mehr Stress, schlechtere Schlafqualität, weniger Einsatzbereitschaft und Zufriedenheit, weniger Commitment). In Bezug auf die Effekte der angenommenen Drittvariablen waren die Ergebnisse nicht eindeutig. Der mediierende Effekt von Detachment konnte für den Zusammenhang zwischen Telepressure als digitalisierungsbedingte Anforderung und den beiden abhängigen Variablen Stress und Schlafqualität gezeigt werden. In der Studie zur Überprüfung des Gesamtmodells konnte dieser mediierende Effekt jedoch nicht repliziert werden. Der angenommene moderierende Effekt von Technostress Inhibitoren auf Wohlbefinden konnte nicht für alle digitalisierungsbedingten Anforderungen als Prädiktoren gezeigt werden. Zudem ergab er sich überwiegend für positive Wohlbefindensindikatoren und Leistung als abhängige Variablen. Signifikante Moderationseffekte gab es insbesondere auf die Zusammenhänge zwischen Technostress Creators und Einsatzbereitschaft, Commitment und Detachment sowie auf den Zusammenhang zwischen Digitalisierungsangst und Leistung. Die mehrdeutige empirische Befundlage zu den Effekten der Drittvariable sollte daher in zukünftigen Studien noch weiter untersucht werden.

Um sich nicht nur mit den negativen Auswirkungen digitalisierungsbedingter Stressoren zu befassen, dreht sich Kapitel 6 um neue Stress-Interventionsmöglichkeiten, welche sich aus der Digitalisierung ergeben, und um die Beantwortung der Frage, was getan werden kann, um negative Auswirkungen digitalisierungsbedingter Anforderungen abzumildern. Nach der Vorstellung

bisheriger Stress Management Interventionen und Befunden zu deren Wirksamkeit, wird eine längsschnittliche Interventionsstudie zur Testung der Effektivität verschiedener App-basierter Interventionen vorgestellt. In dieser Studie wurden drei verschiedene Arten von Interventionen (meditativ, kognitiv-behavioral, informativ) getestet und es ergab sich, dass sowohl in der meditativen als auch in der kognitiv-behavioralen Interventionsgruppe während des Untersuchungszeitraums im Vergleich zu einer Kontrollgruppe signifikante Verbesserungen im Wohlbefinden beobachtet werden konnten. Da die positiven Effekte nicht für alle untersuchten Variablen bestätigt werden konnten und sich insbesondere in der informativen Gruppe sogar eine Verschlechterung des Wohlbefindens gezeigt hat, sind hier ebenfalls noch weitere Studien zur Untersuchung der Zusammenhänge nötig.

Kapitel 7 dient als abschließende Diskussion, in der zunächst die Ergebnisse aller Studien im Hinblick auf die drei aufgestellten Forschungsfragen zusammengefasst werden. Zusätzlich werden auch die Limitationen der Studien komprimiert dargestellt und daraus Hinweise für zukünftige Forschung abgeleitet. Nach der Betonung der Stärken dieser Arbeit werden zudem theoretische und praktische Implikationen aus den durchgeführten Studien zusammengefasst vorgestellt.

Acknowledgments

First of all, I want to express my deepest gratitude to all people, who supported me during my dissertation and who therefore also enabled and facilitated this process.

A special thanks goes to my supervisor Prof. Dr. Erika Spieß for her continuous support and for her helpful and precious feedback! She accompanied me throughout my whole studies by also supervising my bachelor's and master's theses and I deeply appreciate her ongoing interest in new topics and am thankful for everything I was able to learn from her. I also want to thank my further supervisors Prof. Dr. Dieter Frey and Prof. Dr. Rudolf Tippelt for their interest in the topic, which I am dealing with, and for making this dissertation possible.

Further I would like to thank my co-authors, especially Dr. Julia Reif for her extremely supportive and insightful contributions and for her ongoing effort in improving and sharpening our papers and articles.

Another huge thank you goes to my boyfriend Sebastian and to my parents – Gertraud and Andreas – who were all always a reliable place of retreat during the previous years. Without their support, this work would not have been possible!

A special thanks also goes to all of the students I was able to accompany by supervising their theses or projects. They contributed substantially through conducting studies, recruiting participants, and their creative and innovative ideas. I also want to mention all participants of our studies who spent time to answer our questionnaires, to participate in interviews, or to take part in the intervention study. Without their effort and motivation to participate in our studies, the research for this dissertation would have been impossible. My colleagues at the Chair of Organisational and Economic Psychology were a fantastic company throughout the last years and I am very thankful for their valuable advice and comments. I also want to thank the Erasmus+ Project IMPRESS for financially supporting the research conducted within this dissertation.

Thank you very much to all of you! I am very grateful for all of your support!

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List of Abbreviations

α	= Cronbach's Alpha
CFA	= Confirmatory Factor Analysis
CFI	= Comparative Fit Index
CI	= Confidence Interval
DAS	= Digitalisation Anxiety Scale
EFA	= Exploratory Factor Analysis
ICT	= Information and Communication Technology
IT	= Information Technology
f	= Following line/page
ff	= Following lines/pages
K	= Cohen's Kappa
n	= Sample size, number of mentions
M	= Mean Value
Min	= Minimum
Max	= Maximum
p.	= Page
p	= p-value
PC	= Personal Computer
RMSEA	= Root Mean Square Error of Approximation
SD	= Standard Deviation
SRMR	= Standardised Root Mean Square Residual
SEM	= Structural Equation Model
TLI	= Tucker-Lewis Index
#	= Number of interview

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1. General Introduction: Digitalisation and its Consequences

Nowadays, digitalisation is a highly popular and significant topic and affects many aspects of our lives from the way we work to our social interactions and communication. Alongside positive opportunities, digitalisation also involves risks and can evoke negative reactions such as anxiety. Generally, mostly positive aspects are discussed but in order to make full use of the beneficial possibilities, it is necessary to also investigate negative aspects and consequences in order to buffer their effects. The ongoing proliferation of Information and Communication Technologies (ICTs) and associated consequences have been identified and thematised by various scholars:

> "ICTs are increasingly affecting all aspects of human society, especially our workplace and daily life" (Wang, Shu, & Tu, 2008, p. 3010).

> O'Driscoll, Brough, Timms, and Sawang (2010) mentioned "increasing concerns about the 'dark side' of technologies and their negative impacts on levels of individual well-being" (p. 270).

> According to Milligan (2016), "technology has become a double-edged sword, slicing away at workers' private time and creating the expectation that they will always be available" (p. 32).

All of these statements express increasing concerns about digitalisation and new technologies. The aim of this dissertation is to investigate stressors and demands related to digitalisation as well as the consequences of these demands on well-being and productivity. In addition to that, interventions that can buffer negative effects of ICT-specific demands on well-being are examined.

Specifically, this dissertation addresses the following research questions:

Research Question 1: What demands are related to digitalisation?

Research Question 2: What consequences do ICT-specific demands have for well-being?

Research Question 3: What can be done to buffer negative consequences of ICT-specific demands?

After introducing digitalisation as the key underlying process in this chapter, the second chapter presents the specific theoretical background of the conducted studies. In order to answer Research Question 1, the third and fourth chapters address ICT-specific demands: while Chapter 3 introduces two existing concepts, namely technostress creators and telepressure, Chapter 4 describes the conceptualisation of a new concept, digitalisation anxiety, and the development and validation of a corresponding scale. In order to investigate Research Question 2 on the consequences of ICT-specific demands, a research model is theoretically developed in Chapter 5 and empirically tested in four studies. Chapter 6 targets Research Question 3 by introducing existing stress management interventions and by describing a longitudinal study that tested the effectiveness of app-based interventions aiming at decreasing the negative consequences of ICT-specific demands and enhancing the well-being of employees. Chapter 7 summarises this dissertation's key findings and relates them to the research questions. Additionally, this chapter provides a critical discussion of the studies' limitations as well as theoretical and practical implications.

1.1 What Is Digitalisation?

First and foremost, it is necessary to provide an understanding of what digitalisation is. Hence, in the following paragraphs, digitalisation as a recent mega trend and its consequences for our ways of working, communicating, and living are discussed. This section emphasises the relevance of ICTs and the need to further examine their

characteristics and effects. Digitalisation is one of the most important and meaningful topics today and affects most aspects of our lives from the way we work to our social interactions and communication. Although digitalisation, associated technological changes, and the widespread adoption of ICTs offer manifold opportunities, which can potentially improve and simplify our lives, there are also negative aspects that have to be taken into account. Transformations are always difficult as humans generally exhibit resistance to change and its consequences and instead tend to favour stable conditions (e.g., Coch & French, 1948; Dent & Goldberg, 1999). Nevertheless, changes are clearly necessary to allow for developments and might also offer opportunities for improvements.

1.1.1 Definition

Digitalisation "represents the integration of multiple technologies into all aspects of daily life that can be digitized" (Gray & Rumpe, 2015, p. 1319). Another definition is provided by Legner and colleagues (2017), who described digitalisation as "the manifold sociotechnical phenomena and processes of adopting and using these [digital, note by the author] technologies in broader individual, organizational, and societal contexts" (p. 301). They also called for a distinction that has to be made between digitalisation and digitization, the latter of which relates to the technical process and digital technologies that transform analogue signals into digital ones. From a sociological point of view, it has been suggested that scholars avoid trying to define digitalisation, but instead investigate its societal function and determine what problem digitalisation is supposed to solve (Nassehi, 2019). Hence, while it is necessary to define this concept in order to proceed with the intended empirical investigation, it is nevertheless important to also take into consideration the societal circumstances of digitalisation and the context in which it occurs.

1.1.2 Developments

Cascio and Montealegre (2016) described the digital era as the time period following the agricultural (using the power of natural elements such as wind) and the industrial

eras (using industrial power and establishing mass production). According to them, the digital era is characterised by the production and trading of products and services via digitalised data, information, and knowledge and is based on infrastructure and communication technologies. This era originated with the development of computers and advanced communication technologies and is itself divided into four stages (enterprise computing, end-user computing, strategic computing, and ubiquitous computing). Therefore, digitalisation is not a new or recent phenomenon. The invention of the computer as very popular form of ICT took place much earlier: According to the Computer History Museum (2018), it is hard to define a specific date for the invention of the first computer, as related inventions occurred between 1937, when simple demonstration circuits such as the "Model K Adder" were built, and 1942, when the "Atanasoff-Berry Computer" was completed. Moreover, this was just the first of a wide range of developments (e.g., the first computer programs, extensive use of computers for example in public agencies such as the United States Census Bureau, direct keyboard input to computers). In 1981, IBM introduced the first personal computer (PC), and in 1984 Apple launched its popular Macintosh. As a result of a rising scale of production and concomitant price decreases, computer use has spread continuously over the past decades (Cascio & Montealegre, 2016). Whereas in 2000, according to Statista (2018a), just 47% of all private households in Germany possessed a PC, this number increased to about 90% in 2018. Similar developments took place in the working environment, with 95% of companies in Germany using computers by 2017 (Statista, 2018b).

The internet is another ground-breaking technology that penetrates and influences many aspects of our lives today. It is even considered to be "rapidly becoming as infrastructural as electricity" (Barley, 2015, p. 31), "the backbone of the rising digital world" (Hauck, 2019, translated) , or "indispensable to many people in their daily lives" (Hoffman, Novak, & Venkatesh, 2004, p. 37) and can be scientifically described as technical infrastructure that allows computer networks to be linked to each other (Hauck, 2019).

29th of October 1969 can be considered as the internet's day of birth, meaning that it already "celebrated" its 50th birthday in 2019 (Hauck, 2019). On this day in 1969, a message was sent from one computer at the University of California in Los Angeles to another computer located at Stanford University by using a specific protocol that can split information into virtual packages. These two computers comprised the Pentagon's new research network. After transferring the three letters LOG for login, the computer crashed. Further milestones in the practical use of the internet were the advent of e-mail services in the early 1970s and the development of the world wide web in the early 1990s (Hauck, 2019). Although Hannemyr (2003) criticised statements according to which the internet has an exceptionally high adoption rate compared to other types of media (e.g., radio or television) and highlights the difficulty of specifying certain dates for the invention or adoption of new technologies, the number of internet-connected devices clearly illustrates the rapid spread of this technology. In 2015, about 20 billion devices were connected online worldwide and forecasts suggest that this number will increase to half a trillion by 2030 (Althaus, da Silva Matos, Dutschmann, Sharma, & Wilken, 2018). According to a recent study on the penetration of new technologies worldwide, 66% of the world population use mobile phones, 56% are internet users, and 46% are actively using social media. The rate for internet users increased by 8.2% from July 2018 to July 2019, confirming the ongoing proliferation of this technology (Kemp, 2019).

Sproull and Kiesler (1991) described the use of e-mails during their initial implementation phase, when such technologies were not as common as they are today: "Some organizations are already making extensive use of this technology so that all or most employees have an electronic mailbox and send and receive messages on a daily basis. It is quite common in well-established electronic mail communities for people to send and receive between 25 and 100 messages a day" (p. 53). Their description of e-mails and their advantages seems very obvious from today's point of view, when nearly all kinds of jobs across a wide range of sectors require the use of

such new technologies and workers are therefore required to adjust to this reality (Atanasoff & Venable, 2017).

The fourth and final stage in the digital era is termed ubiquitous computing and describes an environment in which computational technology is basically everywhere and permeates almost all aspects of our lives (Cascio & Montealegre, 2016). Continued growth in the adoption of and investment in new technologies is predicted (e.g., Leopold, Ratcheva, & Zahidi, 2018; Tu, Wang, & Shu, 2005). According to Leopold et al. (2018), 85% of surveyed global companies from different industries and countries are likely or very likely to expand their use of big data analytics by 2022.

Generally, the numbers show an ongoing penetration of new technologies into our everyday lives, which will further increase the relevance of dealing with those developments and their consequences in the future.

1.1.3 Examples

Digitalisation is a very broad term that involves numerous technologies and developments – far beyond the simple use of computers and the internet. To make the term digitalisation more tangible, it is necessary to also provide and present exemplary technologies. Daniel Newman (2018) described machine learning, virtual reality, augmented reality, and connected clouds as some of the top trends in digital transformations. Leopold et al. (2018) named technological innovations such as high-speed mobile internet, artificial intelligence, and big data analytics as the most dominant advances in the period between 2018 and 2022. The application of robotics and associated automation of tasks and processes is another example of digitalisation (Cox & Fletcher, 2014). While these new trends might be beneficial from a technological point of view, they primarily refer to cutting-edge technologies, which most people are unfamiliar with. The current digitalisation situation can be compared to the industrialisation period, which also involved profound changes in people's everyday lives, especially with regard to work, and people were forced to adapt to something new and unfamiliar.

Another example of digitalisation on a more practical level is the evolution of the way we pay (e.g., Boel, 2019): An original system of bartering eventually evolved into the exchange of gold and coins in exchange for goods. Later, paper money was introduced, followed by credit card and debit card payments. In more recent years, contactless payment systems using a card or even mobile phone have been introduced and are becoming increasingly widespread. When asked about their preferred method of payment in stores, 35% of the German sample named payment by card as preferred method and already 15% would prefer some kind of digital payment such as smartphone payment or payment apps (Sonnenberg, 2019). While these changes can be quite convenient and timesaving for customers, there are also risks associated with new forms of payment, e.g., data security issues and losing track of how much one has spent.

Other examples of how digitalisation penetrates many areas of private, public, and working life include smart homes (e.g., digital interconnectedness of devices/buildings through the internet of things, automated and remote regulation of light and blinds depending on weather and light conditions), smart mobility (e.g., automated traffic management based on air quality), or e-healthcare (e.g., digital patient files, telemedicine) (Benevolo, Dameri, & D'Auria, 2016; Federal Ministry for Economic Affairs and Energy, 2018; Federal Ministry of Health, 2018; Gray & Rumpe, 2015).

Wearable technologies such as smart watches or pedometers are another example of a practical application of ubiquitous computing (Cascio & Montealegre, 2016; Cox & Fletcher, 2014). They consist of computer chips and sensors that are attached to clothing or the body. There is thus no longer a need to carry a device as these gadgets can be used to collect and immediately transfer information (e.g., about the movements or physiological state of the person wearing the device). They can be utilised as a motivator for physical exercise (e.g., tracking calories or steps per day), in the field of e-health (e.g., quick reactions in emergency situations or for patient monitoring), preventative health at work (e.g., tracking of blood pressure or stress

level), or in an ethically questionable application also to monitor employees (e.g., GPS tracking, observing the number and length of breaks). Another wearable technology providing an example of how humans and machines can merge are exoskeletons. An exoskeleton is a robot that imitates the human walking movements and thus makes it possible for paralysed people – after some practice and learning time – to walk (e.g., Herr et al., 2007; Oertli, 2019).

Technological advances have also brought about new business models that can influence our lives. Four will be briefly described here: (1) Uber is a company focussing on transporting people, food, and other items. It started as a private alternative for taxis, with customers using an app to order transportation for a specific route at a fixed price. The driver will pick up the customers at the indicated location and drive them to the desired destination. Afterwards, the customers can pay via the app and also rate the driver. Uber also creates business opportunities for people to register as drivers, although drivers' employment conditions and qualifications have been the subject of some controversy. Additionally, Uber has been condemned by taxi drivers with official taxi licenses, who criticise Uber's business practices and expressed concerns about additional competition by Uber drivers (Lehrke, 2019). Uber has now extended its services and also offers food delivery, cargo services, business travel planning, and even bike and e-scooter rental through their new app "Jump" (Uber Technologies Inc, 2020).

(2) Airbnb is a platform people can use to either offer their homes as short-term rentals to travellers or to book private accommodation during their own travels. It was founded in San Francisco in 2008 as "Airbed & breakfast", and originally aimed at offering alternative private accommodation in times of hotel bed shortages in cities during conferences or special events. Airbnb has also extended its services and today, in addition to accommodation, guests can book services as a pretzel-baking course in Munich to experience a city together with locals (Airbnb, 2020).

(3) Sharenow offers app-based car-sharing in which people can flexibly rent cars for a fixed price that includes fuel, parking, and insurance. The app is also used to

validate the person's driving licence, locate rentable cars, unlock and lock the cars, and process the payment (Car2Go Deutschland GmbH, 2019).

(4) Duolingo is an app that enables people to learn new languages. It combines implicit and explicit learning strategies and uses machine learning algorithms to individualise learning by adapting the level of difficulty (Duolingo, 2020).

1.2 What Are Consequences of Digitalisation?

Digitalisation, ICTs, and rapid technological advances have a huge impact on our lives, well-being, and how we communicate, interact, and work (e.g., Cascio & Montealegre, 2016; O'Driscoll et al., 2010; Wang et al., 2008). In 19 interviews conducted by Cox and Fletcher (2014) with people working in the organisational safety and health field or as general foresight experts in various European countries, the impact of ICTs and work location on organisational safety and health was rated as the most important challenge. Specifically, the development of new technologies that increase possibilities for mobile working and work intensification were considered to represent possible risks to occupational health and safety and change the way we work (Cox & Fletcher, 2014). Cox and Fletcher (2014) summarised three ways in which technologies can affect work: Firstly, the emergence of new technologies can impact how people work (e.g., devices that track employees' physiological indicators and adapt their assigned tasks accordingly). Secondly, the spread of existing technologies (e.g., smartphones) can impact work by facilitating communication across geographical boundaries. Thirdly, new ways of using technology to structure and organise work within organisations can be developed (e.g., use of big data in workforce planning).

Other scholars identified positive (e.g., higher efficiency and productivity at work and more flexibility) as well as detrimental consequences (e.g., impaired psychological and physical health or decreased employee satisfaction and commitment) of technology use (e.g., Atanasoff & Venable, 2017). Some consequences are also related to insecurity and can be seen as both positive and negative consequences at

the same time. One example of this ambiguity is the expected effect of digitalisation on the number of jobs: On the one hand, the automation of tasks and the increasing use of robotics at work can entail a reduction in the required workforce (e.g., the number of employees completing ordinary manual tasks has declined, Aeppel, 2019 or Cascio & Montealegre, 2016). Although reducing the number of employees might not be a universal goal, reducing labour intensiveness might be an economical way to increase the profitability and efficiency of processes (Corbyn, 2015). On the other hand, new jobs can arise as a result of the ongoing use of ICTs and further technological developments (e.g., new jobs as web designers or information technology (IT) consultants). Automation can reduce boring or dangerous duties, making it possible for employees to focus on more important, creative, or interesting tasks or even provide them with more leisure time. Some researchers state that the total number of jobs has never declined due to technological developments in the past and that as many or even more jobs were created as destroyed during periods such as the industrial revolution (Aeppel, 2019; Cascio & Montealegre, 2016; Corbyn, 2015).

1.2.1 Positive consequences

This section presents potential positive consequences of digitalisation for society, work, well-being, and interaction and communication.

Societal consequences

Cascio and Montealegre (2016) stated that new business models can be developed as result of technological advances (e.g., Uber, Sharenow, Duolingo which were already introduced in Chapter 1.1.3). Such new companies and the services they offer can improve people's lives by offering new and easy ways to e.g. organise travels, transportation, or acquire new skills. Leopold and colleagues (2018) described how extensive technological transformations can positively influence employment relationships and predict that more flexible types of jobs will be offered in the future (e.g., external contract positions or jobs offering greater flexibility in terms of time and

location of work). Flexible working hours can also have advantages for companies, as individual working time accounts can help them buffer capacity variations due to economic conditions (Möller, 2010). There is also empirical evidence that organisational performance improves when innovations, including new technologies, are introduced (Sawang, Unsworth, & Sorbello, 2007).

Consequences for work

Apart from consequences for the societal and employment level, digitalisation also impacts the way employees work and how tasks are structured. Trade unions, which represent the rights and interests of employees and can therefore be considered employee-focused and -friendly, have also identified several positive consequences of mobile work, which is a new form of work made possible through digitalisation and characterised by flexibility with regard to working time and location: specifically, they note opportunities for improved work-life-balance, greater flexibility for employees in terms of working time, the elimination of commuting time, and the possibility to work without office-related disturbances as positive effects (e.g., IG Metall, 2015).

Automation can also make specific tasks less dangerous or strenuous (Cox & Fletcher, 2014) and enable them to be completed more efficiently, thus increasing productivity (Cascio & Montealegre, 2016; Corbyn, 2015). Employees can design and structure their work processes in a more individualised way (e.g., by individually adapting their folder structure or by creating individual shortcuts, Cox & Fletcher, 2014).

Consequences for well-being

Digitalisation also has positive consequences for employee behaviour and well-being at work, ranging from higher employee engagement (e.g., through the use of social media platforms, Richardson, 2017) and commitment to promoting self-motivation and general improvements in employee well-being at work (Cascio & Montealegre, 2016).

Consequences for interactions and communication

In addition, specific aspects and digitalisation-related developments have consequences for people's interactions and communication. ICT-mediated communication can improve how discussions are conducted and decisions are made: In particular, greater opportunities for participation (e.g., equalization) and possible increases in task focus during discussions are named as potential advantages (Kouzmin & Korac-Kakabadse, 2000). Moreover, ICT-mediated communication channels can increase the perceived informational and emotional connection of employees who are not in continuous personal contact with colleagues or supervisors due to remote working arrangements (Sproull & Kiesler, 1991).

Sproull and Kiesler (1991) described the use of computers and e-mails during their initial implementation phase and named several advantages of this new digital form of communication that seem very obvious from today's point of view, when nearly everybody is used to working with such technologies on a daily basis. They considered e-mails as being a very fast method of communication, as asynchronous medium of communication (meaning people can send and read e-mails whenever they want and do not have to pick up the phone when it is ringing), and an easy way to send information to a group of people. E-mails can also increase employees' flexibility by allowing them to communicate with each other independently of location and time, as e-mails can be checked from any location with an internet connection (Barley, Meyerson, & Grodal, 2011; Trinczek, 2011).

ICT-mediated communication also offers the possibility to enrich the quality of communication, e.g. with images as virtual cues during video calls. Especially in cross-cultural teams, it can be advantageous to hold meetings via video calls instead of phone conferences so that team members can see each other and receive virtual information during the communication and discussions.

The Foresight Mental Capital and Wellbeing Project (2008) addresses upcoming challenges and opportunities and how they can be dealt with in a way that takes into account mental well-being. Although the reported study focusses on the United

Kingdom, some of its implications can be generalised to other societies as well. The study places significant emphasis on new technologies and highlights the opportunities they provide to work on one's mental well-being (e.g., personalisation of education, addressing learning difficulties or mental disorders, changing how we socialise, work, learn, and communicate).

All in all, digitalisation has positive consequences in a variety of areas ranging from new business opportunities that can improve our lives, the organisation and completion of tasks, employee behaviour and well-being at work, to the way how people interact and communicate.

1.2.2 Negative consequences

In addition to the previously mentioned positive consequences, digitalisation might also entail a variety of negative effects. This notion is expressed in descriptions of technology as a "double-edged sword" (Milligan, 2016, p. 32) or as having a "dark side" (O'Driscoll et al., 2010, p. 270).

Societal consequences

The rising use of ICTs might contribute to the establishment of a 24/7 economy characterised by working time stress and excessive working hours (Cox & Fletcher, 2014). Richardson (2017) described how a culture of workaholism has developed due to changes in organisations, which face increased competition in a globalised world and therefore also incentivise hard work by employees. Workaholism has even been described as the most rewarded addiction in Western cultures and might be promoted by organisational culture and the opportunities new technologies provide to be constantly connected to work (Spruell, 1987).

This ongoing competitiveness can be also explained by the fact that digitalisation might lead to the destandardisation of work and an increasing number of atypical forms of employment such as part-time work, temporary contracts, subcontracted labour, or marginal employment, which could pose challenges for future society (Trinczek, 2011). Consequently, precarisation could be another risk

resulting from digitalisation (Trinczek, 2011): Despite the unclear definition of precarisation (e.g., low income, unstable employment or lack of access to social insurance benefits), increased levels of precarious employments (e.g., low-paid or insecure) even in previously safe branches have been noted. Trinczek (2011) also identified a more subjective "felt precarisation" (p. 610, translated) due to a diffuse fear of social descent, which is also reaching the middle class. Moreover, Leopold et al. (2018) described an increasing inequality in skills and a growing instability of skills, which might represent further societal challenges and even impede the situation on the employment market. More generally, a reduction in the full-time workforce due to automation of tasks can be seen as a possible risks of the fourth industrial revolution and associated technological transformations (Leopold et al., 2018; Wang et al., 2008) that is especially likely to occur if current changes and developments are not managed correctly.

Consequences for work

As our work rhythms adapt to the constantly increasing speed of computers and machines, a general rise in the velocity of work has been reported, which is also described as a "feeling of being 'a hamster in a cage'" (Clark & Kalin, 1996, p. 30). Moreover, general workload is increasing, which can also be accompanied by an expansion of working hours (Wang et al., 2008). Barley et al. (2011) examined the consequences of e-mails as a new digitalised form of communication and described that additional working time is required to organise and answer them. They even found that the volume of e-mails extends employees' working hours. Given the growing amount of information available for work, especially in times of big data, a high level of coordination and processing effort are required to cope with these "'information intense' environments" (Cox & Fletcher, 2014, p. 12). Work intensification is another trend resulting from digitalisation, as not only the amount of work increases, but work also becomes more and more multifaceted due to technology overload and increasing technological complexity (Stich, Tarafdar, &

Cooper, 2018; Trinczek, 2011; Tu et al., 2005). Digital technologies can also be a source of interruptions at work, e.g. in the form of incoming e-mails or reminders that pop up on one's screen (Barley et al., 2011; Stich et al., 2018).

Additionally, digitalisation is accompanied by new employer expectations concerning employees' availability or productivity. The spread of mobile devices and mobile working opportunities makes it possible for employees to be constantly available and accessible for work-related messages and requests, as employees can theoretically check their e-mails anytime and from anywhere (IG Metall, 2015; O'Driscoll et al., 2010). This can also blur the boundaries between work and home and lead to work-home interferences (Cox & Fletcher, 2014; Milligan, 2016; Stich et al., 2018; Trinczek, 2011). Although there are already court judgements calling for a resolution to this issue (e.g., a decision by the Court of Justice of the European Union (2019) on the need to track one's working hours even when working from home, which needs to be incorporated into national law), it continues to represent a highly critical issue in today's work environment. Digitalisation is also related to higher expectations concerning employee productivity, as employees receive support from numerous applications and programs that are supposed to make their work faster, better, or easier (Clark & Kalin, 1996; O'Driscoll et al., 2010; Wang et al., 2008). Ongoing technological developments can also lead to pressure on employees to quickly learn and update their skills to stay on top of new developments, new systems, and applications, which are becoming more and more complex (Tu et al., 2005; Wang et al., 2008). Additionally, the belief that technology and machines cannot fail might actually lead to a higher number of accidents (Cox & Fletcher, 2014). Especially in supervisory tasks, it is crucial to maintain one's attention while monitoring machines and automated processes. Research has shown that it is difficult to keep attentively focused on a task for longer periods of time and that errors become more likely as time goes on, especially if a task is rather easy and repetitive (e.g., Langner & Eickhoff, 2013). If an employee's job is reduced to supervising and monitoring automated tasks,

ways have to be found to keep their attention up in order to prevent possible accidents resulting from inattentiveness.

Consequences for well-being

Digitalisation is associated with high levels of uncertainty, as it is not clear what will change, how it will change, and when these changes will happen. A recent study by Kirchner (2019) on perceptions of digitalisation in Germany revealed that nearly 40% of survey respondents felt unsure about and left behind by digitalisation. Uncertainty associated with external or environmental factors can result in anxiety reactions (Cambre & Cook, 1985). However, phenomena such as negative feelings towards technology and technological developments are not a new issue but have already been described earlier: Heinssen, Glass, and Knight already conceptualised computer anxiety as such a phenomenon in 1987 with reference to the technological innovations of the prior 30 years, particularly the spread of computers, which had a huge impact on society at that time. Yaverbaum (1988) mentioned that technological innovation does not necessarily lead to higher perceived meaningfulness for managers and professional workers but can evoke negative feelings such as anxiety and fear. Ragu-Nathan, Tarafdar, Ragu-Nathan, and Tu (2008) focused on the experience of stress as a result of ICT use, thus highlighting another negative consequence of digitalisation. Technostress is described as a negative psychological experience related to the use of technology in general, which encompasses different forms: technoaddiction and technostrain (Salanova, Llorens, & Cifre, 2013; Salanova, Llorens, & Ventura, 2014).

The severe potential effects of digitalisation-related anxieties were also recently postulated by Wiederhold (2017), who predicted that they will particularly impact the mental health of the next generation due to their dependence on or even addiction to technological devices. Individuals can even experience physiological reactions to IT problems such as system breakdowns, e.g. increased levels of cortisol, a stress hormone (Riedl, Kindermann, Auinger, & Javor, 2012). Employees can also perceive a lack of autonomy if they feel constrained by technologies or their work only (or

mostly) consists of responding to IT demands (Cascio & Montealegre, 2016; Cox & Fletcher, 2014). Such feelings can also evoke negative consequences for well-being, e.g. stress or demotivation. Other negative feelings in response to digitalisation and new technologies such as technostress, distress, or frustration have been described as well (e.g., Stich et al., 2018; Tu et al., 2005).

Higher expectations by employers (e.g., being constantly accessible) might have negative consequences for employees' well-being due to the pressure to fulfil such expectations, e.g. continuously being in stand-by mode and thus having problems to relax and recover after work (IG Metall, 2015). People with higher levels of education seem more likely to fulfil the expectation of unlimited availability, particularly when it is associated with attractive career prospects (Trinczek, 2011). Scholars also warn that employees might feel tempted to take medication to improve their performance and enable them to work longer hours (Cox & Fletcher, 2014). Interestingly, e-mails as a specific outcome of digitalisation are also regarded as a "symbol of general overload" (Barley et al., 2011, p. 903) because they are related to social norms (e.g., concerning responsiveness) and anxieties (e.g., losing control, missing essential information or not meeting response time expectations).

Work overload and the increasing amount of information that needs to be processed require coping mechanisms, such as dividing one's attention or multi-tasking, which might be burdensome for employees and negatively impact their well-being (Stich et al., 2018). According to Trinczek (2011), the increasing number of people suffering from burn-out and the rise of absenteeism due to mental or psychological complaints indicates that employees can no longer cope with the performance pressure and the limits of work intensity and work-related stress have been reached.

Alongside psychological or emotional consequences, scholars also warn of physiological complaints resulting from fixed body positions and physical inactivity at work due to the increasing use of computers (Cox & Fletcher, 2014).

Consequences for interactions and communication

In general, digitalisation at work might lead to a decrease in the amount of personal contact with colleagues, supervisors, and works councils, especially if employees do not always work from the office and engage in mobile forms of work (IG Metall, 2015).

This can cause a feeling of social isolation, especially if employees are working from home without personal contact to supervisors or colleagues and if their work is reduced to interacting with their laptop or other technical devices (Cox & Fletcher, 2014). Employees who work remotely or from home might also be afraid of missing something at the workplace or of being overlooked in the selection for promotions or training (IG Metall, 2015). Cyberbullying at the workplace is another possible negative consequence of the use of social media platforms at work, where messages can be spread quickly and sometimes even anonymously (Richardson, 2017). Additionally, the quality of ICT-mediated communication cannot be compared to personal communication. E-mails, for example, are purely text-based and lack cues such as tone of the voice or handwriting, which can provide further hints for interpreting the content (Sproull & Kiesler, 1991).

To conclude, digitalisation can have a variety of negative effects on several aspects of life and society.

1.3 Outlook

The ongoing proliferation and acceleration of digitalisation and its positive as well as negative consequences make obvious that it is crucial to manage digitalisation in a way that facilitates the use of its chances and opportunities and avoids negative consequences and risks. In particular, the emergence of risks related to digitalisation depends on how it is managed and implemented.

Cascio and Montealegre (2016) claimed that the goal must be to "[m]aximize the positive consequences for individuals and organizations and minimize the negative effects" (p. 369). For organisations, it is specifically necessary to find "a balance between giving employees the technology they want and protecting them from these" (Stich et al., 2018, p. 98). If digitalisation is managed in a positive way and our society and economy can be successfully reorganised, we might in the future live in a world with more time for hobbies and family (Corbyn, 2015).

In order to understand the psychological consequences of digitalisation, it is necessary to further investigate the underlying mechanisms and also examine possible ways to help people cope with digitalisation-related demands. As stress is one of the most relevant consequences of digitalisation and many of the aforementioned consequences of digitalisation can also be considered stressors or stress factors, the following chapter will focus on stress and well-being.

2. Theoretical Background: Stress and Well-being

In this chapter, different theories of stress and well-being are presented, which also provide the theoretical framework for the development of the research model in Chapter 5.

Generally, high levels of stress at work are reported, which might at least partly be caused by the digitalisation and its consequences: In a recent study, among 1.650 surveyed participants 51% rated their work as rather or very stressful (pronova BBK, 2018). In another study conducted in scope of the IMPRESS project[1] in four European countries (Germany, Spain, Ireland, and Latvia) 24% of 979 respondents rated their stress level as high or very high, which illustrates the fact that stress at work is not just a German, but a cross-cultural issue (Pfaffinger, Reif, Czakert, Spieß, & Berger, 2018).

There are different kinds of costs related to stress at work: Firstly, psychological costs such as exhaustion, anxiety, burnout, depression, pessimism, resentment, reduced job satisfaction, and impaired general mental health are associated with stress (e.g., Reif, Spieß, & Stadler, 2018). Secondly, stress and its consequences also cause economical costs: Physiological and psychological disorders can lead to rising absenteeism rates and decreases in productivity (Colligan & Higgins, 2006). The total annual cost to Europe (EU-27) resulting from work-related depression has been estimated at EUR 617 billion. These include costs to employers for absenteeism, presenteeism, and productivity loss, health care costs, as well as social welfare costs in the form of disability benefit payments (European Agency for Safety and Health at Work, 2013, 2014).

[1] The Erasmus+ Project IMPRESS ("Improving management competences on Excellence based Stress avoidance and working towards Sustainable organisational development in Europe") aims at developing and validating an innovative toolset for identifying and dealing with stress-related issues in organisations. The results are expected to provide support by means of new coaching and training materials addressing the identified problems. Disclaimer: The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

These facts further illustrate the necessity to deal with stress-related issues and find ways how the stress-level can be reduced – especially in times of rising demands, which also result from the digitalisation and ICTs.

There are several theoretical models describing how and why stress at work generally occurs, which also negatively affects well-being. Although those models are not specifically focusing on stressors or demands related to ICTs, they can provide a framework to also explain effects of specific forms of stressors or demands, which is why five of those models will be shortly introduced in the following section.

2.1 Transactional Theory of Stress (Lazarus, 1991)

The Transactional Theory of Stress has been developed by Lazarus (1991) and contains a "transactional, process, contextual, and meaning-centered approach to stress" (p. 1). Transactional means that individual as well as environmental factors are relevant for stress. The two kinds of factors depend on each other and constantly influence each other. According to Lazarus (1991), stress only occurs if such a transaction between a person and the environment is evaluated as personally relevant harm (describing a negative event that already took place), threat (defined as anticipated harm that might happen in the future), or challenge (condition of high demand with emphasis on positive outcome possibilities such as expanding resources etc.). The emergence of stress therefore depends on two conditions: First, the outcome needs to be relevant and personal stake has to be involved and second, the appraisal of the situation needs to come to the conclusion that the demands exceed the available resources. The appraisal of the situation describes a subjective judgement of the situation with regard to the demands, environmental constraints of the situation, and individual resources or abilities. The primary appraisal includes whether any personal stake is involved in the situation. The secondary appraisal relates to the evaluation of available coping mechanisms and resources for dealing with the identified harm, threat or challenge and depends on the situational and

individual conditions. A schematic overview of the process how stress emerges according to the model by Lazarus (1991) can be found in Figure 1.

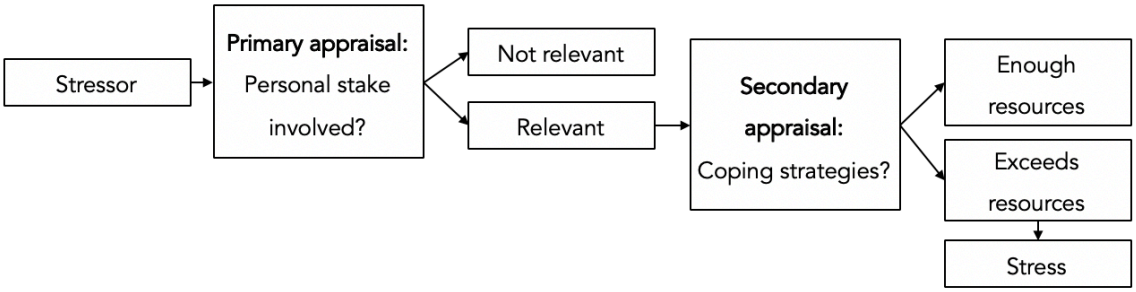

Figure 1. Schematic overview of the Transactional Theory of Stress by Lazarus (1991).

Coping is defined as "cognitive and behavioral efforts a person makes to manage demands that tax or exceed his or her personal resources" (Lazarus, 1991, p. 5). It therefore can be seen as process, which adapts to changing conditions and which influences the appraisal of a situation. There are two different categories of coping strategies (Lazarus, 1991): (1) Problem-focused coping draws on the situation itself by either changing one's own behaviour or the environment to remove or diminish the reasons for the stressful appraisal of a situation. This coping form is predominantly used in situations, which are evaluated as controllable. (2) Emotion-focused coping does not change the situation itself but draws on the emotional consequences of harm or threat. Strategies can either be avoidance to think about the situation, denial, positive thinking, or distancing. Such strategies are typically used in cases in which one has the belief that nothing can be done to change the situation or the problem. Coping strategies influence the appraisal process as well as long-term adaptational outcomes such as subjective well-being or somatic health.

Typical stressors at the workplace, which can cause situations of stress and which were mentioned by Lazarus (1991), are time pressure, noise, role ambiguity, or conflicts with superiors and subordinates. Possible stressors can also be caused or promoted by digitalisation and ICTs.

What can be concluded from the Transactional Theory of Stress is that stress depends on an individual and subjective appraisal of a situation, which takes into account situational demands as well as individual resources. Furthermore, interventions can be derived from this model, which draw on increasing a person's resources or coping strategies. Lazarus (1991) already stated that "[i]t is important to consider how the sources of stress and the coping process change as society changes" (p. 6). Due to the digitalisation and its societal consequences, this statement further highlights the need to also focus and investigate new digitalisation-related and ICT-specific stressors.

2.2 Job Demands-Resources Model (Bakker & Demerouti, 2007)

In their Job Demands-Resources Model, Bakker and Demerouti (2007) described how stress can be caused in the work environment (see Figure 2). They differentiate between job demands and resources, which both are "physical, psychological, social, or organizational aspects of the job" (Bakker & Demerouti, 2007, p. 312). While job demands are aspects that "require sustained physical and/or psychological (cognitive and emotional) effort or skills" (Bakker & Demerouti, 2007, p. 312), job resources are "[f]unctional in achieving work goals[,] [r]educe job demands and the associated physiological and psychological costs [or] [s]timulate personal growth, learning, and development" (Bakker & Demerouti, 2007, p. 312). According to them, job demands are related to physiological and/or psychological costs as meeting any kind of demands requires effort. Exemplary job demands stated by Bakker and Demerouti (2007) are work pressure, a strenuous physical environment, or difficult contacts with clients. Digitalisation and ICTs can either intensify existing traditional job demands (e.g., increasing number of interruptions through e-mails, information overload reinforced by rising number of communication channels) or cause new types of demands (e.g., expectations from employer regarding continuous availability). Computer problems were exemplary mentioned and investigated by Bakker, Demerouti, and Schaufeli (2003) as job demands.

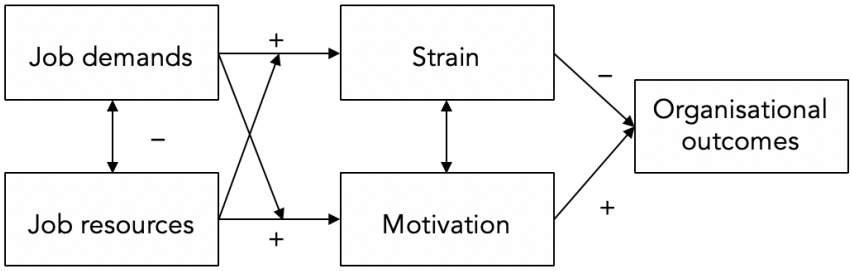

Figure 2. Job Demands-Resources Model (Bakker & Demerouti, 2007, p. 313).

Job resources can occur on different levels such as the organisational level (e.g., salary, career opportunities, job security), the interpersonal level (e.g., social relations, team climate), the organisation of work (e.g., role clarity, participation in decision making), or the task level (e.g., skill variety, performance feedback, autonomy, task significance).

Bakker and Demerouti (2007) described two possible processes through which job demands and resources affect well-being and work-related outcomes: (1) The health impairment process describes how job demands can lead to an exhaustion of mental and physical resources of employees, which consequently depletes their energy. Health problems can result from this process and also from the use of performance protection strategies such as intensified subjective effort, which might also increase physiological costs. (2) The motivational process describes how job resources can potentially foster work engagement and performance and decrease negative behaviours such as cynicism.

The Job Demands-Resources Model and also the derived assumptions have been empirically tested and validated. The dual process assumption has been empirically confirmed in several studies in different samples (e.g., call centre employees in the Netherlands, Finnish teachers), which also investigated various stressors as job demands (e.g., work pressure, computer problems, emotional demands, changes in tasks), job resources (e.g., social support, supervisory coaching, participation), and outcome variables (e.g., health problems, burnout, exhaustion,

(dis)engagement, organisational commitment, involvement) (Bakker, Demerouti, de Boer, & Schaufeli, 2003; Bakker, Demerouti, & Schaufeli, 2003; Bakker, Demerouti, & Verbeke, 2004; Demerouti, Bakker, Nachreiner, & Schaufeli, 2001; Hakanen, Bakker, & Schaufeli, 2006).

The buffer effect of job resources was found on the relation between job demands and outcomes as well as on the effect of job resources on outcomes: Bakker, Demerouti, and Euwema (2005) discovered in their study how autonomy, social support from colleagues, a high-quality relationship with the supervisor, and performance can buffer the relation between work overload and exhaustion. A study by Xanthopoulou, Bakker, Demerouti, and Schaufeli (2006) showed that personal resources mediated the effect of job resources on engagement/exhaustion and also impacted how job resources are perceived.

As ICT-related demands can be seen as job demands and digitalisation might provide possibilities for new job resources, the Job Demands-Resources Model can be useful when investigating ICT-related stress and well-being and corresponding interventions.

2.3 Job Demands-Control Model (Karasek, 1979, 2011)

Karasek's (1979, 2011) Job Demands-Control Model also provides an explanation for the occurrence of stress and strain at work (see Figure 3). According to this model, mental strain and dissatisfaction result from an interaction of high job demands and low job control. Job demands are described as stressors that an employee faces at work such as workload. Such demands can also result from ICTs or digitalisation, which makes this model relevant for investigating stress and well-being with regard to digitalisation. Job control is defined as level of decision latitude an employee has in how job demands are met. Decision latitude has two components: task authority (control over task performance, also called autonomy) and skill discretion (control over use of skills). Karasek (1979, 2011) assumed that specific combinations (high demands and high decision latitude indicating a high strain job) can even be beneficial for

learning and the development of new behaviours. High demands therefore not necessarily have to be seen as purely negative, which can be seen as positive insight from the Job Demands-Control Model.

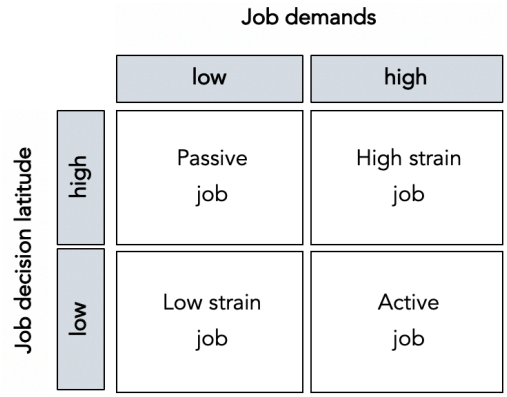

Figure 3. Job Demands-Control Model (Karasek, 1979, p. 288).

2.4 Effort-Recovery Theory (Meijman & Mulder, 1998)

Generally, meeting any kinds of demands requires effort, which is a basic assumption of the Effort-Recovery Theory by Meijman and Mulder (1998). They described three factors determining a work procedure: work demands, work potential, and decision latitude. How they are related to each other is depicted in Figure 4.

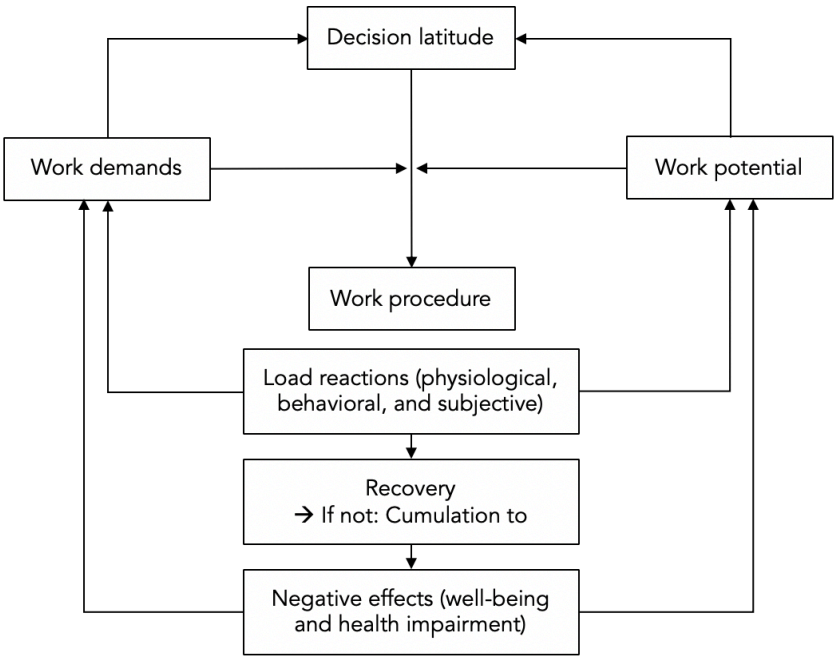

Figure 4. Effort-Recovery Theory (Meijman & Mulder, 1998, p. 9)

Regarding work demands, especially the actual level of task demands is important, which is described by the manifestation of formal work aspects in a concrete situation as well as environmental factors. Formal work aspects are characterised by work assignment (e.g., specified results of work), work conditions (e.g., agreements on the way the work is done), work environment and facilities (e.g., workplace, available support), as well as work relations (e.g., social and organisational aspects). Meijman and Mulder (1998) described the work potential as actual mobilisation of work abilities and effort and also took into account the behavioural repertoire of the person which includes e.g. psychological dispositions. Decision latitude is defined as choice of how the work is done, which also depends on the possibilities of control and the individual's abilities. Especially when the decision latitude is small, a situation can be stressful as the person has no possibilities to change the way of working.

Regarding the outcomes of work procedures, Meijman and Mulder (1998) differentiate between the physical product and reversible short-term physiological and psychological reactions resulting from work. As dealing with work demands requires effort and might deplete the person's resources, recovery is crucial for employees as this contributes to the stabilisation of the psychobiological system when the exposure to demands ends. If no recovery is possible, there might be negative long-term effects such as chronic stress complaints or well-being impairment. This prolonged response to work demands might interfere with important recovery processes such as psychological detachment from work, which means not thinking about work and work-related events (Sonnentag & Fritz, 2007).

Interestingly, negative consequences of demands are not inevitable: Only when meeting those demands requires high levels of effort and it is not possible to cope with them or to recover adequately, job demands can transform into job stressors (Bakker & Demerouti, 2007; Lazarus, 1991; Meijman & Mulder, 1998). Therefore, continuous and extreme job demands can deplete the resources of employees and consequently entail negative well-being outcomes such as stress (Demerouti et al., 2001; Grawitch, Werth, Palmer, Erb, & Lavigne, 2018).

2.5 Effort-Reward Imbalance Model (Siegrist, 1996)

Effort is also a meaningful aspect of the Effort-Reward Imbalance Model by Siegrist (1996), which is depicted in Figure 5. According to this model, experiencing an imbalance between high effort spent and low reward received at work leads to stress as this disrupts common expectations about reciprocity and adequate exchange in a crucial area of social life. Siegrist (1996) distinguished extrinsic efforts (e.g., demands or obligations) from intrinsic efforts (e.g., personal coping patterns). Rewards can consist of money, esteem, or status. In case of a lack of reciprocity between costs and gains (i.e., high-cost/low-gain conditions) a state of emotional distress can evolve. He also found that this perceived imbalance does not only negatively influence psychological strain but can also be a risk constellation for cardiovascular diseases.

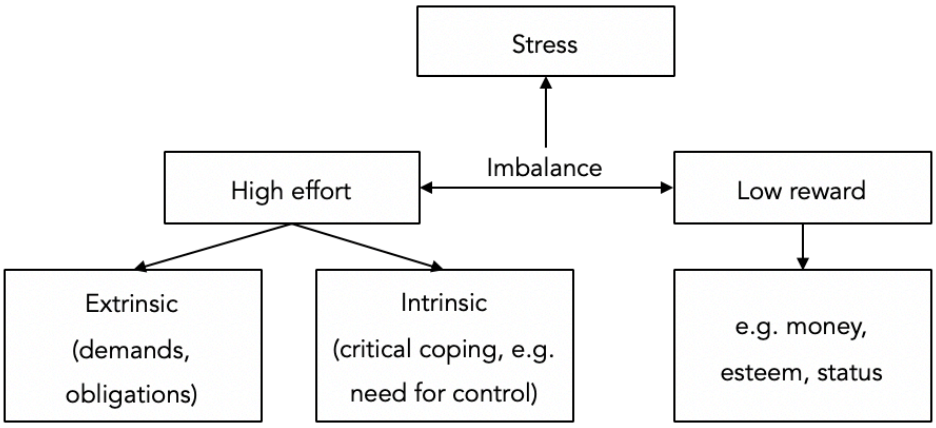

Figure 5. Effort-Reward Imbalance Model (Siegrist, 1996, p. 30).

2.6 Conclusion

All of the previously introduced models describe some kind of imbalance between external demands and resources, which can either lie in the person itself or the environment or coping strategies. As digitalisation, new technologies, and ICTs have become an important part of our work and everyday life, they also have the potential to constitute such kinds of demands or stressors as well as resources. Consequently, existing models can be relevant for investigating stress and well-being in a digitalised and digitalising environment.

3. ICT-Specific Demands: Existing Concepts

After having introduced digitalisation as current trend and existing stress models in the previous two chapters, this chapter combines the previous ones by describing specific demands related to digitalisation and the use of ICTs. This chapter therefore addresses Research Question 1 (*What demands are related to digitalisation?*). Traditional stress and recovery models, which were introduced in Chapter 2, can also be used to explain the emergence of negative consequences with regard to digitalisation and ICTs. Demands related to digitalisation or new ICTs can be considered as job demands as described in the Job Demands-Resources Model by Bakker and Demerouti (2007) or the Job Demands-Control Model by Karasek (1979, 2011) and therefore entail stress. They can also be seen as stressors based on the Transactional Theory of Stress by Lazarus (1991). Following the Effort-Reward Imbalance Model by Siegrist (1996), digitalisation and ICTs can lead to a perceived imbalance between high effort spent (e.g., high learning effort to get used to new software) and low reward received (e.g., no felt improvements through using a new software, lack of organisational recognition), which accordingly entails negative consequences.

Lazarus (1991) as originator of the Transactional Theory of Stress already stated that "[i]t is important to consider how the sources of stress and the coping process change as society changes" (p. 6). Due to the societal consequences of digitalisation it is therefore also necessary to investigate how the sources of stress change as a result of digitalisation. Besides giving an overview of various demands (e.g., information overload, data security concerns, technical problems, complexity, etc.) there is a specific focus on technostress creators and telepressure, which were chosen to be further examined in the empirical studies that were conducted in scope of this dissertation. Although the use of ICTs is quite common today, there is evidence on negative effects of ICTs on well-being, which could be explained by specific demands related to those new technologies and the stress theories described in Chapter 2.

Negative consequences of digitalisation already have been outlined in Chapter 1.2.2, which also contained some ICT-specific stressors. ICTs can take effect in two ways. Firstly, they might increase demands and therefore entail negative psychological consequences: ICTs can either strengthen existing demands such as work overload or interruptions (e.g., Yun, Kettinger, & Lee, 2012) or be a source of new stressors (e.g., telepressure). Secondly, ICTs might impede recovery processes and therefore make it harder for employees to refill their resources.

On the one hand side, ICTs can create stressors or demands including overload, role ambiguity, or job insecurity (Fenner & Renn, 2010; Knani, 2013). Newly arising demands and stressors related to ICTs already have been conceptualised and described such as telepressure (Barber & Santuzzi, 2015), permeability, which is described as the "extent to which a boundary allows the psychological or behavioral aspects of one domain to enter another" (Leung, 2011, p. 252), or work intensification (Kubicek & Tement, 2016). Day, Paquet, Scott, and Hambley (2012) named ICT hassles (e.g., computer problems or lost data), response expectations, availability (e.g., higher expectation on employees to always be available even outside of working hours), workload (e.g., use of ICTs can also increase the amount of work), lack of control (e.g., missing control over ICTs), learning (e.g., continuous developments and need to further educate oneself), employee monitoring (e.g., use of ICTs to control employees), and poor communication (e.g., greater risk of miscommunication due to less verbal and nonverbal cues) as facets constituting ICT-specific demands.

On the other hand side, positive effects of ICTs are reported as well: for example, scholars have found that broadband internet access can reduce the negative spillover effect of work into the home and private domain (Leung, 2011).

In many cases ICTs seem to have an ambiguous effect: E-mails can be considered as effective communication tool but at the same time be a source of stressors (Brown, Duck, & Jimmieson, 2014). The number of e-mails is related to work effectiveness but concurrently increases work stress (Mano & Mesch, 2010). Yun et al. (2012) also found that an increased work overload due to the use of job phones at

home or private phones at work results in greater work-to-life conflict, which might entail job stress and resistance to use them. At the same time, productivity, which is gained due to this practice, can reduce work overload, which can be seen as positive aspect.

Due to the broad variety of existing ICT-specific stressors there is a focus on two specific types of demands that are related to ICTs: (1) technostress creators and (2) telepressure, which will be further introduced in the following paragraphs.

3.1 Technostress Creators

Which aspects of technologies can be considered as demands or stressors is described by Ragu-Nathan et al. (2008), who established a Conceptual Model for Understanding Technostress. Their model is based on the assumptions of the Transactional Theory of Stress (Lazarus, 1991), which was already introduced in Chapter 2.1, and Ragu-Nathan et al. (2008) transferred the general stress model to the specifics of technostress. According to them, technostress creators are "factors that create stress from the use of ICTs" (p. 417) and can be influenced by individual differences such as age, gender, education, or computer confidence (see Figure 6).

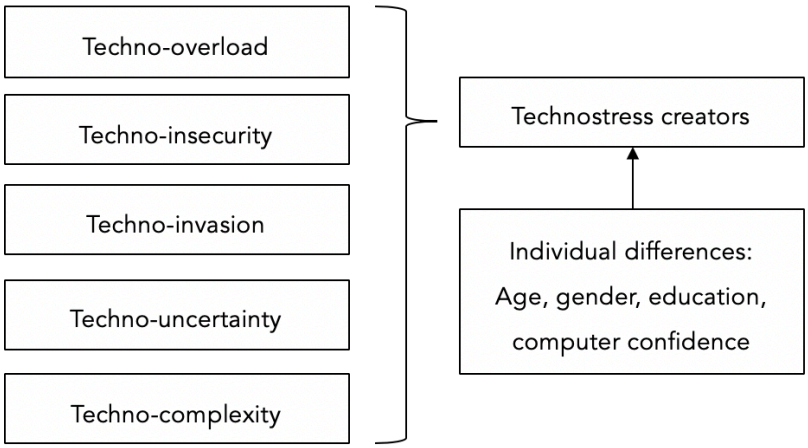

Figure 6. Overview of technostress creators according to the Conceptual Model for Understanding Technostress (Ragu-Nathan et al., 2008, p. 421).

Ragu-Nathan et al. (2008) mentioned various aspects, why ICTs generally cause stress: ICTs can e.g. create stress because they are complex and change rapidly, which makes it hard to get used to them or develop experience. This also requires employees to continuously learn new skills and programs. ICTs also can involve additional work, call for multitasking, or might be accompanied by technical problems and errors. The ongoing exposure to ICTs combined with expectations to constantly be accessible and connected can even extend the regular workday. They also might require handling different sources of information at the same time. Ragu-Nathan and colleagues (2008) developed a scale measuring technostress creators, which consists of the following five subscales (see also Figure 6): techno-overload (e.g., "I am forced by this technology to do more work than I can handle"), techno-invasion (e.g., "I feel my personal life is being invaded by this technology"), techno-complexity (e.g., "I need a long time to understand and use new technologies"), techno-insecurity (e.g., "I feel constant threat to my job security due to new technologies"), techno-uncertainty (e.g., "There are always new developments in the technologies we use in our organization").

As technostress creators summarise a variety of ICT-specific demands, they are of interest for subsequent empirical studies aiming at investigating the consequences of digitalisation and ICTs.

3.2 Telepressure

When analysing the job situation in a digitalised work environment, the rising number of incoming job-related messages, e-mails, and notifications can be seen as demanding job aspect. In this case, telepressure as urge of employees to quickly respond to work-related messages can be considered as psychological response to those perceived work demands, namely, demands to respond quickly to work-related ICT messages (Santuzzi & Barber, 2018). According to Richardson (2017), telepressure represents a "combination of preoccupation and urge to immediately respond to

work-related information and communications technologies (ICT) messages" (p. 426) and negatively influences employees' physical and psychological health.

As opposed to technostress creators, telepressure constitutes a more detailed form of ICT-specific demands.

3.3 Conclusion

Technostress creators and telepressure pose two forms of ICT-specific demands which is why it was decided to investigate their consequences in empirical studies, which will be presented in successive parts of this dissertation (Chapter 5). As digitalisation is an ongoing process, it is necessary to make sure that the current developments are incorporated in constructs describing ICT-specific demands. In the next chapter, the construct of digitalisation anxiety will be presented, which represents such an approach to develop and conceptualise a new and updated construct.

4. ICT-Specific Demands: Digitalisation Anxiety as New Concept

In this chapter, the phenomenon of digitalisation anxiety is presented in order to further examine Research Question 1 (*What demands are related to digitalisation?*). After introducing existing constructs related to negative feelings about technologies, a qualitative study was conducted to investigate the current thoughts of people concerning digitalisation and to conceptualise digitalisation anxiety as new construct. Afterwards, the development and validation of a scale to measure this newly conceptualised construct are described.

4.1 Theoretical Background: Existing Concepts

Scales and measures for negative feelings related to technologies were quite popular in the 1980s and 1990s when concepts such as computer anxiety (Raub, 1981; Rosen & Weil, 1995), computerphobia (Jay, 1981; Rosen, Sears, & Weil, 1987), computer aversion (Meier, 1985), or computer resistance (Gibson & Rose, 1986) were introduced. Afterwards, research on this topic decreased although some new scales with a focus on new technologies such as robots (Nomura, Kanda, & Suzuki, 2005) or autonomously driving vehicles (Hudson, Orviska, & Hunady, 2019) were developed.

There are three main reasons why a new concept is necessary: Firstly, it is necessary to include a process perspective in a new construct and scale. The previously mentioned concepts are all related to specific items but not to digitalisation as the underlying ongoing process. Secondly, a new scale should not depend on knowledge about existing technologies but also include new technologies, which might not have been developed yet. This can also be provided through the process-perspective, which also includes future technologies that might emerge. Thirdly, research has shown that negative feelings about digitalisation are related to stressors on different levels (O'Driscoll et al., 2010; Pfaffinger, Reif, Spieß, Witte, & Berger, 2018; Ragu-Nathan et al., 2008), which have not fully been considered in existing measures. A new scale therefore needs to take into account triggers on multiple

levels. Specifically, a focus on digitalisation in general as societal mega trend is missing in existing scales on negative feelings related to technologies (Khasawneh, 2018; Martínez-Córcoles, Teichmann, & Murdvee, 2017; Osiceanu, 2015).

Definitions and concepts describing various types of negative feelings with regard to technologies are already existing and an overview of them can be found in Table 1 and in the following paragraphs.

4.1.1 Negative feelings related to computers

As computers were one of the first digital innovations that changed the way people work and live, there are many definitions focusing on computers. Several scholars have used different terms to describe negative feelings people are facing when thinking of or using computers (e.g., Gaudron & Vignoli, 2002; Meier, 1985) such as computer anxiety (Raub, 1981), computerphobia (Jay, 1981; Rosen et al., 1987), computer aversion (Meier, 1985), or computer resistance (Gibson & Rose, 1986). Computer anxiety includes negative feelings such as fear, stress, or worries that are aroused by the actual or anticipated use of computers (Heinssen et al., 1987; Maurer, 1983; Raub, 1981; Simonson, Maurer, Montag-Torardi, & Whitaker, 1987; Tekinarslan, 2008). When considering digitalisation in total, such negative feelings can also be directed towards other technological devices or technology in general.

Table 1
Overview of existing constructs, definitions, and measures

Construct	Definition	Measure	Exemplary items	Reliability	Source
Computer Anxiety	"Computer anxiety was operationally defined through the utilization of four well established physiologic measures" (Best & Taylor, 1961 as cited in Powers, Cummings, & Talbott, 1973, p. 3)	Physiological measures	Blood pressure (systolic and diastolic), heart rate, electro dermal response	Not indicated	Best & Taylor (1961); Powers et al. (1973)
	"Computer anxiety is defined here as the complex emotional reactions that are evoked in individuals who interpret computers as personally threatening. This definition describes an anxiety state, in contrast to an anxiety trait." (p. 9) "Computer anxiety represents an anxiety state in that the emotional reactions fluctuate according to the presence (real or anticipated) or absence of a computer." (p. 10)	Attitudes About Computers Questionnaire, 25 items	E.g., "Computer terminology sounds like confusing jargon to me."; "Computers are beneficial aids to modern society."; "I will use a computer in my future occupation."	Not indicated	Raub (1981)

(continued)

Construct	Definition	Measure	Exemplary items	Reliability	Source
Computer Anxiety	"computer anxiety is defined as the fear and apprehension felt by an individual when considering the implications of utilizing computer technology, or when actually using computer technology. The individual is in this state (of computer anxiety) because of the fear of interaction with the computer, even though the computer posses [sic] no immediate or real threat." (p. 2)	CAIN (= Computer Anxiety Index), 26 items	E.g., "If I had to use a computer for some reason, it would probably save me some time and work."; "I avoid using computers whenever I can."; "I am usually uncomfortable when I have to use computers."; "I sometimes get nervous just thinking about computers."	Cronbach's α: Group 1: α = .94 Group 2: α = .96 Test-retest reliability (4 weeks): r = .90	Maurer (1983)
	"computer anxiety involves a more *affective* response, such that resistance to and avoidance of computer technology are a function of fear and apprehension, intimidation, hostility, and worries that one will be embarrassed, look stupid, or even damage the equipment." (p. 50)	CARS (= Computer Anxiety Rating Scale), 19 items	E.g., "I feel insecure about my ability to interpret a computer printout"; "It scares me to think that I could cause the computer to destroy a large amount of information by hitting the wrong key"	Cronbach's α = .87 Test-retest reliability (4 weeks): r = .70	Heinssen et al. (1987)
	"Computer anxiety was defined as 'the fear or apprehension felt by individuals when they used computers, or when they considered the possibility of computer utilization.'" (p. 238)	Use of CAIN scale (= Computer Anxiety Index), 26 items			Simonson et al. (1987)

(continued)

Construct	Definition	Measure	Exemplary items	Reliability	Source
Computer Attitude	"The Computer Attitude Scale is a Likert-type instrument consisting of 30 items which present statements of attitudes toward computers and the use of computers. Three main types of attitudes are represented: (a) anxiety or fear of computers; (b) liking of computers or enjoying working with computers; and (c) confidence in ability to use or learn about computers." (p. 502)	CAS (= Computer Attitude Scale), 30 items, 3 subscales with 10 items	Computer Anxiety Subscale: e.g., "Computers usually make me feel nervous and uncomfortable"; "Computers do not scare me at all." Computer Liking Subscale: e.g., "I like working with computers"; "Once I start working on the computer, I find it hard to stop" Computer Confidence Subscale: e.g., "I'm not the type to do well with computers"; "I'm sure I could do advanced work in computers"	Cronbach's α: Total scale: α = .95 Subscales: Computer Anxiety: α = .86 Computer Liking: α = .91 Computer Confidence: α = .91	Loyd & Gressard (1984b)
	"The Computer Attitude Scale (CAS) is a Likert scale devised to measure positive and negative attitudes toward computers in society" (p. 305)	CAS (= Computer Attitude Scale), 20 items (8 expressing positive attitudes and 12 expressing negative attitudes)	Positive: e.g., "The use of computers is enhancing our standard of living."; "Computers are bringing us into a bright new era."; "Life will be easier and faster with computers." Negative: e.g., "Computers make me uncomfortable because I don't understand them."; "I feel intimidated by computers."; "Computers are dehumanizing to society."	Cronbach's α: Total scale: α = .95 Subscales: Computer Anxiety: α = .86 Computer Liking: α = .91 Computer Confidence: α = .91	Nickell & Pinto (1986)

(continued)

Construct	Definition	Measure	Exemplary items	Reliability	Source
Techno-stress	"a modern disease of adaptation caused by an inability to cope with new computer technologies in a healthy manner" (p. 16)				Brod (1984)
	"stress experienced by end users of Information and Communication Technologies" (Ragu-Nathan et al., 2008, p. 417) "stress created by information and computer technology (ICT) - that is, 'technostress'" (Tarafdar, Tu, Ragu-Nathan, & Ragu-Nathan, 2007, p. 302)	Measure for technostress creators, 23 items, 5 subscales	Techno-overload (5 items): e.g., "I have a higher workload because of increased." Techno-invasion (4 items): e.g., "I have to be in touch with my work even during my vacation due to this technology." Techno-complexity (5 items): e.g., "I need a long time to understand and use new technologies." Techno-insecurity (5 items): e.g., "I feel constant threat to my job security due to new technologies." Techno-uncertainty (4 items): e.g., "There are always new developments in the technologies we use in our organization."	Cronbach's α: Ragu-Nathan et al., 2008 Techno-overload: α = .82 Techno-invasion: α = .80 Techno-complexity: α = .77 Techno-insecurity: α = .78 Techno-uncertainty: α = .83 Tarafdar et al., 2007: Techno-overload: α = .89 Techno-invasion: α = .81 Techno-complexity: α = .84 Techno-insecurity: α = .84 Techno-uncertainty: α = .82	Ragu-Nathan et al. (2008); Tarafdar et al. (2007)

(continued)

Construct	Definition	Measure	Exemplary items	Reliability	Source
Technostress	"we propose that the term *technostress* acts as an umbrella encompassing two different but related psychological experiences: technostrain and technoaddiction." (p. 423)				Salanova et al. (2013)
Computer-phobia	"branch of a larger technophobia in our society that has been engendered by our recent period of rapid technological growth and development." (p. 47)				Jay (1981)
	"It is generally accepted that the exponential growth of microcomputers in education and the workplace has produced an adverse reaction in many people that is referred to as 'computerphobia', ie. fear of computers." (p. 2)				Jonassen (1985)
Computer aversion	"This article suggests that a set of psychological reactions to computers exists that can be broadly classified as computer aversion. Aversion is defined here as a negative affective reaction with concomitant behaviors and cognitions." (p. 171)				Meier (1985)

(continued)

Construct	Definition	Measure	Exemplary items	Reliability	Source
Technology Anxiety	"TA is different from computer anxiety in that TA focuses on a user's state of mind about general technology tools whereas computer anxiety is more narrowly focused on anxiety related to personal computer usage. [...] TA specifically focuses on the user's state of mind regarding their ability and willingness to use technology-related tools." (p. 900)	TAS (= Technology Anxiety Scale), 9 items, based on Attitudes About Computers Questionnaire by Raub (1981)	E.g., "I am confident I can learn technology-related skills."; "I feel apprehensive about using technology."; "I hesitate to use technology for fear of making mistakes I cannot correct."	Cronbach's α = .90	Meuter, Ostrom, Bitner, & Roundtree (2003)
Negative Attitude towards Robots	"We consider negative attitudes toward robots as a psychological factor preventing individuals from interaction with robots having functions of communication in daily life" (Nomura et al., 2005, p. 2)	NARS (= Negative attitude toward robots scale), 14 items, 3 subscales	S1: Negative attitudes toward situations of interaction with robots: e.g., "I would feel uneasy if I was given a job where I had to use robots" S2: Negative attitudes toward the social influence of robots: e.g., "I would feel uneasy if robots really had emotions" S3: Negative attitudes toward emotions in interaction with robots: e.g., "I would feel relaxed talking with robots" (reversed)	Cronbach's α: S1: α = .750 S2: α = .782 S3: α = .648 Test-retest reliability (4-5 weeks): S1: r = .706 S2: r = .740 S3: r = .538	Nomura et al. (2005); Nomura, Suzuki, Kanda, & Kato (2006)

(continued)

Construct	Definition	Measure	Exemplary items	Reliability	Source
Information Technology Anxiety	"The present study focuses on the assessment of a measurement scale of anxiety towards ICTs in general. Our scale is based on two scales previously used in the literature. We believe that these two scales can jointly represent anxiety towards ICTs. TA scale focuses on technologies in general, while CAS Anxiety focuses on the use of PCs. We think that a scale of anxiety towards ICTs must reflect both aspects and thus must not be limited exclusively by one of them." (p. E58)	ITAS (= Information Technology Anxiety Scale), 12 items	E.g., "I feel apprehensive about using information technologies (ITs.)."; "Technological information sounds like confusing jargon to me."; "I hesitate to use ITs for fear of making mistakes I cannot correct."	Cronbach's α = .94	Lopez-Bonilla & Lopez-Bonilla (2012)
Technostrain	"users report feelings of anxiety, fatigue, scepticism and inefficacy beliefs related to the use of technologies" (p. 422)	4 items, based on Salanova, Llorens, Cifre, & Nogareda (2007)	Anxiety: "I feel tense and anxious when I work with ICT" Fatigue: "It is difficult for me to relax after a day's work using ICT" Scepticism: "As time goes by, ICT interest me less and less" Inefficacy: "In my opinion, I am inefficacious when using ICT"	Cronbach's α of original scale (Salanova et al., 2007) Anxiety: α = .83 Fatigue: α = .92 Scepticism: α = .93 Inefficacy: α = .84	Salanova et al. (2013)

(continued)

Construct	Definition	Measure	Exemplary items	Reliability	Source
Techno-addiction	"users feel bad due to an excessive and compulsive use of these technologies" (p. 422)	2 items, based on Del Líbano, Llorens, Salanova, & Schaufeli (2010)	Working excessively: "I feel I use ICT in excess in my life" Working compulsively: "I seem to have an inner compulsion to use ICT in whatever place and time"	Cronbach's α of original scale (Del Líbano et al., 2010) Working excessively: α = .78 Working compulsively: α = .79	Salanova et al. (2013)
Techno-phobia	"Technophobia […] is fear, dislike or discomfort by using modern technologies and complex technical devices (especially computers)." (p. 1139)				Osiceanu (2015)
	"technophobia is understood here as fear, anxiety and discomfort toward new technologies (including a wide range of new devices, not only computers)" (p. 184)	Technophobia Scale, 12 items	E.g., "I feel an irrational fear of new equipment or technology"; "I avoid the use of new equipment and technology"; "I feel uncomfortable when I use new equipment or technology"	Cronbach's α = .95	Martínez-Córcoles et al. (2017)

(continued)

Construct	Definition	Measure	Exemplary items	Reliability	Source
Techno-phobia	"an irrational fear and/or anxiety that individuals form as a response to a new stimulus that comes in the form of a technology that modifies and/or changes the individual's normal or previous routine in performing a certain job/task. Individuals may display active, physical reactions (fear) such as avoidance and/or passive reactions (anxiety) such as distress or apprehension." (p. 98)	16 items, 5 factors	Techno paranoia (5 items): e.g., "I am fearful that someone is using technology to watch and listen to everything that I do." Techno fear (5 items): e.g., "I am afraid of new technologies because they may interfere with my life emotionally, physically, and psychologically." Techno anxiety (2 items): e.g., "I feel restless when I have to use a new communication device." Cybernetic revolt (2 items): e.g., "I am fearful that robots may take over the world." Cellphone avoidance (2 items): e.g., "I try to avoid using new technologies such as cell phones whenever possible."	Cronbach's α: Total scale: α = .867 Techno paranoia: α = .826 Techno fear: α = .777 Techno anxiety: α = .799	Khasawneh (2018)

(continued)

Construct	Definition	Measure	Exemplary items	Reliability	Source
Attitude toward Computers/ Robots	"Therefore, it is proposed that general aversion to technology (i.e., negative attitude) is a detriment to technology adoption in the case of self-driving cars." (p. 3)	ACR (= Attitude toward Computers/ Robots), 20 items, 4 factors, based on CAS (Nickell & Pinto, 1986) either with robots or computers	(Un)beneficial (7 items): e.g., "Computers (Robots) are responsible for many of the good things we enjoy." (reversed) Dehumanizing (5 items): e.g., "Computers (Robots) are dehumanizing the society." Intimidating (4 items): e.g., "Computers (robots) intimidate me because they seem so complex." Controlling (4 items): e.g., "Soon our world will be completely run by computers (robots)."	Cronbach's α: (Un)Beneficial: α = .84 Dehumanizing: α = .84 Intimidating: α = .89 Controlling: α = .77	Tussyadiah, Zach, & Wang (2017)

Note. The overview is not conclusive but the most relevant constructs for the present digitalisation context have been chosen. Abbreviations: p = page; α = Cronbach's Alpha coefficient; *r* = Correlation coefficient.

4.1.2 Negative feelings related to technology

Technology anxiety "focuses on a user's state of mind about general technology tools […] [and] specifically focuses on the user's state of mind regarding their ability and willingness to use technology-related tools" (Meuter et al., 2003, p. 900). Research has not only examined anxiety caused by technology but also other negative feelings such as stress. Technostress results from the increasing complexity of technology merged with an inability to adapt or cope with new ICTs in a healthy manner (Ragu-Nathan et al., 2008) and is compared to the "feeling of being 'a hamster in a cage'" (Clark & Kalin, 1996, p. 30) combined with a perceived lack of control. Technostress is also related to societal developments through its description as "modern disease of adaptation caused by an inability to cope with new computer technologies in a healthy manner" (Brod, 1984, p. 16). Especially expectations of employers about enhanced productivity by employees through using new technologies can increase the feeling of technostress (Tarafdar et al., 2007). Interestingly, there are also traditional stressors such as multitasking, which are relevant in the technostress concept e.g. when you talk on the phone and at the same time check your e-mail account. There already exists a scale measuring different categories of technostress creators: techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty (Ragu-Nathan et al., 2008; Tarafdar et al., 2007). Apart from anxiety and stress as a result of technology or its use, more recently developed scales often focus on technophobia as new concept. Osiceanu (2015) defined technophobia as "fear, dislike or discomfort by using modern technologies and complex technical devices (especially computers)" (p. 1139). Although possible secondary consequences e.g. on society are described as component of technophobia, the negative feelings are still directed at technologies and their use (Khasawneh, 2018; Martínez-Córcoles et al., 2017; Osiceanu, 2015).

4.1.3 Negative feelings related to IT

López-Bonilla and López-Bonilla (2012) transferred the concept of technology anxiety to IT anxiety in order to comply with the technological changes and the ongoing spread of ITs. They also argued that it is necessary to combine different previous concepts (namely computer anxiety and technology anxiety) to comply with the specific characteristics of ITs.

4.1.4 Conclusion

Taking all of the definitions together, there are some aspects that are consistent across the previously described constructs:

- Negative feelings (e.g., stress, anxiety, fear)
- Related to the (anticipated) use of technology in general or specific types of technologies (e.g., robots, computer, ITs)

4.2 What Aspects Related to Digitalisation Cause Anxiety?

Chapter based on Pfaffinger, K. F., Reif, J. A. M., Spieß, E., & Berger, R. (2020). Anxiety in a digitalised work environment. *Gruppe. Interaktion. Organisation. (GIO)*. Advance online publication. Doi: 10.1007/s11612-020-00502-4.

Digitalisation is associated with high levels of uncertainty as it is not clear what will change, how it will change and when those changes will happen. A recent study by Kirchner (2019) on perceptions of digitalisation in Germany revealed that nearly 40% of survey respondents representative for the population felt unsure about and left behind by digitalisation. Uncertainties resulting from external or environmental factors can lead to anxiety (Cambre & Cook, 1985). Anxiety can be defined as "characteristic symptom of modern times, including the pressure for social change produced by rapid scientific and technological advances" (May, 1950, quoted in Cambre & Cook, 1985, p. 38) and can have negative behavioural consequences such as impeded performance, avoidance or impaired interactions (Heerey & Kring, 2007; Marcoulides, 1988; Torkzadeh & Angulo, 1992).

ICT-Specific Demands: Digitalisation Anxiety as New Concept

Anxiety can generally be described as "tense, unsettling anticipation of a threatening but vague event" (Rachman, 2004, p. 3) where it is hard to identify the cause for the tension (Rachman, 2004). According to Sanders and Wills (2003), "[a]nxiety is a combination of different elements – cognition, emotion, biology, behaviour and environment – which are linked and trigger one another off" (p. 3f). Anxiety also has been described as typical for times characterised by pressure for changes due to technological or scientific innovations (Cambre & Cook, 1985). Anxiety consequently can emerge in a digitalised and digitalising environment, which also contains such changes and resulting pressures. Digitalisation anxiety can therefore be defined "as feelings of tension and discomfort with respect to the emergence of new technologies and the integration of those technologies in all aspects of daily life, which changes the way information is presented and processed and thus how people communicate, work and live" (Pfaffinger, Reif, Spieß, et al., 2020, p. 2). As such, digitalisation anxiety not only refers to a specific technology, but covers a broader range of feelings and relates to technologies in general as well as the process of the technologies' penetration into and permeation of daily life. Integrating a process perspective and a content perspective, digitalisation anxiety therefore distinguishes from related concepts, such as technostress, which refers to "stress experienced by end users of Information and Communication Technologies (ICTs)" (Ragu-Nathan et al., 2008, p. 417), or computer anxiety, which is defined as an "anxiety state in that the emotional reactions fluctuate according to the presence (real or anticipated) or absence of a computer" (Raub, 1981, p. 10). All of these concepts target at the (anticipated) use or presence of specific forms of technology or technology in general but do not include the process of their integration in all aspects of daily life and the consequences of this integration.

Research has shown that stress and anxiety related to technology can have negative effects on individual and organisational outcomes: For example, technostress results in perceived work overload, demoralised and frustrated users, information fatigue, loss of motivation, dissatisfaction at work, decreased

organisational and continuance commitment, decreased individual productivity and increased role stress (Brod, 1984; Ragu-Nathan et al., 2008; Tarafdar et al., 2007). Technology anxiety negatively influences role clarity, motivation, and perceived ability (Meuter, Bitner, Ostrom, & Brown, 2005) and can significantly impact the acceptance of newly introduced systems (Kummer, Recker, & Bick, 2017).

Due to the severe consequences of digitalisation-related stress and anxiety on health, well-being, and organisational outcomes, it is necessary to better understand the psychological roots, triggers, and organisational manifestations of digitalisation anxiety, which goes beyond existing concepts by referring not only to the use of new technologies but also to the process of their integration in many aspects of life. Hence, it was empirically investigated in Study 1a [2] how employees feel about the digitalisation of the work environment and (if they associate it with anxiety) what triggers for digitalisation anxiety are. Due to the exploratory nature of this research, a qualitative approach was applied, which will be introduced in the following paragraph.

4.2.1 Methods Study 1a

Sampling procedure

Following Robinson's (2014) 4-point approach to qualitative sampling, the target population was defined at first. Being employed was specified as an inclusion criterion as the aim was to assess work-related stress and negative feelings. Following the exploratory approach, a heterogeneous sample was targeted. Second, the minimum sample size was determined. Recommendations range from 3 to 25 participants for qualitative interview studies examining people's experiences or exploring a topic for purposes such as generating items for a scale (Sandelowski, 1995; Smith, Flowers, & Larkin, 2009). Third, a sampling strategy was chosen. Convenience sampling was chosen and interviewees who were convenient to reach and willing to take part in the study were selected. They were included in the sample on a first-come-first-served

[2] This study was conducted in scope of a master's thesis by Tobias Witte.

basis (Robinson, 2014). As the study was part of the Erasmus+ Project IMPRESS as broader research project, several project partners were involved in the data collection process. Interviewees were recruited through different sources (using project partners' as well as personal contacts) and included people from different industries and educational backgrounds in order to ensure generalisability. Fourth, all interviewees were informed about their rights, the voluntary nature of their participation, the general topic of the study, and the interview structure in order to ensure informed consent. Interviewees were not compensated for taking part in the interviews.

Sample

An international consortium of 10 project partners conducted 26 qualitative interviews (Gender: male: n = 13, female: n = 11, no gender indicated: n = 2, Age: M = 43.1 years, no age indicated: n = 2). To ensure a common standard, all interviewers were provided with detailed instructions for data collection. Interviewees worked in different sectors (public sector, healthcare, banking, consulting, industrial sector) and had different amounts of work experiences and employment durations (indicated durations ranged between 3 and 40 years). All of the interviewees used some kind of digital tools in their everyday work (e.g., computer systems, virtual communication tools, digital service products, or programs such as SAP) and therefore were affected by digitalisation. Some were directly involved in strategic decisions concerning digital transformation and some worked in consulting and thereby advised other companies on digitalisation issues.

Data collection

Semi-structured interviews were conducted, which focused on the interviewees' experiences and feelings with regard to digitalisation. An interview guideline was prepared to ensure that the same questions were asked in the same order in each interview. The interview guide consisted of the following main questions[3]:

1. Do you feel optimistic or pessimistic about digitalisation?
2. To what extent does digitalisation of the work environment cause you happiness/anxiety? If anxiety is mentioned: Why do you feel anxious about digitalisation?

Interviews were conducted in German (*n* = 18), English (*n* = 6), and Spanish (*n* = 2). One of the project partners with profound knowledge of both languages translated the Spanish interviews into English. The interviews took place between January and March 2018 and lasted approximately 35 minutes on average (*Min* = 19.73 minutes, *Max* = 75 minutes, in eight cases the length of the interview was not specified).

Data analysis

Data analysis was conducted in English and German and finally translated into English in cooperation with a native speaker. The interviews were recorded, transcribed according to rules formulated by Kuckartz, Dresing, Rädiker, and Stefer (2008), and a qualitative content analysis following Mayring and Fenzl (2014) was conducted: units of meaning were identified, paraphrased, and classified into inductively generated categories. As the analysis progressed, the categories were summarised into more abstract, interpretative axial codes.

In order to ensure objectivity in the data analysis, the interviews were coded by two raters and Cohen's Kappa was calculated as a measure for interrater reliability.

[3] Additional questions about personal experiences, digitalisation as a motivator and stressor, reasons for positive feelings about digitalisation, and expectations about the future workplace were also part of the interview guide but will not be reported in this chapter.

Cohen's Kappa was acceptable for question 1 (K = .93), and, after a further round of discussing and refining the identified categories, excellent for question 2 (K = 1.00).

4.2.2 Results

Do people feel optimistic or pessimistic about digitalisation?

The interviewees' overall attitudes were examined by combining their answers to the first question into an overall attitude code, which was either positive (interviewee gave only optimistic answers), negative (interviewee gave only pessimistic answers), or ambivalent (interviewee gave both optimistic and pessimistic answers): 11 interviewees were generally optimistic (e.g., "I feel optimistic about the digitalisation of the work environment", #5, line 101), five were generally pessimistic (e.g., "Personally, I am rather pessimistic", #18, line 277), six were ambivalent (e.g., "In my opinion it is hard to say everything is very good or I think it is all bad", #24, lines 211f) and four interviewees did not provide an answer to this question.

Why do people feel anxious about digitalisation?

To identify triggers of digitalisation anxiety, the interviewees were asked about the extent to which the digitalisation of the work environment caused them happiness or anxiety. 19 interviewees talked about anxieties related to digitalisation and were subsequently asked why they felt anxious about the digitalisation of the work environment. Interviewees answered this question on different levels of abstraction, which were categorised as *society*, *organisation* and *individual*. Table 2 provides an overview of the content that was mentioned on each level.

Table 2
Triggers of digitalisation anxiety

Societal triggers	Organisational triggers	Individual triggers
– Consequences of digitalisation - Lack of predictability - Job insecurity - Reduced amount of work - Social exclusion – Stressful digitalisation process - Stressful initial phase of digitalisation - Challenge to keep up with developments – Surveillance – Concerns about data usage – Technologisation - Dependency on technology - Robotisation of humans - Work routines controlled by machines	– Organisations' expectations - Constant availability - Quick understanding of new processes - Taking part in trainings - Quick implementation of new technologies – Organisational structure - Lack of organisational infrastructure - Lack of user-friendly, individually supportive IT systems - Inexperienced people in powerful positions – Technical issues - Vulnerability to hacker attacks - Technical problems	– Personal development - Lack of time for training - Internal pressure to understand new developments - Lack of technological affinity – Changes in work - Increased speed of work - Loss of individual control – Individual communication problems

It was also assessed whether each interviewee mentioned digitalisation anxiety triggers on one, two, or three levels. The majority only mentioned triggers on one (*n* = 10) or two levels (*n* = 8) and just one interviewee named triggers on all three levels.

Societal triggers of digitalisation anxiety. Interviewees most frequently described being afraid of the general impact of digitalisation on society (*n* = 22 statements). They mentioned the *consequences of digitalisation*: the lack of predictability in the effects of digitalisation on society, job insecurity resulting from ongoing automation, and a decrease in the total amount of available work (e.g., "I have a critical view because it is always stated that many new jobs are created due to digitalisation. But more and more jobs are disappearing as well. And I am of the opinion that digitalisation cannot completely compensate for those jobs", #21, lines 280ff). Interviewees also talked about social exclusion as a further trigger of anxiety, which refers to the risk that people may become isolated from society if they are no longer able to participate in the digitalised world (e.g., "The anxiety is not directly caused by technology itself but by society. By the fact that one might drop out of the part of society which participates [in digitalisation]", #12, lines 239ff). Moreover, strain related to the *process of digitalisation* was brought up as a trigger. Specifically, strain related to the initial implementation phase of new technologies as well as the ongoing challenge of keeping up with the latest developments were mentioned (e.g., "For many people the 'comfort zone' gets lost due to the challenge of keeping up to date", #7, line 92). Furthermore, interviewees mentioned feelings of being monitored in the sense of general behavioural *surveillance* (e.g., by facial recognition systems).

Concerns about data usage were another anxiety trigger mentioned by the interviewees (e.g., "Understanding how much data is generated and processed by Industry 4.0[4] I am a bit nervous about what happens to all this data", #8, lines 48f).

[4] Industry 4.0 is a term, which describes "the use of digital technologies in the manufacturing process to produce higher-quality goods at reduced costs" (Statista, 2019, p. 2).

Other societal triggers were related to *technologisation* itself. Interviewees mentioned an increasing dependency on technology. They mentioned the robotisation of humans, i.e., the fear that humans will become more and more similar to robots as a result of the ongoing automation of processes and workflows. Interviewees also named the control of everyday work routines by machines as a trigger for anxiety (e.g., "Thinking about my whole working day being regulated by a machine […] seems very strange to me", #16, lines 247f).

Organisational triggers of digitalisation anxiety. Interviewees also mentioned triggers of digitalisation anxiety that were related to and can be controlled by organisations (*n* = 11 statements). They mentioned *organisations' expectations*, which mainly referred to the expectation that employees should constantly be available for work duties even after the official end of the workday due to new technologies such as smartphones. Organisations also expected them to be able to quickly understand new processes and technologies and to participate in trainings. Additionally, organisations often expected new technologies to be implemented unreasonably quickly and underestimated the time necessary for their introduction. Interviewees also described *organisational structures* as triggers for anxiety, specifically the lack of an organisational support infrastructure to help employees deal with technical issues, e.g. an IT helpdesk (e.g., "Sadly, in my company […] supporting infrastructure like technical equipment, ICT tools etc. have not been provided", #3, lines 26f).

A further trigger was the lack of user-friendly IT systems and applications that could individually support employees in getting their work done. They mentioned how IT experts without leadership experience and a broader organisational perspective could reach high-level positions due to the increasing importance of IT in organisations. Interviewees identified *technical issues* on the organisational level as a further trigger for anxiety. First, organisations' vulnerability to becoming victims of hacker attacks was named (e.g., "If you see how computers are locked by a virus and you sometimes need to pay ransom money. It is not funny when whole companies are paralysed, if nothing works anymore and the server is down. You depend on those

systems and cannot do anything anymore", #26, lines 408ff). According to the interviewees, organisations often do not take preventive security measures as they underestimate the risk of being attacked. However, when an attack does take place, the implications can be quite dramatic, ranging from an inability to work for several days to data loss. Second, technical problems with programs or systems used in the organisations were mentioned as a further trigger for digitalisation anxiety.

Individual triggers of digitalisation anxiety. Interviewees also stated intrapersonal factors as triggers of digitalisation anxiety (n = 9 statements). They described issues concerning their *personal development,* such as a lack of time for trainings, which are necessary to keep up with technological innovations at work. Interviewees also described an internal pressure to comprehend new technological developments, which is often difficult due to the increasing complexity of new systems (e.g., "I often do not have time to check for new relevant training content on the company intranet and study the courses", #7, lines 92ff). Comprehending new technology is even more difficult if employees lack technological affinity, which was described as a further trigger of anxiety.

Furthermore, interviewees described how digitalisation caused *changes in their work,* which in turn led to feelings of anxiety: some interviewees mentioned how the speed of work is generally increasing due to factors such as higher-speed communication and clients' or colleagues' expectations of immediate answers (e.g., "The client sends documents or information and rapidly expects an answer", #13, line 74). Some interviewees mentioned a decreasing ability to individually control their own work procedures, as multiple monitoring processes need to be followed. At the same time, opportunities for individual flexibility in how to complete one's tasks are declining. Interviewees also reported *communication problems* resulting from changes in communication methods, the increasing number of technology-supported communication channels and associated challenges in finding the right balance between digital and personal communication. They mentioned concerns about the efficiency of digital communication in specific situations, the risk of

misunderstandings, and the difficulty of choosing the right channels in specific situations (e.g., "People don't meet each other face to face but instead have meetings over Skype. I feel that this is not the most efficient way of communication", #4, lines 49ff).

4.2.3 Discussion

Employees' feelings about digitalisation and triggers for digitalisation anxiety were qualitatively investigated in Study 1a. Digitalisation of the work environment evoked mixed feelings: while about 50% of interviewees expressed positive feelings, 50% had negative or ambivalent feelings. Interviewees most often mentioned digitalisation anxiety triggers on the societal level, where they associated digitalisation with unpredictable consequences for living and working within society. On the organisational level, digitalisation mainly caused anxiety due to rising organisational expectations for employees. On the individual level, employees feared that digitalisation goes along with self-imposed pressure and a perceived loss of personal control.

Triggers on the societal level were more often mentioned than triggers on the organisational or individual level. One explanation for this finding could be the interviewees' decreasing amount of control in handling anxiety triggers as one moves from the individual to the organisational and finally the societal level. According to the Job Demands-Control Model (Karasek, 1979, 2011; see also Chapter 2.3), mental strain results from an interaction of high demands (e.g., workload) and low control. Job control is defined as the level of decision latitude employees have in how to meet demands. This decision latitude is low for societal triggers, as they often depend on political or legal institutions, with individuals therefore having very limited control. Organisational and individual anxiety triggers, by contrast, were described more tangibly and might be more susceptible to individual control which makes them easier targets for interventions.

Most triggers mentioned by interviewees were related to uncertainty: not knowing what happens to one's data, or what consequences digitalisation will have for the job market and for society in general resulted in negative feelings and digitalisation anxiety. Previous research has also shown that uncertainty is related to anxiety in the work environment (e.g., Marks & Mirvis, 1997). Reducing uncertainty thus seems to be a key starting point for designing practical interventions to reduce digitalisation anxiety (see practical implications).

Interviewees often mentioned anxieties related to job insecurity as a result of digitalisation. An analysis by PricewaterhouseCoopers LLP (2018) stated that about 37% of jobs in Germany are at high risk for potential automation by the 2030s. In particular, jobs for workers with low or medium levels of education are at a higher risk of being automated than jobs for highly educated workers. Thus, for workers with low or medium levels of education, concerns regarding job insecurity seem to be justified. However, there will not only be job cuts but also opportunities for new types of jobs, especially in the IT sector. This is why some researchers speak of shifting roles rather than a decrease in the number of jobs (Statista, 2019).

Consequently, digitalisation anxieties could serve as a motivation to proactively search for training opportunities to qualify for jobs requiring higher levels of education and skills.

Theoretical implications

The results showed that digitalisation anxiety is a prevalent phenomenon that goes beyond previous conceptualisations such as technostress (Ragu-Nathan et al., 2008), computer anxiety (Raub, 1981), technostrain (Salanova et al., 2013, 2014), or technophobia (Osiceanu, 2015), which primarily focus on information and communication technologies or technical devices themselves as the roots of strain and anxiety and not the process of their integration into daily life. Although some of the results are in line with Ragu-Nathan and colleagues' (2008) findings regarding techno-overload (e.g., higher pace and amount of work), techno-invasion (e.g.,

blurring spatial and temporal boundaries of work), techno-complexity (e.g., lack of knowledge about technology), techno-insecurity (e.g., threats to job security), and techno-uncertainty (e.g., constant changes), the study showed that digitalisation anxiety also arises from societal triggers. The societal triggers identified in this study offer new insights into Ragu-Nathan and colleagues' (2008) techno-uncertainty category, as they describe reasons for anxiety related to the integration of digitalisation in the way we work and live in society. The results also identify new uncertainty-related stressors concerning the societal consequences of digitalisation such as a reduced amount of work due to automation, the risk of social exclusion, or fear of surveillance. Those societal triggers have not been included sufficiently in previous concepts such as technostress, computer anxiety, or technology anxiety. Furthermore, the results point to additional stressors on the organisational (e.g., vulnerability to hacker attacks and technical problems) and individual levels (e.g., loss of control and communication problems).

Additionally, many existing scales were developed between the 1980s and 2010s: computer anxiety was defined by Raub (1981) and technostress was conceptualised by Ragu-Nathan et al. (2008). Such scales need to be updated due to the technological advances, which create new forms of human-technology interaction such as living in a smart home or paying contactless, which also should be taken into account when conceptualising people's digitalisation-related concerns and anxieties. From the interviews it can be inferred that anxiety is not only related to the (anticipated) use of technologies but also to the integration (process) of those technologies in many aspects of life. As digitalisation is an ongoing process and not just an "item" or one-time event, it is crucial to also take a process perspective which is missing in previous concepts referring only to specific "items" such as computers or technology in general. These findings demonstrate the need for the concept digitalisation anxiety and a corresponding updated measure (Pfaffinger, Huber, Reif, & Spieß, 2019; see also Chapter 4.3).

In addition to the integrative character of the concept by combining a content with a process view, digitalisation anxiety could also be beneficial through explaining various societal phenomena related to digitalisation such as participation in demonstrations related to digitalisation, the creation of new digitalisation-related laws, or the success or failure of implementing new IT systems in organisations. The individually perceived level of control could be an intervening variable in the relationship between digitalisation anxiety and different behavioural outcomes.

However, the results also showed that about 50% of interviewees felt optimistic about digitalisation. In this vein, theorising about (triggers of) digitalisation anxiety should also consider resources related to digitalisation, in the sense of "digitalisation optimism".

Practical implications

Organisations should carefully consider employees' concerns when planning and implementing new digital technologies. Based on the results of this study, interventions on different levels are proposed to prevent or reduce the occurrence of digitalisation anxiety and to further improve employees' feelings towards digitalisation. Societal triggers can be dealt with on a political and legislative level, organisational triggers must be dealt with on an upper management level, and individual triggers can be addressed by individuals and their supervisors. Table 3 provides an overview of potential interventions structured according to their initiator and the level of triggers they address. These interventions either (1) emphasise the positive aspects of digitalisation, (2) decrease negative triggers of digitalisation anxiety, or (3) provide support for employees in coping with negative triggers and increase their resources. Some examples will be further illustrated in the following section.

Interventions on the societal level. Providing opportunities for participation in digital changes (e.g., offer public trainings or IT helpdesks) can be one way to prevent social exclusion. Moreover, laws to regulate new forms of work could help ensure that

they do not lose sight of the human element. The Court of Justice of the European Union (2019) has already ruled on the necessity of tracking one's working hours even when working from home. Such tracking should be incorporated into national laws.

Interventions on the organisational level. Flexibility with regard to the location and time of work can help employees come to grips with the perceived loss of control resulting from automatised processes. At the same time, organisations need to clarify their expectations with regard to employees' temporal availability and ensure their compliance with relevant legal regulations (maximum working hours per day, etc.) to avoid blurring the boundaries of work. In teams, communication rules regarding digital media should be established (e.g., Who needs to be included in cc? Who is expected to react to e-mails? When are different communication channels appropriate? What problems can potentially arise when using indirect forms of communication?).

Interventions on the individual level. Employees' individual learning needs can be satisfied by taking part in either organisational trainings or external workshops. Setting boundaries with respect to work (e.g., working only from a specific desk at home, limiting one's working hours, switching off one's mobile phone after work) could be beneficial to facilitate detachment and recovery from work. Especially when combined with organisational interventions to clarify communication rules and expectations, such measures could help employees regain a feeling of control over their work.

In conclusion, practical interventions should be directed towards reducing employees' uncertainty or insecurity regarding digitalisation, which should in turn lead to a reduction of digitalisation anxiety. The interviews showed how employees are aware of opportunities related to digitalisation and also see positive aspects (e.g., for facilitating work, higher flexibility regarding the time and location of work). This generally optimistic view can be seen as a starting point for practical interventions.

Table 3
Overview of possible interventions against digitalisation anxiety on different levels

Initiator	Societal triggers	Organisational triggers	Individual triggers
Society/Public	**Social exclusion** - Ensuring participation possibilities for digitalisation (especially for older people) - Offering public trainings or IT helpdesks - Offering public Wifi to facilitate internet access - Expanding the distribution of high-speed internet for mobile phones **Surveillance and data usage** - Prohibiting or restricting surveillance - Ensuring data security through legal regulations for data ownership - Establishing punishments in the case of violations **Job insecurity** Introducing/fostering social welfare programs to provide security in the case of job loss **Consequences of digitalisation:** **New forms of work** Ensuring humanity of new forms of work through corresponding legal regulations	**Organisational expectations** Creating legal regulations to restrict blurring boundaries of work (Decision of the Court of Justice of the European Union (2019) about the necessity of tracking one's working hours even when working from home) **Technical issues** Establishing a functioning infrastructure that allows organisations to be interconnected in a technically safe way	

(continued)

Initiator	Societal triggers	Organisational triggers	Individual triggers
Organisation	**Surveillance and data usage** Investing in IT security to ensure the safety of employees' data **Unpredictability of developments and stressful process** - Influencing and structuring introduction process of new technologies/applications in an employee-friendly way that takes into account possible anxiety triggers - Communication of planned changes (What will change? When will it happen? What consequences will it have for employees?) **Consequences of digitalisation** - Development of new concepts of work - Providing formats to foster the development of innovative ideas, e.g. creating focus groups or providing a forum for ideas and offering incentives for employees to participate in organisational development	**Organisational expectations** - Organisational supports such as flexibility with regard to location and time of work - Clarifying expectations regarding employees' temporal availability - Ensuring compliance with work regulations (maximum hours of work per day, rest times, etc.) - Respecting ergonomic aspects of home-office workspaces **Organisational structure** - Providing new technology and ensuring support for it - Offering a competent helpdesk - Offering leadership trainings - Making use of more flexible hierarchies **Technical issues** - Investing in IT security to avoid hacker attacks - Providing new technology, keeping it up to date, and ensuring support for it	**Personal development** - Offering trainings to support individual learning needs (taking into account employees' time constraints, reducing training time to an appropriate level) - Offering a competent helpdesk **Changes in work** Establishing organisational supports to help employees cope with higher demands and increase their flexibility

(continued)

Initiator	Societal triggers	Organisational triggers	Individual triggers
Team		**Organisational expectations** Establishing team rules on expectations regarding availability, etc.	**Communication problems** Establishing communication rules (e.g., Who needs to be included on cc? Who is expected to react to e-mails? When are different communication channels appropriate? What possible problems might arise when using indirect forms of communication?)
Individual	**Consequences of digitalisation** Participation in organisational programs to foster innovation and create new business opportunities **Stressful process** Relying on the adaptation effect (sometimes it is necessary to just keep persevering)	**Organisational expectations** Setting boundaries for one's own work (e.g., only working from a specific desk at home and trying to set limits to working hours, switching off one's mobile phone)	**Personal development** - Taking part in organisational trainings (if available and relevant) - Trainings outside the organisation (e.g., how to structure e-mails effectively) - Proactively requesting specific workshops or trainings at work **Changes in work** Structuring working day in an efficient way that prevents distractions from new technologies and information overload (e.g., setting specific times for checking e-mails (and not continuously doing so))

Limitations and future research

Future research should quantitatively examine how the triggers identified in Study 1a actually cause digitalisation anxiety and test whether uncertainty and lack of control statistically mediate this effect. As a first step towards achieving this, an instrument to measure triggers of digitalisation anxiety should be developed, which can be based on the qualitative findings of Study 1a (Pfaffinger et al., 2019; see also Chapter 4.3). Furthermore, a digitalisation anxiety scale would enable practitioners and researchers to measure individuals' levels of digitalisation anxiety, compare it across organisations, industries, and cultures, and make ongoing changes more visible. The scale could also be used to further investigate behavioural consequences of digitalisation anxiety and its role in the stress process (see also Chapter 5). Knowing more about underlying mechanisms of effect of digitalisation anxiety on behaviour and stress could also further inform interventions aiming at designing the digitalisation and the related changes in a humane way.

A rather high number of interviewers were involved in the data collection, which might have led to differences in how the interviews were conducted. However, it was tried to avoid biases by making all interviewers familiar with the rules for conducting interviews. Moreover, the interviews were conducted in different languages and participants stemmed from different cultural backgrounds. Potential cultural differences were not analysed due to the limited sample size. However, future research should be encouraged to delve deeper into cross-cultural studies on digitalisation anxiety, as there are differences in digital readiness between countries (Cisco, 2018).

Future research should also address how people react to more recent technologies such as artificial intelligence, robotics, the internet of things, or virtual reality (Statista, 2019), which might have even more profound implications for our lives and which are associated with higher levels of insecurity (in our study, employees mostly referred to e-mails or chat tools). Finally, in order to complete the picture regarding feelings towards digitalisation, future research should focus on positive

feelings towards digitalisation, which could serve as resources that help to increase feelings of certainty and control.

4.2.4 Need for a new construct

Inferring from the introduction of existing constructs in Chapter 4.1 and the results of the qualitative interviews (Study 1a) in this chapter, there are three main reasons why digitalisation as a new construct needs to be conceptualised:

(1) All of the previously introduced and already existing concepts target at the (anticipated) use or presence of specific forms of technology or technology in general but do not include the process of their integration in all aspects of daily life and the consequences of this integration. As digitalisation is an ongoing process and not just an object or one-time event, it is crucial to also take a process perspective which is missing in previous concepts referring only to specific objects such as computers or technology in general. Digitalisation anxiety not only refers to a specific technology, but covers a broader range of feelings, technologies as well as the process of the technologies' penetration into and permeation of daily life.

(2) The technological developments ranging from the introduction of the first PCs and their proliferation (Computer History Museum, 2018) to the increasing use of the internet (Kemp, 2019) and ubiquitous computing as predicted environment in which computational technology is basically everywhere and permeates almost any part of our lives (Cascio & Montealegre, 2016) and their increasing velocity also call for a construct, which is not limited to specific technologies (which might not even have been developed yet) but which is related to the process of development and therefore also includes future technologies. Consequently, a new construct, which integrates a process perspective and a content perspective is necessary. Digitalisation anxiety therefore includes the previously introduced constructs and additionally contains a process perspective which distinguishes digitalisation anxiety from related constructs.

(3) Due to the penetration and permeation of technologies, digitalisation has consequences on multiple levels (organisational, individual, societal), which have not been taken into account sufficiently in previous concepts. Although techno-insecurity as subdimension of technostress or technophobia (e.g., Ragu-Nathan et al., 2008) also include some triggers on societal level, the concerns are limited to the fear of being replaced with regard to the job and other implementation processes but long-term consequences, which also affect other people in society (e.g., becoming dependent on technologies or the fear of being controlled by artificial intelligence), are also missing in those scales.

The procedure of developing and validating a scale measuring digitalisation anxiety will be described in the following sections.

4.3 Development of a New Scale Measuring Digitalisation Anxiety

Chapter based on Pfaffinger, K. F., Reif, J. A. M., Huber, A. K., & Spieß, E. (2020). *Digitalisation anxiety – Development and Validation of a new scale*. [Submitted]. A previous version of this scale was presented at the WASAD Congress in Würzburg, Germany: Pfaffinger, K. F., Huber, A. K., Reif, A. M., & Spieß, E. (2019, October). *Development and test of a new scale for the measurement of digital anxiety*. Poster presented at the WASAD Congress in Würzburg, Germany.

After having introduced existing constructs with regard to negative feelings about digitalisation (Chapter 4.1) and having defined and conceptualised digitalisation anxiety in Chapter 4.2, in this part of the dissertation the development and validation of a new scale to measure digitalisation anxiety (Digitalisation Anxiety Scale, DAS) are described.

Developing a scale is necessary to quantitatively examine how strong the digitalisation anxiety triggers identified in Study 1a actually are and how they are related to stress, well-being, and other consequences. Such a scale could enable practitioners and researchers to measure individuals' levels of digitalisation anxiety,

compare them across organisations, industries, and cultures, and make ongoing changes more visible. Such a scale could also be used to further investigate behavioural consequences of digitalisation anxiety and its role in the stress process. Knowing more about underlying mechanisms of effect of digitalisation anxiety on behaviour and stress could also further inform interventions aiming at designing digitalisation and the related changes in a humane way. In this chapter the development of a digitalisation anxiety scale is described and findings regarding its reliability and validity are presented.

4.3.1 Scale development and validation

By following the suggested steps of scale development by Hinkin, Tracey, and Enz (1997) and including recommendations of Wright, Quick, Hannah, and Hargrove (2017), Study 1a was used to generate items, which were tested with regard to their comprehensibility and content adequacy. Additionally, the factor structure of the items was assessed, and the items were descriptively analysed in order to choose items for the final scale version. Furthermore, the scale's test-retest reliability and also consequences of digitalisation anxiety were examined. An overview of the scale development process and the studies that were conducted is depicted in Figure 7.

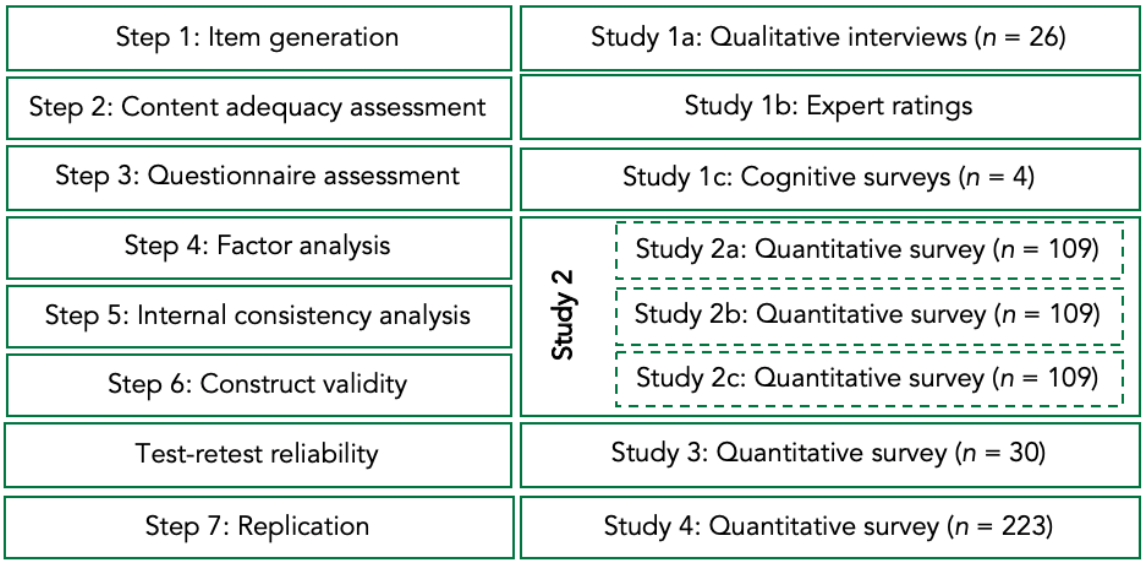

Figure 7. Overview of studies and the scale development process.

4.3.1.1 Study 1a: Item generation (step 1)

Methods

In order to generate items for the digitalisation anxiety scale, the sample of Study 1a (see Chapter 4.2.1) was used as the conducted interviews also were the foundation for conceptualising digitalisation anxiety.

Results

Based on the interview statements, 73 preliminary items were generated.

4.3.1.2 Study 1b[5]: Content adequacy assessment (step 2)

To guarantee content adequacy, expert ratings were used to ensure that the three identified levels of digitalisation anxiety are covered sufficiently by the 73 items and the scale complies with the developed model of digitalisation anxiety (Pfaffinger, Reif, Spieß, et al., 2020; Pfaffinger, Reif, Spieß, Witte, et al., 2018).

4.3.1.3 Study 1c: Questionnaire administration (step 3)

Methods

The items' comprehensibility was ensured by conducting cognitive interviews. Therefore, four participants (Study 1c, Age: M = 35.50 years, SD = 14.53 years), which were heterogeneous regarding gender (male: n = 2, female: n = 2) and education (intermediate school-leaving certificate: n = 2, general higher education entrance qualification: n = 1, university degree: n = 1) were interviewed and asked to think out loud while consciously going through the items and answering them.

Results

Participants of the interviews reported comprehension problems with four items, a perceived similarity to previously answered items with nine items and suggested adapting the syntax of two items. Resulting from the cognitive interviews, some of the items were adapted and others were excluded, which resulted in a second version of the questionnaire including 67 adapted and comprehensive items.

[5] Studies 1b, c and 2a, b, c were conducted in scope of a bachelor's thesis by Andreas Huber (2019).

4.3.1.4 Study 2a: Factor analysis to examine the factorial structure (step 4)

In the next step, an online study (Study 2) with 109 employees was conducted. This study was used to descriptively evaluate the items, to calculate a factor analysis (Study 2a), to assess the internal consistency of the scale (Study 2b), and to assess the scale's construct validity (Study 2c).

Sample

In total, 109 employees completed the online survey (Gender: male: *n* = 44, female: *n* = 65, Age: *M* = 33.11 years, *Min* = 18 years, *Max* = 67 years). Employment was a prerequisite for participation and the average working time was 27.74 hours per week (*SD* = 13.77 hours per week, *Min* = 4 hours per week, *Max* = 50 hours per week). The participants worked in different sectors to ensure the generalisability of the results (industry: *n* = 12, services: *n* = 37, administration: *n* = 4, education: *n* = 22, health: *n* = 13, other: *n* = 20, no information: *n* = 1).

The items were answered on a 6-point Likert scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *rather disagree*, 4 = *rather agree*, 5 = *agree*, 6 = *strongly agree*). The suggestions of Bühner (2011) and Jonkisz, Moosbrugger, and Brandt (2012) were taken into account and using a middle category was avoided as such a category might be comprehended differently by individual participants. Furthermore, no reversed items were included as they could create an artificial factor structure (Bühner, 2011).

Methods

An exploratory factor analysis (EFA) (Maximum-Likelihood-Method with Promax Rotation where correlations of subdimensions are possible) was conducted to examine the structure of the items. Parallel analysis (Horn, 1965) as well as an explicit theory and an existing hypothetical model were used for the extraction of factors (Bühner, 2011). By analysing the scree plot (Figure 8) and combining it with the explicit theory, four dimensions were identified within the item structure.

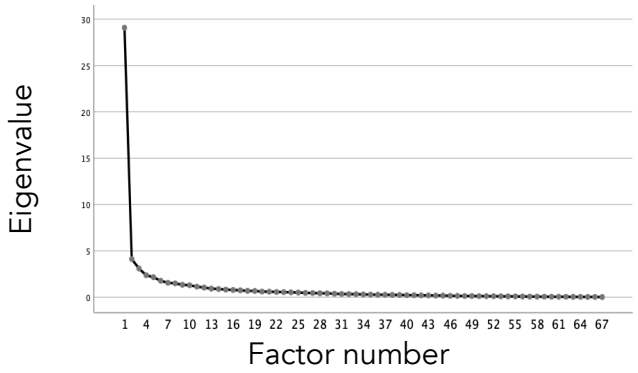

Figure 8. Screeplot for extracting factors by using parallel analysis.

In order to select items for the final scale, the range of answers, mean scores, factor loadings, and distribution of answers (e.g., are there 2 modi in the distribution of answers?) were descriptively evaluated. The following requirements suggested by Kelava and Moosbrugger (2012) and Hinkin (1998) were used as criteria for inclusion:

1. Factor loading of item should be higher than .40
2. Highest factor loading of item should be at least twice as large as second highest factor loading on next factor
3. Side loadings of items should not be higher than .30
4. Communalities of items should be at least .40
5. Distribution of answers should not show two modi

Results

Table 4 shows the factor loadings, mean values, standard deviations (*SD*s), and communalities after extraction of the scale's final items. The information for all preliminary items and the reasons for exclusion of items can be found in the Annex (Table A1).

Table 4
Items, descriptives, factor loadings, and communalities resulting from the exploratory factor analysis

Item (English version)	Item (German version)	Factor loadings 1	2	3	4	*M*	*SD*	Communalities after extraction
I am concerned about digital systems not being secure enough.	Es bereitet mir Sorgen, dass digitale Systeme nicht sicher genug sind.	**.840**	-.270	-.079	.054	4.21	1.42	.435
I am afraid that humanity will become dependent on technology due to digitalisation.	Es macht mir Angst, dass die Menschheit infolge der Digitalisierung von Technologie abhängig wird.	**.812**	-.041	.059	-.092	4.00	1.64	.598
As a result of digitalisation I am increasingly afraid of hacker attacks.	Infolge der Digitalisierung habe ich zunehmend Angst vor Hacker-Angriffen.	**.801**	-.242	.115	-.172	4.01	1.42	.413
I am afraid that surveillance will increase due to digitalisation.	Mir macht es Angst, dass die Überwachung durch die Digitalisierung zunimmt.	**.794**	.069	-.279	-.021	4.18	1.58	.467
I am afraid that in a digital world technology will be used against humans.	Ich habe Angst, dass in einer digitalisierten Welt Technologie gegen den Menschen eingesetzt wird.	**.773**	-.027	.100	-.050	3.61	1.61	.632
I am afraid of a lack of control due to digitalisation.	Ich habe Angst vor einem Kontrollverlust infolge der Digitalisierung.	**.721**	.285	-.175	-.007	3.38	1.62	.694
I am concerned about how the increasing amount of data due to digitalisation will be used.	Mir bereitet es Sorgen, wie die durch Digitalisierung steigende Menge an Daten genutzt wird.	**.687**	.135	-.130	-.089	4.08	1.61	.441

(continued)

Item (English version)	Item (German version)	Factor loadings 1	2	3	4	*M*	*SD*	Communalities after extraction
I am afraid of a new extent of criminality which is made possible by the use of digital technology.	Ich habe Angst vor einem neuen Ausmaß an Kriminalität, das durch den Einsatz digitaler Technologien ermöglicht wird.	**.676**	-.260	.263	-.058	4.08	1.47	.437
I am concerned that the human working force will be replaced due to digitalisation.	Es macht mir Angst, dass die menschliche Arbeitskraft infolge der Digitalisierung ersetzt werden könnte.	**.628**	.149	.222	-.259	3.15	1.47	.621
I am concerned about digitalisation as it entails consequences on many aspects of life.	Mir bereitet die Digitalisierung Sorgen, weil sie Auswirkungen auf viele Bereiche des Lebens hat.	**.564**	.265	.113	-.044	3.26	1.62	.698
I am concerned about the human needs not being taken into account sufficiently in the implementation of digitalisation.	Ich mache mir Sorgen, dass die Bedürfnisse des Menschen bei der Umsetzung der Digitalisierung nicht ausreichend berücksichtigt werden.	**.548**	.056	.007	.201	4.05	1.53	.530
I am afraid that people will trust technology more than humans due to digitalisation.	Es macht mir Angst, dass infolge der Digitalisierung der Technologie mehr vertraut wird als Menschen.	**.529**	-.058	.281	.026	3.40	1.53	.509
I am afraid of a too strong trust in the proper functioning of technology in a digitalised world.	Mir macht es Angst, dass in einer digitalisierten Welt zu sehr auf das Funktionieren der Technik vertraut wird.	**.498**	-.007	.174	.151	3.94	1.43	.514
I am afraid of digitalisation as I see risks in the technological progress.	Ich habe Angst vor der Digitalisierung, weil ich Risiken im technologischen Fortschritt sehe.	**.475**	.246	.074	.126	3.06	1.51	.652
I am afraid of the society being controlled by artificial intelligence due to digitalisation.	Ich habe Angst, dass die Gesellschaft infolge der Digitalisierung von künstlicher Intelligenz gesteuert wird.	**.444**	.110	.181	.036	2.72	1.52	.471

(continued)

Item (English version)	Item (German version)	Factor loadings 1	2	3	4	*M*	*SD*	Communalities after extraction
I worry that I won't be able to keep up due to digitalisation.	Ich befürchte, dass ich selbst durch die Digitalisierung nicht mehr mithalten kann.	-.194	**1.092**	.005	-.172	2.33	1.34	.811
I worry that I will be overwhelmed by the developments in the digitalised world.	Ich befürchte, dass ich von den Entwicklungen in der digitalisierten Welt überfordert werde.	-.100	**1.088**	-.002	-.153	2.51	1.43	.910
I am afraid that I won't be able to understand new processes in the digital world.	Ich habe Angst, dass ich neue Prozesse in der digitalen Welt nicht verstehe.	-.168	**1.039**	.064	-.077	2.59	1.42	.872
I am concerned that I am expected to quickly understand new processes in the digital world.	Mir macht es Sorgen, dass von mir erwartet wird, neue Prozesse in der digitalen Welt schnell zu verstehen.	-.031	**.806**	.196	-.088	2.57	1.39	.782
I am skeptical about the use of digital technology at work.	Ich stehe dem Einsatz neuer digitaler Technologien bei meiner Arbeit skeptisch gegenüber.	.016	**.639**	.131	-.005	2.47	1.46	.552
I am afraid of digitalisation as I feel helplessly exposed to it.	Ich habe vor der Digitalisierung Angst, weil ich mich dieser hilflos ausgesetzt fühle.	.107	**.578**	.228	-.022	2.28	1.40	.677
I worry that digitalisation will not facilitate my work.	Ich befürchte, dass die Digitalisierung meine Arbeit nicht erleichtert.	.050	**.537**	-.005	.152	2.94	1.53	.437
I worry that digital technology is not user friendly.	Ich befürchte, dass digitale Technologie nicht benutzerfreundlich ist.	-.046	**.503**	.160	.143	2.71	1.29	.451
I am afraid that a robot could be my next coworker due to digitalisation.	Es macht mir Angst, dass infolge der Digitalisierung ein Roboter mein nächster „Kollege“ sein könnte.	.046	-.004	**.739**	-.118	2.05	1.39	.518

(continued)

Item (English version)	Item (German version)	Factor loadings 1	2	3	4	*M*	*SD*	Communalities after extraction
I am afraid of being personally blamed for technical problems.	Ich habe Angst, für technische Probleme persönlich verantwortlich gemacht zu werden.	-.081	.029	**.692**	.118	2.45	1.46	.518
I am feeling anxiety about the future due to digitalisation as I perceive a threat to my workplace due to it.	Mir bereitet die Digitalisierung Zukunftsängste, weil ich meinen Arbeitsplatz dadurch bedroht sehe.	-.263	.269	**.566**	.064	1.99	1.21	.408
I worry that I will face communication problems due to digital communication.	Ich befürchte, dass ich durch die digitale Kommunikation Verständigungsprobleme haben werde.	-.080	.217	**.550**	.025	2.44	1.41	.451
I am afraid that the work of humans will be less valued as a result of digitalisation.	Ich habe Angst, dass die Arbeit von Menschen infolge der Digitalisierung weniger wertgeschätzt wird.	.259	-.097	**.523**	.106	3.03	1.44	.502
I am afraid that I will be other-directed by technology due to digitalisation.	Ich habe Angst, dass ich infolge der Digitalisierung von Technik fremdbestimmt werde.	.288	.030	**.488**	.090	2.93	1.47	.615
I am afraid of being replaced by younger and better educated employees due to digitalisation.	Ich habe Angst, infolge der Digitalisierung von jüngeren, besser ausgebildeten Mitarbeitern ersetzt zu werden.	.077	.244	**.447**	-.051	2.17	1.34	.448
I am afraid that there is no sound concept for the implementation of digitalisation.	Mir macht es Angst, dass es kein gutes Konzept für die Umsetzung der Digitalisierung gibt.	-.029	-.009	-.125	**.933**	3.63	1.50	.751
I am afraid that many questions related to digitalisation have not been clarified yet.	Mir macht es Angst, dass viele Fragen der Digitalisierung noch nicht geklärt sind.	.231	.002	-.055	**.661**	3.54	1.56	.617

(continued)

Item (English version)	Item (German version)	Factor loadings 1	2	3	4	*M*	*SD*	Communalities after extraction
I am concerned about the appropriate education of future generations in a digital world.	Ich mache mir Sorgen um die passende Ausbildung zukünftiger Generationen in der digitalen Welt.	.014	.012	.111	**.576**	3.36	1.54	.422
I am concerned about digitalisation as employees are not incorporated in the changes.	Die Digitalisierung bereitet mir Sorgen, weil Mitarbeiter in die Veränderung nicht miteinbezogen werden.	.077	-.034	.140	**.530**	3.48	1.35	.405
I worry about the occurrence of chaos due to digitalisation.	Ich befürchte, dass durch die Digitalisierung ein Chaos entsteht.	.135	.185	.070	**.447**	3.00	1.45	.500

Note. Method of extraction: Maximum Likelihood; Method of rotation: Promax with Kaiser-normalization; Rotation is converged in 8 iterations; Factor loadings in bold indicate that those are the highest factor loadings of the individual item; Only items of the final scale are shown in the table; Descriptives, factor loadings, and communalities refer to the German version of the DAS. Abbreviations: *M* = Mean Value; *SD* = Standard Deviation.

The results indicated four factors, which are described in Table 5.

Table 5
Description of four factors identified in Study 2a

Factor	Factor description	Assignment to anxiety trigger levels (Pfaffinger, Reif, Spieß, et al., 2020)
1	General digitalisation anxiety	Societal level
2	Self-related digitalisation anxiety	Individual level
3	Interaction- and leadership-related digitalisation anxiety	Organisational level
4	Implementation-related digitalisation anxiety	Organisational level

4.3.1.5 Study 2b: Internal consistency analysis (step 5)

Methods

In Study 2 Cronbach's α was calculated for the DAS and its subdimensions to assess the scale's internal reliability (Study 2b).

Results

Cronbach's α for the full scale consisting of 35 items is .96, which hints at a very good internal consistency. Cronbach's α values for each of the subdimensions also all show quite high values:

- General digitalisation anxiety (15 items): Cronbach's α = .94
- Self-related digitalisation anxiety (8 items): Cronbach's α = .94
- Interaction- and leadership-related digitalisation anxiety (7 items): Cronbach's α = .88
- Implementation-related digitalisation anxiety (5 items): Cronbach's α = .83

4.3.1.6 Study 2c: Construct validity (step 6)

In order to assess the construct validity of the DAS, several measures in Study 2 were used to test the scale's convergent as well as discriminant validity (Study 2c).

Convergent validity

To assess the scale's convergent validity ("confirmation by independent measurement procedures", Campbell & Fiske, 1959, p. 81), a scale measuring IT anxiety (IT anxiety scale, López-Bonilla & López-Bonilla, 2012) as well as the subdimension techno-insecurity from the technostress scale by Tarafdar et al. (2007) were included in the questionnaire for Study 2.[6]

The IT anxiety scale (ITAS, López-Bonilla & López-Bonilla, 2012) consists of 12 items (e.g., "Working with IT would make me very nervous"), which can be answered on a 7-point Likert scale indicating the level of consent (ranging from 1 = *strong disagreement* to 7 = *strong agreement*). It was designed by combining two existing scales: The technology anxiety scale developed by Meuter et al. (2003), which is focused on technologies in general and the computer anxiety scale developed by Loyd and Gressard (1984 a, b), which is concentrated on the use of computers. ITAS also assesses anxiety, which is why the scale is similar to the DAS. Nevertheless, the two scales differ from each other as DAS assesses anxiety related to digitalisation in general whereas ITAS measures anxiety related to ICTs, which are one aspect of digitalisation but not conclusive.

The techno-insecurity subscale of the technostress scale (TINS) by Tarafdar et al. (2007) consists of five items (e.g., "In my current job I am continuously feeling threatened by new technologies"), which can be answered on a 5-point Likert scale indicating the level of consent (1 = *strong disagreement*, 5 = *strong agreement*) with a sixth option for participants without an opinion (6 = *no opinion*). This scale is not just focused solely on the use of ICTs, but also assesses negative feelings towards ICTs on a more general level, which also involves aspects such as a fear of risks like job loss. Nevertheless, the scale assesses techno-insecurity as subscale of technostress and not anxiety, which is why the scales examine similar constructs but not the same.

[6] An overview of all scales and items used in the studies can be found in Annex D.

Therefore, middle to high positive correlations between the DAS and the ITAS as well as the TINS, which both measure similar constructs are expected. Cohen (1988) categorised effect sizes for correlation coefficients and considers $r = .10$ as small effect, $r = .30$ as medium effect, and $r = .50$ as large effect. It is hypothesised that the correlation between the DAS and the TINS as well as the ITAS is $r \geq .30$.

Hypothesis 1: Middle to high positive correlations between DAS and measures for similar constructs.

Hypothesis 1a: Middle to high positive correlations between DAS and ITAS ($r \geq .30$).

Hypothesis 1b: Middle to high positive correlations between DAS and TINS ($r \geq .30$).

Discriminant validity

Discriminant validity describes the relation of the scale with scales examining different constructs. Therefore, no or low correlations with such scales are expected. In order to inspect the scale's discriminant validity, the Penn State Worry Questionnaire (PSWQ) by Glöckner-Rist and Rist (2014) was included in the survey. It consists of 16 items (e.g., "I am always worried about something"), which are answered on a 5-point Likert scale indicating how typical the items are for oneself (1 = *not at all typical for me*; 5 = *very typical for me*). The scale examines excessive and unrealistic worrying as central cognitive concurrent symptom of a generalised anxiety disorder and includes 11 items indicating a tendency to worry as well as five items, which deny this tendency or ask for its controllability. As opposed to the DAS, the PSWQ therefore examines general negative feelings and not only feelings directed at a specific aspect such as digitalisation. For discriminant validity small correlations with scales examining different constructs are expected. Following the categorisation of Cohen (1988) for effect sizes for correlation coefficients, which was already mentioned in the section on convergent validity, it is hypothesised that the correlation between the DAS and the PSWQ is $r < .30$.

Hypothesis 2: Small correlations between DAS and measures for different constructs (PSWQ) ($r < .30$).

Criterion-oriented validity

Criterion-oriented validity exists when it is possible to predict a practically relevant criterion based on the result of the scale (Hartig, Frey, & Jude, 2012). In order to investigate this type of validity, behavioural indicators, namely avoidance of digitalisation ("I avoid digital technologies at work when possible") as well as disliking digitalisation ("I do not like dealing with topics concerning digitalisation"), were assessed. Both items were answered on a 6-point Likert scale indicating to which degree the item applies to the participants (ranging from 1 = *not at all* to 6 = *to a great degree*). It is hypothesised that high values on the DAS are related to high levels of avoidance of and disliking digitalisation:

Hypothesis 3: Middle to high positive correlations between DAS and behavioural indicators ($r \geq .30$).

Hypothesis 3a: Middle to high positive correlations between DAS and avoidance of digitalisation as behavioural indicator ($r \geq .30$).

Hypothesis 3b: Middle to high positive correlations between DAS and disliking digitalisation as behavioural indicator ($r \geq .30$).

Table 6 shows the correlations between the different scales and indicators and the DAS.

Table 6
Correlations between DAS and other scales and indicators to assess the scale's validity

	DAS	PSWQ	ITAS	TINS	Avoidance	Disliking
DAS	.963					
PSWQ	.255**	.761				
ITAS	.725**	.328**	.834			
TINS	.329**	.047	.294**	.815		
Avoidance	.526**	.216*	.698**	.309**	-	
Disliking	.486**	.252**	.618**	.153	.643**	-

Note. Numbers in diagonal indicate Cronbach's α of the scales (if more than 1 item). ** $p < .01$, * $p < .05$.

The correlations between the DAS and the ITAS (r = .725) as well as the TINS (r = .329) are both higher than .30. Therefore, Hypothesis 1 about the convergent validity can be supported and the correlation coefficients indicate at least a medium effect. The correlation between the DAS and the ITAS can even be considered as strong according to the classification of Cohen (1988). This provides evidence for the convergent validity of the DAS.

The correlation between the DAS and the PSWQ (r = .255) is smaller than .30 which is why Hypothesis 2 regarding the discriminant validity can be maintained. This finding provides evidence for the discriminant validity of the DAS.

Both of the behavioural indicators examining avoiding tendencies of digitalisation and disliking digitalisation were significantly positively related with the DAS (both correlation coefficients are higher than .30), which also provides evidence for the scale's criterion-oriented validity (Hypothesis 3).

4.3.1.7 Study 3: Test-retest reliability

An additional study (Study 3[7]) to examine the test-retest reliability of the scale was conducted. A high correlation between the two measurement points was expected as digitalisation anxiety is conceptualised as attitude or predisposition to react to digitalisation-related issues in a similar form, which is supposed to be stable across different situations. Following the categorisation of effect sizes for correlation coefficients by Cohen (1988), it is hypothesised that the correlation between the two measurement points is $r > .50$, which indicates a large effect:

Hypothesis 4: High positive correlations between the two measurement points of the DAS ($r > .50$).

[7] Study 3 was conducted in scope of a university seminar (Lehr-Forschungs-Projekt) in the Master program Economic-, Organisational, and Socialpsychology at the Ludwig-Maximilians-Universität München. Participating students: Clara Stegmaier, Laura Weidner, Vera Eger, and Amelie Hinrichs. The sample also has been used in Study 9 to investigate the effectivity of an app-based intervention as control group (Chapter 6).

Methods

In order to examine the test-retest reliability of the DAS, the test-retest correlation coefficient was calculated, which is the indicator that is most often used as measure of reliability (Silk, 1977). 30 participants (Gender: male: *n* = 6, female: *n* = 23, no gender indicated: *n* = 1, Age: *M* = 31.87 years, *Min* = 19 years, *Max* = 59 years) answered the DAS in an online survey at the beginning of the study and after a time lag of 13 days.[8]

Results

The test-retest correlation was *r* = .84 and therefore above the categorisation by Cohen (1988) for an effect size, which can be considered as large effect (*r* > .50), and provides evidence for Hypothesis 4. The test-retest correlation also is above the suggestion by Post (2016) for acceptable test-retest reliabilities (*r* >.70), which is even a more restrictive threshold.

4.3.1.8 Study 4: Replication (step 7)

Another survey (Study 4[9]) was conducted to assess the adequacy of the scale's structure by calculating a confirmatory factor analysis (CFA).

Sample

223 employees (Gender: male: *n* = 92, female: *n* = 121, diverse: *n* = 2, no information: *n* = 8, Age: *M* = 33.02 years, *Min* = 18 years, *Max* = 68 years, no information: *n* = 10) took part in this study. Participants worked in different positions (employee: *n* = 160, self-employed: *n* = 8, working-student: *n* = 27, intern: *n* = 4, student assistant *n* = 10, other: *n* = 6, no information: *n* = 8) in various sectors (consulting: *n* = 21, IT: *n* = 11, research: *n* = 11, services: *n* = 29, automotive: *n* = 22, culture: *n* = 1, administration: *n* = 12, education: *n* = 25, energy: *n* = 2, sales: *n* = 5, marketing: *n* = 15, insurance: *n* = 23, other: *n* = 38, no information: *n* = 8) to ensure

[8] Between the two measurement points, participants answered three items on stress, satisfaction, detachment, and work every two days.

[9] This study was conducted in scope of a bachelor's thesis by Margarita Rashkova and a master's thesis by Melina Dengler.

the generalisability of the results. Participants reported a mean regular working time of 31.6 hours per week. They used ICTs on average for 20.0 hours per week at work and for work-related purposes at home on average for 6.4 hours per week.

Methods

Participants answered an online questionnaire[10] containing the DAS items and further demographic items.

Results

A CFA was calculated to examine the appropriateness of the factorial structure. For estimating the model fit the thresholds suggested by Fuglseth and Sørebø (2014) were used:

- Insignificant χ^2 statistic with a $p > .05$
- Ratio of χ^2 to degrees of freedom < 3:1
- Root Mean Square Error of Approximation (*RMSEA*) < .06
- Comparative Fit Index (*CFI*) > .90
- Tucker-Lewis Index (*TLI*) > .90
- Standardized Root Mean Square Residual (*SRMR*) < .08

The following fit indices were found for the model when allowing for 12 correlated error terms between individual items[11]: $\chi^2(542) = 1015.92$, $p < .001$, Ratio χ^2 to degrees of freedom: 1015.92/542 = 1.87, *RMSEA* = .064, *CFI* = .910, *TLI* = .902, *SRMR* = .060. As four of the six thresholds were met (ratio χ^2 to degrees of freedom, *CFI*, *TLI*, and *SRMR*) it can be concluded that the proposed model shows an acceptable fit and that the proposed factorial structure with the four factors seems to be suitable.

[10] Other scales were also included in the questionnaire and the sample was also used in Study 8 to investigate the holistic research model, which will be introduced and described in Chapter 5.8.

[11] Correlated error terms were allowed between the following item pairs of the DAS (see Annex B, first the subscale and item number on the subscale is indicated, followed by the item number in brackets): General_3 (3) & General_8 (8), General_1 (1) & General_8, General_1 (1) & General_3 (3); Interaction_1 (24) & Interaction_3 (26); Interaction_3 (26) & Interaction_7 (30); Interaction_5 (28) & Interaction_7 (30); Self_2 (17) & Self_3 (18); Self_5 (20) & Self_7 (22); General_15 (15) & Implementation_3 (33) ; General_9 (9) & Interaction_1 (24) ; Self_4 (19) & Interaction_7 (30); General_6 (6) & Implementation_4 (34).

4.3.2 Conclusion

The developed Digitalisation Anxiety Scale (DAS) consists of 35 items, which can be categorised to one of four factors representing different categories of digitalisation anxiety triggers: one general factor describing societal triggers, one factor including triggers related to interaction and leadership, one factor describing triggers lying in oneself and one factor representing triggers resulting from the implementation process of digitalisation. The scale is characterised by a high internal consistency (Study 2b) as well as a high test-retest reliability (Study 3). The construct validity was also assessed, and digitalisation anxiety measured with the DAS can be seen as distinct concept (Study 2c). In Study 4, the adequacy of the scale's factor structure was confirmed.

4.4 Discussion

4.4.1 Theoretical implications

The DAS extends existing work on technology-related fears and meets the identified requirements for a new scale in three ways:

First, the scale is not related to specific technologies and therefore is also applicable to new technologies, which might not even have been developed yet: The items refer to digital technology, digital communication, digital systems, or digitalisation in general.

Second, the DAS targets digitalisation as ongoing process and also incorporates the integration of technology into all aspects of daily life. This process-perspective is reflected in two ways: (1) There is a separate subscale in the DAS describing anxiety triggers related to the implementation of technologies and digitalisation. (2) Items are formulated in a way that incorporates a process perspective, mostly by using suitable verbs such as "become" or "increase", which describe processes or developments (e.g., "I am afraid that humanity will become dependent on technology due to digitalisation", "I am afraid that surveillance will increase due to digitalisation").

Third, the multilevel structure of anxiety triggers is integrated in the DAS. The three-factor structure by Pfaffinger, Reif, Spieß, et al. (2020) was quantitatively replicated. In addition to that, the structure was further differentiated by splitting the organisational factor into an implementation factor and an interaction and leadership factor describing two distinct organisational aspects.

4.4.2 Practical implications

The new DAS allows for an examination of relationships between digitalisation anxiety and health- and performance-related outcomes, which can contribute to a holistic model of digitalisation stress, its antecedents and consequences. It can also be used to examine relations between different kinds of digitalisation-related demands and to also inspect mechanisms of effects how they influence well-being and organisational outcomes.

By using the DAS, different levels of digitalisation anxiety can be measured precisely and reliably, and the scale can be applied by managers or supervisors to identify the "top-triggers" for digitalisation anxiety within an organisation or by individuals to detect their own main triggers. Completing the DAS can thereby help organisations or individuals to derive corresponding measures to counteract the identified worries. If e.g. data security issues are identified as main concern, it could be an idea for organisations to have their organisational data security strategies and procedures examined professionally. If data security risks are identified, measures have to be taken to reduce those risks and to find solutions for them and employees should be informed about this procedure. If existing data security strategies are evaluated as sufficient, this also should be communicated and explained to the employees. In the case of identified concerns mainly on the implementation-subscale, giving employees the possibility to participate in the implementation process of new technologies or applications and informing them about the developments can be a possible idea to reduce the employees' worries on an organisational level.

A lack of employee participation in the decision-making process for the introduction of new technologies can also increase technostress, which might be a further reason to allow them to participate (Wang et al., 2008). Participation can furthermore be seen as resource according to the Job Demands-Resources Model (Bakker & Demerouti, 2007; Bakker, Demerouti, & Schaufeli, 2003) and therefore buffer the negative effect of demands on well-being and organisational outcomes. Participation as resource was also found to be positively related to commitment, which could also be beneficial for reducing the effects of digitalisation anxiety (Bakker, Demerouti, de Boer, et al., 2003). Causes of digitalisation on the self-subscale could possibly be counteracted with training and qualification measures. Tarafdar, Pullins, and Ragu-Nathan (2015) also found how empowering strategies such as the development of technology self-efficacy, enhancement of information systems literacy, or the involvement in information systems initiatives can reduce the negative consequences of technostress creators, which might also be applicable to digitalisation anxiety.

The results reveal, how digitalisation anxiety is related to behavioural indicators, and therefore indicate a potential vicious circle: digitalisation anxiety is related to avoidance behaviour, which makes it hard to create positive experiences related to digitalisation, which possibly could decrease the perceived level of digitalisation anxiety. The specification of digitalisation anxiety levels could provide hints for potential ways to stop this vicious circle by specifically intervening either on levels with lower digitalisation anxiety levels (as avoidance behaviour might not be as strong as for other levels) or by purposefully targeting levels with high digitalisation anxiety in order to achieve the greatest possible impact and to help employees cope with their strongest fears and worries.

4.4.3 Limitations and future research

In this chapter, a scale to assess digitalisation anxiety was developed and validated. In order to assess the scale's external validity, it is necessary to also investigate behavioural consequences of it. Two studies (Studies 7 and 8), which also investigate consequences of digitalisation anxiety, will be presented in Chapter 5.

This chapter's analyses regarding the development and validation of the DAS are based on data from small samples and the scale therefore needs further confirmatory validation and tests in larger samples in order to replicate the findings. It would also be interesting to further confirm the validity of the scale's factorial structure in samples with other demographical backgrounds.

Although existing general theories on stress and well-being such as the Transactional Theory of Stress by Lazarus (1991) or the Job Demands-Resources Model by Bakker and Demerouti (2007) can be consulted to at least theoretically derive assumptions concerning the causal effect of digitalisation anxiety on well-being and productivity, Study 2c, in which the external validity was examined, was a cross-sectional study and it is consequently not possible to make statements about any causal effects of digitalisation anxiety. Therefore, longitudinal designs should be conducted to provide insights into causal relationships between digitalisation anxiety and its consequences.

The scale was originally developed in German and validated in German-speaking samples. The English translation of the scale therefore also needs to be validated with regard to the factorial structure in English-speaking samples in future studies. Nevertheless, a translated version already has been provided, which can also facilitate this process.

Third variables as moderating or mediating mechanisms were not investigated in this chapter's studies, which is why no statements about digitalisation anxiety's mechanisms of effect can be made. In spite of this, there are several theoretical models, which might hint at possible third variables, e.g. the Stressor-Detachment Model by Sonnentag and Fritz (2015) in which a moderating as well as mediating

effect of detachment on the relationship between stressors and outcome variables is postulated. Those effects could also hold true for digitalisation anxiety as demand and indicate that the effect of digitalisation anxiety on well-being could be mediated or moderated by detachment. According to the Conceptual Model for Understanding Technostress by Ragu-Nathan and colleagues (2008), technostress inhibitors (e.g., literacy facilitation through end-user training, provision of technical support, or involvement of employees in the selection and introduction of new technologies) moderate the relationship between technostress creators and outcome variables. Consequently, detachment and technostress inhibitors could be investigated as third variables influencing the relationship between digitalisation anxiety and well-being indicators.

Antecedents for digitalisation anxiety should also be tested in future studies. Wang et al. (2008) found that the extent of power centralisation in an organisation is positively related to the level of employee technostress, which could also hold true for digitalisation anxiety. Possible ideas for antecedents could be the organisational culture or the level of digitalisation at the workplace and previous experience with digital technologies.

In this chapter, digitalisation anxiety has been conceptualised as negative aspect, but digitalisation can evoke positive as well as negative emotions and reactions and it is therefore extremely important to not only focus on one side. There definitely also is a need for a positive counterpart, which could e.g. be termed digitalisation optimism. Mick and Fournier (1998) found eight technology paradoxes, which consumers have to cope with: control/chaos, freedom/enslavement, new/obsolete, competence/incompetence, efficiency/inefficiency, fulfils/creates needs, assimilation/isolation, and engaging/disengaging. Those paradoxes can also hint at the need to consider the positive as well as negative side of digitalisation. In the interviews, participants also mentioned positive aspects and expectations with regard to digitalisation and those statements could be a starting point for conceptualising this positive counterpart. Positive aspects related to digitalisation or

technology already have been described, e.g. technology readiness, which has been defined by Parasuraman (2000) as "people's propensity to embrace and use new technologies for accomplishing goals in home life and at work. The construct can be viewed as an overall state of mind resulting from a gestalt of mental enablers and inhibitors that collectively determine a person's predisposition to use new technologies" (p. 308).

4.4.4 Conclusion

In this chapter, the conceptualisation of digitalisation as feeling of an uncomfortable tension related to digitalisation and its effects and the development of the digitalisation anxiety scale (DAS) as measurement tool for it were described. With regard to digitalisation as megatrend and the ongoing changes affecting the way people live, communicate, and work, it is crucial to have a measure, which can detect possible worries of people that might take effect as hindrance factors for realising the digitalisation's positive opportunities and chances.

After having described technostress creators and telepressure as existing constructs for ICT-specific demands and introduced digitalisation anxiety as new construct for ICT-specific demands, the consequences of such demands will be examined and empirically investigated in the following chapter.

5. Consequences of ICT-Specific Demands on Well-being

ICT-related stress, which is distinct from general work stress, adds to overall work stress even when job demands, demographics, and job variables are controlled (e.g., Ayyagari, Grover, & Purvis, 2011) and can impede family life and recovery from work (Diaz, Chiaburu, Zimmerman, & Boswell, 2012). In order to further examine the consequences of ICT-specific demands and to target Research Question 2 (*What consequences do ICT-specific demands have for well-being?*), this chapter describes the investigation of how those demands (specifically technostress creators as concept summarising demands from various areas, telepressure as more detailed form of ICT-specific demand, and digitalisation anxiety as newly developed and conceptualised construct) are related to well-being and performance and what underlying mechanisms could be. First of all, prior empirical findings regarding the consequences of ICT-specific demands on well-being and performance will be discussed and a research model will be developed. Afterwards, four empirical studies investigating the postulated relations, which were conducted in scope of this dissertation will be presented.

5.1 Consequences of ICT-Specific Demands on Well-being and Performance

ICT use and ICT-specific demands were found to have a variety of consequences on the users' well-being, health, and performance. They can have negative short- and long-term consequences on employee well-being (Kubicek, Korunka, & Ulferts, 2013; Leung, 2011; Sonnentag, 2018) and can entail job strain (Green, 2004; Stadin et al., 2016), exhaustion (Kubicek et al., 2013), or burnout (Berg-Beckhoff, Nielsen, & Ladekjær Larsen, 2017; Kubicek et al., 2013). They are also related to worse self-ratings of health even when controlling for age, gender, socio-economic status, lifestyle, and Body Mass Index (Stadin et al., 2016). The hours worked with ICTs were also found to be significantly related to stress and the hours using a cell phone were one of the consistent predictors of musculoskeletal pain (Goldfinch, Gauld, & Baldwin,

2011). Continuous availability, which is enabled through the use of new ICTs, was found to potentially impede recovery (Dettmers, 2017). Additionally, ICT-specific demands can contribute to a perceived workplace effort-reward imbalance (Stadin et al., 2016) and reduced job satisfaction (Green, 2004). The use of desktop computers also seems to be related to several mental health indicators (sleeping disorders/disturbances, depression, exhaustion at work, substance addiction, anxiety, and fear, Korpinen & Pääkkönen, 2009). Interestingly, the effects of desktop computer use varied between men and women and also between different age groups and no effects were found for the use of portable or minicomputers or for the use of mobile phones (Korpinen & Pääkkönen, 2009). ICT hassles are also associated with increased strain and perceived stress, even after controlling for traditional job demands such as role overload, role ambiguity or lack of job control, which also accentuates the need to further investigate ICT-specific demands and their consequences (Day et al., 2012). Apart from well-being consequences, ICT-specific demands also seem to have negative consequences on the performance of employees (e.g., Jena, 2015; Tarafdar et al., 2015).

A systematic review by Berg-Beckhoff et al. (2017) summarising quantitative studies in the work environment found associations between ICT use and stress as well as burnout. Interestingly, clear relations between ICT use and stress measures only occurred in cross-sectional studies, but not in the two reported longitudinal studies (Chen, Westman, & Eden, 2009; Torp, Hanson, Hauge, Ulstein, & Magnusson, 2008). In the longitudinal study by Torp et al. (2008), ICT use consisted of a provided computer, an ICT course developed to provide knowledge, and a digital social network, which offered the possibility to exchange experiences. Therefore, their study followed a slightly different approach and ICT use was not considered as demand but rather seen as source of informational and emotional support. Although no significant findings were reported for the quantitative outcome measures (stress, mental health problems), qualitative data provided insights in positive perceptions of the participants.

Especially the introduction of new technologies in companies can negatively influence different aspects of employee well-being such as health, satisfaction, and productivity (Knani, 2013). In a longitudinal study by Chen et al. (2009) the consequences of the introduction of a new IT system and possible effects of a resource workshop, which was given to the experimental group, were investigated. Although no differences were found in the workload, which was considered as stress measure, increases in dissatisfaction and exhaustion were reported in the control group, which did not occur in the experimental group with the resource workshop.

Inferring from existing stress theories (see also Chapter 2) considering demands or stressors as reasons for stress and previous empirical findings it is therefore hypothesised:

Hypothesis 1: ICT-specific demands are negatively related to well-being.

Hypothesis 2: ICT-specific demands are negatively related to performance.

Due to the variety of ICT-specific demands, there is a focus on three specific types of demands, namely technostress creators, telepressure, and digitalisation anxiety. Existing research on the consequences of those specific forms will be introduced in the following paragraphs.

5.1.1 Consequences of technostress creators

The Conceptual Model for Understanding Technostress by Ragu-Nathan et al. (2008) not only specifies technostress creators as technology-specific stressors of Lazarus' (1991) Transactional Theory of Stress, which were described in Chapter 3.1, but they also transfer the whole stress process and outcomes to the specifics of technostress (see Figure 9).

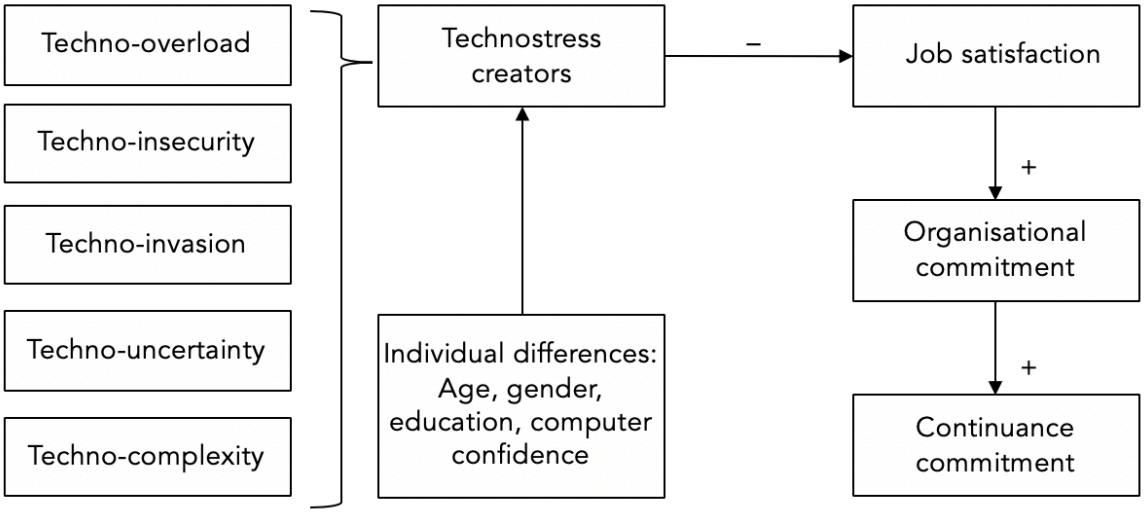

Figure 9. Extract of the Conceptual Model for Understanding Technostress (Ragu-Nathan et al., 2008, p. 421).

They see job satisfaction as (reversed) parallel to strain as outcome in the Transactional Theory of Stress by Lazarus (1991) and organisational commitment as well as continuance commitment as further organisational outcome measures. In their model, Ragu-Nathan and colleagues (2008) assume how technostress creators negatively influence job satisfaction and how the so-called technostress inhibitors as mechanisms, that can reduce the effects of technostress and can be compared to resources in the general stress models, moderate this relationship.

A study by Fieseler, Grubenmann, Meckel, and Müller (2014) investigated how techno-overload and techno-complexity as subscales of technostress creators are significantly related to technostress (ICT strain, Ayyagari et al., 2011), which was related to work exhaustion. They concluded that technostress creators lead to a specific form of technostrain, which is positively correlated with the general strain level. Other studies report negative effects of technostress creators on job satisfaction (e.g., Fuglseth & Sørebø, 2014; Jena, 2015). In the study by Fuglseth and Sørebø (2014) satisfaction was also related to the intention to extend the use of ICTs. Jena (2015) found effects of technostress creators on organisational commitment, negative affectivity, and technology-enabled performance. As they examined a sample of

Indian academics, their findings suggest that technostress is also an issue in other countries (India) and branches (education sector). Technostress creators are also positively related to burnout (Srivastava, Chandra, & Shirish, 2015) and exhaustion associated with specific technologies such as social networking services (Maier, Laumer, Weinert, & Weitzel, 2015). Tarafdar et al. (2015) found a negative relation between technostress creators and performance. Building technology competence or empowering strategies (e.g., developing technology self-efficacy, information systems literacy enhancement or involvement in information systems initiatives) was found to reduce the negative consequences of technostress creators (Tarafdar et al., 2015). Tu et al. (2005) conducted a study in China to investigate the consequences of technostress creators on productivity. While the overall technostress level (mean score of the five components) did not significantly influence employee productivity, single subscales had significant consequences: techno-overload was positively and techno-invasion as well as techno-insecurity were negatively related to productivity.

The main Hypotheses 1 and 2 were therefore specified with regard to technostress creators as ICT-specific demands:

Hypothesis 1a: Technostress creators, as ICT-specific demands, are negatively related to well-being.

Hypothesis 2a: Technostress creators, as ICT-specific demands, are negatively related to performance.

5.1.2 Consequences of telepressure

Workplace telepressure is related to burnout, sleep problems, and - in case of interference with recovery - lower work engagement (Santuzzi & Barber, 2018). At work, information overload resulting from e-mails is already one of the most mentioned stressors (Wohlers & Hombrecher, 2016). At home, using work-related ICTs has negative effects on recovery, specifically on detachment and sleep (Sonnentag, 2018).

This relation is not just relevant for employees in the work context but was also observed among students: according to a study by Barber and Santuzzi (2017), telepressure at the beginning of the semester was related to students' reports of burnout, perceived stress, and poor sleep hygiene one month later, but there was no effect on work-life-balance or general life satisfaction. However, in a study by Grawitch and colleagues (2018) the effect of workplace telepressure on well-being outcomes (emotional exhaustion, psychological detachment, and satisfaction with work-life balance) was not significant anymore when including other variables (e.g., gender, marriage, ICT responsiveness, ICT availability, ICT control, work overload, neuroticism, workaholism, and self-control). Due to existing empirical evidence on the main effect of telepressure, as ICT-specific demand, on well-being and performance and the theoretical background, Hypotheses 1 and 2 are therefore specified in the following way:

Hypothesis 1b: Telepressure, as ICT-specific demand, is negatively related to well-being.

Hypothesis 2b: Telepressure, as ICT-specific demand, is negatively related to performance.

5.1.3 Consequences of digitalisation anxiety

As digitalisation anxiety was conceptualised as new form of ICT-specific demand in Chapter 4.2 it is assumed that the relations, which were found for technostress creators and telepressure, also hold true for digitalisation anxiety. Following the Effort-Recovery Theory by Meijman and Mulder (1998), which postulates that meeting any kinds of demands requires effort, the negative feelings associated with digitalisation can be considered as demand and consequently effort is necessary to handle this demand and to still use digital technologies, which might be necessary at the workplace. Due to negative consequences on well-being, recovery, and productivity, which have been found for similar constructs describing negative feelings related to digitalisation or technology (e.g., Derks & Bakker, 2014; Heinssen,

et al. 1987; Meuter et al., 2003; Ragu-Nathan et al., 2008; Tarafdar, Tu, Ragu-Nathan, & Ragu-Nathan, 2011), it is assumed that those relations should also be found for digitalisation anxiety. Hypotheses 1 and 2 are therefore specified for digitalisation anxiety as ICT-specific demand:

Hypothesis 1c: Digitalisation anxiety, as ICT-specific demand, is negatively related to well-being.

Hypothesis 2c: Digitalisation anxiety, as ICT-specific demand, is negatively related to performance.

5.2 Mediating Role of Detachment

The role of recovery processes in the stress process has already been described in the Effort-Recovery Theory by Meijman and Mulder (1998). Wang and colleagues (2017) also emphasised the significant role of positive psychological resources as mediators in the stress process in order to develop intervention strategies. Etzion, Eden, and Lapidot (1998) investigated recovery processes from job stressors and conceptualised an alternative to the dichotomous differentiation between respite and no respite. They defined this so-called detachment as "individual's sense of being away from the work situation" (p. 579). Detachment does not only include actually not working (e.g., not being occupied by work-related obligations and not actively working on work-related activities) but also mental disengagement, which means to not think about work-related issues (Sonnentag & Fritz, 2007). Detachment has been found to be particularly important for positive worker well-being and recovery as it is associated with less burnout, fewer psychosomatic complaints, better sleep, and higher life satisfaction (Sonnentag & Fritz, 2007).

The Stressor-Detachment Model by Sonnentag and Fritz (2015) extends the Effort-Recovery Model by including the importance of psychological detachment for positive worker well-being. In their model, Sonnentag and Fritz (2015) assumed a moderating as well as mediating effect of detachment on the relation between stressors and outcome variables (see Figure 10).

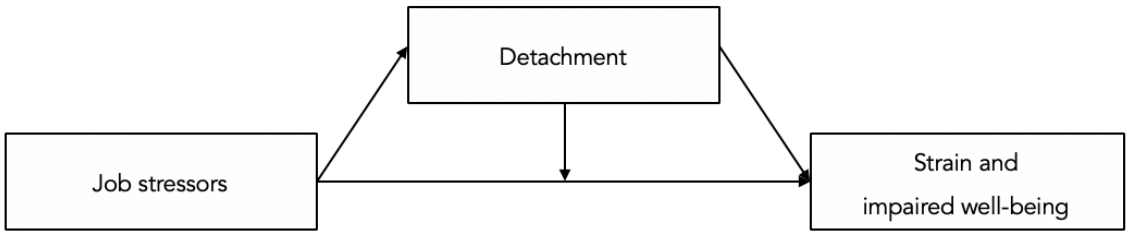

Figure 10. Stressor-Detachment Model (Sonnentag & Fritz, 2015, p. 76).

The model already was investigated empirically and evidence for the mediating effect of detachment was found in cross-sectional as well as longitudinal studies: Cross-sectional studies provided evidence for the mediating role of detachment on the relationship between different kinds of job stressors (e.g., time pressure, working hours) and exhaustion, fatigue at work, or perceived stress (e.g., Kinnunen, Feldt, Siltaloppi, & Sonnentag, 2011; Safstrom & Hartig, 2013, Sonnentag, Kuttler, & Fritz, 2010).

Longitudinal studies with different methodologies (e.g., diary study, time lag of 6 months) also found mediating effects of detachment on the relations between job demands and different kinds of tasks in the evening (work-related and household tasks, social, low-effort, and physical activities) on fatigue, next-day recovery, and next day vigour (ten Brummelhuis & Bakker, 2012; von Thiele Schwarz, 2011).

Santuzzi and Barber (2018) already analysed the mediating effect of detachment with regard to telepressure as ICT-specific demand. They discovered a negative relation between telepressure and detachment and also support for the indirect effect of telepressure on physical exhaustion and sleep problems through psychological detachment at the between-person level.

Although a study by Sonnentag, Binnewies, and Mojza (2010) provided empirical evidence for the role of detachment as moderator in a way that job demands such as time pressure are less harmful when employees mentally disengage from their work during off-job time, no moderating effects were found by Safstrom and Hartig (2013), who specifically focused on the dual role of detachment as mediator and moderator.

Due to prior empirical findings on the mediating effect, there is a focus on this specific path of the Stressor-Detachment Model.

According to Sonnentag and Fritz (2015), digitalisation and advances in technologies as new developments should be included in further research on detachment as resulting demands such as continuous availability might impede detachment. It is therefore assumed that psychological detachment should serve an intervening role in the relationship between ICT-related demands and well-being outcomes and the following hypothesis is derived:

Hypothesis 3: Detachment mediates the relationship between ICT-specific demands and well-being.

5.3 Moderating Role of Technostress Inhibitors

Digitalisation also allows for specific job aspects that can be seen as resources such as the opportunity for home-office, which is made possible by technological solutions and which can facilitate work for employees. Furthermore, ICTs can also act as resource by simplifying certain aspects of tasks and by exemplary also facilitating communication. ICTs can therefore be considered as job resources according to the Job Demands-Resources Model (e.g., Bakker & Demerouti, 2007) or as situational factors in the Transactional Theory of Stress by Lazarus (1991), which buffer the negative effect of demands on well-being and at the same time are positively related to motivational aspects and organisational outcomes. Salanova et al. (2014) also emphasised that the emergence of technostress "does not occur as a result of the negative impact of technology per se, but depends on the relationship between demands and resources" (p. 88).

Especially in the implementation period of a new technology, several resources such as social support or training have been found to be beneficial for employee well-being and can buffer possible negative effects of new technologies on well-being (Chen et al., 2009; Knani, 2013).

The organisational culture also has been found to be influential for the technostress process. Wang et al. (2008) discovered that the extent of power centralisation in an organisation is positively related to the level of employee technostress due to a lack of participation for employees in the decision-making processes of the introduction of new technologies. This could consequently increase the level of technology-related stress following the assumptions of the Job Demands-Control Model (Karasek, 1979, 2011), where this lack of participation could entail a lower decision latitude. An organisational culture of innovation increases the level of employee technostress due to the fact that this is a culture, which might promote frequent technological changes and internal environment changes, which are important antecedents to individual stress.

Another identified resource is ICT support: ICT personal assistance as well as ICT resources/upgrades were found to reduce negative well-being outcomes such as stress or burnout (e.g., Day et al., 2012). Apart from this beneficial main effect, moderating effects were found as well: Personal assistance moderated the effects of ICT hassles on strain and ICT resources/upgrades moderated the relationship between learning expectations and most strain outcomes and between ICT hassles and strain.

In their Conceptual Model for Understanding Technostress, Ragu-Nathan and colleagues (2008) also assume how the so-called technostress inhibitors, which are described as mechanisms having the potential to reduce effects of technostress (e.g., training, technical support, the involvement of employees in implementation, as well as communication of changes), moderate the relationship between technostress creators and job satisfaction and also directly influence the outcome variables (see Figure 11). Ragu-Nathan and colleagues (2008) developed a scale for measuring technostress inhibitors, which consists of three subscales: literacy facilitation (support employees in building knowledge and sharing experiences with each other), technical support provision (organisational offers for support such as an auxiliary help desk), and involvement facilitation (encouraging employees in using technologies and

providing participation possibilities in situations of technology introduction or change).

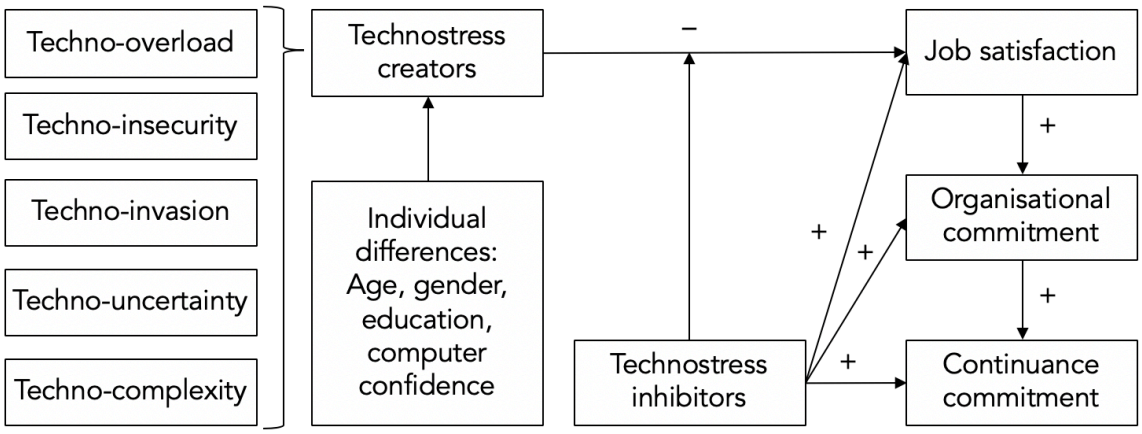

Figure 11. Conceptual Model for Understanding Technostress (Ragu-Nathan et al., 2008, p. 421).

In a study by Ragu-Nathan et al. (2008), technostress inhibitors were found to positively influence job satisfaction, organisational commitment, and continuance commitment but no evidence was discovered for their assumed moderating effect.

Generally, empirical evidence for the existence of the moderating effect of technostress inhibitors is very rare and many studies failed to show this effect: Fuglseth and Sørebø (2014) investigated the consequences of technostress inhibitors and found a significant positive main effect on satisfaction. The hypothesised moderating effect of inhibitors on the relation between technostress creators and satisfaction was not significant in their study as well. The moderating effect for technology self-efficacy on the relationship between technostress creators and sales performance was not significant in a study by Tarafdar et al. (2015). Booker, Rebman, and Kitchens (2014) conducted a study in the online educational environment and also found no support for a moderating effect of technostress inhibitors (literacy facilitation, technical support provision, and involvement facilitation were adapted for the use in the online educational environment). Ahmad, Amin, and Ismail (2014) found empirical evidence for the moderating role of technical support in the relationship between techno-

overload and organisational commitment but this effect was neither found for literacy facilitation nor for involvement facilitation. Generally, those results might lead to the conclusion that technostress inhibitors are not a moderator between technostress creators and end-user satisfaction. Nevertheless, there is still a necessity to further investigate technostress inhibitors in general and specifically their moderating effect as they were found to be good predictors for positive outcomes such as higher end-user satisfaction levels, lower levels of distress, and higher levels of eustress (Califf, Sarker, Sarker, & Fitzgerald, 2015; Tu, Tarafdar, Ragu-Nathan, & Ragu-Nathan, 2008). The fact that few moderating effects were found could possibly be traced back to the fact that many stressor measures were not adequately specified and operationalised and often contained an evaluative component (e.g., Wall, Jackson, Mullarkey, & Parker, 1996). Due to the empirical foundation of the role of resources in the Job Demands-Resources Model (e.g., Bakker & Demerouti, 2007) and the call to include new technological advancements in stress theories and research (Lazarus, 1991), the moderating role of technostress inhibitors as resources in the stress process is further investigated within this dissertation and it is hypothesised:

Hypothesis 4: Technostress inhibitors moderate the relationship between ICT-specific demands and well-being. A high degree of inhibitors can reduce the negative effect of ICT-specific demands on well-being.

Hypothesis 5: Technostress inhibitors moderate the relationship between ICT-specific demands and performance. A high degree of inhibitors can reduce the negative effect of ICT-specific demands on performance.

Hypothesis 6: Technostress inhibitors moderate the relationship between ICT-specific demands and detachment. A high degree of inhibitors can reduce the negative effect of ICT-specific demands on detachment.

5.4 Research Model

Figure 12 gives an overview of the proposed research model and the hypotheses, which were developed in the previous paragraphs:

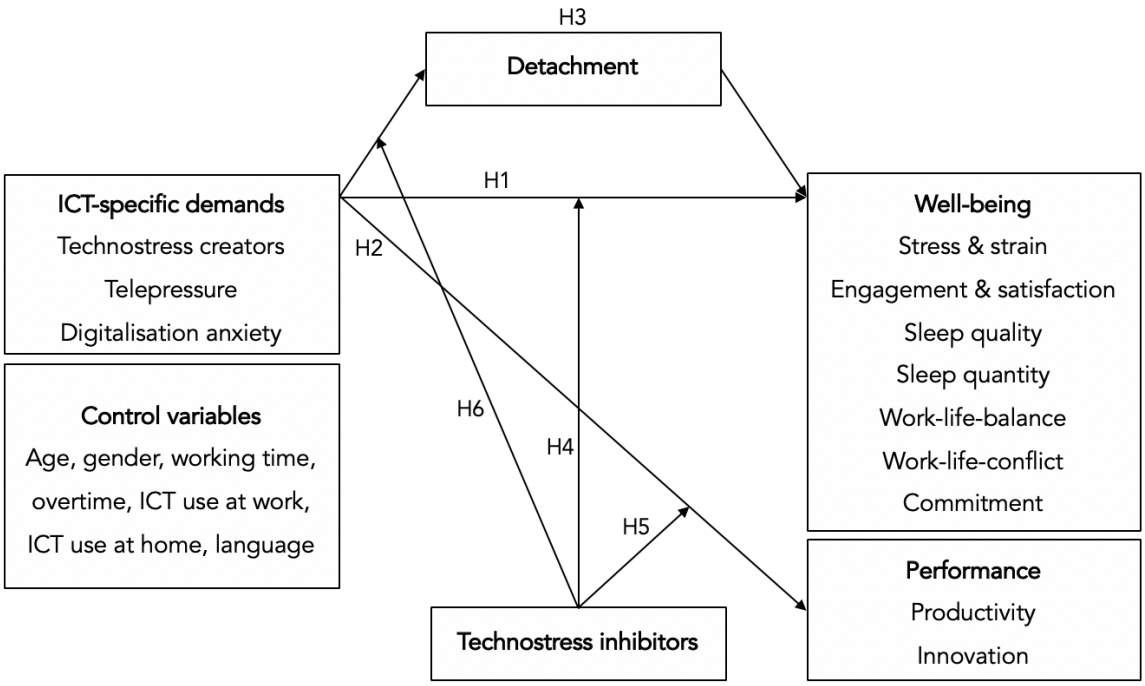

Figure 12. Research model based on the Stressor-Detachment Model by Sonnentag & Fritz (2015) and the Conceptual Model for Understanding Technostress by Ragu-Nathan et al. (2008).

Due to the complexity of the model, it was at first tested in three individual studies focusing on specific types of ICT-specific demands (Study 5: focus on telepressure, Study 6: focus on technostress creators, Study 7: focus on digitalisation anxiety). Afterwards, the holistic model was tested in a separate study (Study 8).

5.5 Study 5 (Focus on Telepressure)

Chapter based on Pfaffinger, K. F., Reif, J. A. M., & Spieß, E. (2020a). *How are technology-specific demands related to well-being?*. [Submitted].

Study 5[12], an online survey conducted with 296 employees (Gender: female: *n* = 151, male: *n* = 143, other: *n* = 1, gender not indicated: *n* = 1, Age: *M* = 39.29 years, *Min* = 19 years, *Max* = 65 years, age not indicated: *n* = 3), focused on telepressure, as ICT-specific demand, and examined the relationship between telepressure and employee well-being. Well-being was operationalised with stress and strain (reverse) as well as sleep quality. Moreover, it was investigated whether detachment mediates the relationship between telepressure and well-being. Hypotheses 1 and 3 therefore can be specified as follows:

Hypothesis 1b: Telepressure, as ICT-specific demand, is negatively related to well-being (lower stress and strain, higher sleep quality).

Hypothesis 3: Detachment mediates the relationship between ICT-specific demands (telepressure) and well-being (stress and strain as reverse indicator, sleep quality).

5.5.1 Measurement

An overview of all scales and items that were used in this and the subsequent studies can be found in Annex D.

ICT-specific demand: Telepressure. A scale with six items by Barber and Santuzzi (2015) was used to measure telepressure (Cronbach's α = .86, e.g., "It's hard for me to focus on other things when I receive a message from someone"). Items were answered on a 5-point Likert scale (1 = *do not agree at all*, 5 = *fully agree*).

Well-being: Stress and strain and sleep quality. Stress and strain as reverse indicator and sleep quality were analysed as outcome variables covering several aspects of well-being.

[12] This study was conducted in scope of a bachelor's thesis by Catherine Gronover.

Stress and strain were measured with 10 items covering several well-being facets such as stress, burnout, and physical strain (Cronbach's α = .88, e.g., "I feel exhausted", Haslam & Reicher, 2006, items were answered on a 5-point Likert scale indicating the level of agreement (1 = *not at all*, 5 = *to a very great degree*)).

Sleep quality was assessed with four items (Cronbach's α = .75, e.g. "How often in the past month did you have trouble falling asleep?", Jenkins, Stanton, Niemcryk, & Rose, 1988) that were answered on a 6-point Likert scale indicating the frequency of sleep problems (1 = *never*, 2 = *1-3 days*, 3 = *4-7 days*, 4 = *8-14 days*, 5 = *15-21 days*, 6 = *22-31 days*) and were reverse-coded such that higher values indicate a higher quality of sleep.

Detachment. A 4-item scale by Sonnentag and Fritz (2007) was used to measure detachment (Cronbach's α = .89, e.g., "I forget about work", items were answered on a 5-point Likert scale ranging from 1 = *do not agree at all* to 5 = *fully agree*).

Control variables. ICT use, gender, and age were included as control variables as they were found to affect well-being and sleep quality or the consequences of ICT-specific demands (e.g., Korpinen & Pääkkönen, 2009; Martin, Grünendahl, & Martin, 2001; Reyner & Horne, 1995; Thomée, Eklöf, Gustafsson, Nilsson, & Hagberg, 2007).

Since the participants of the study were German speaking, the scales were translated into German.

5.5.2 Results

A structural equation model was calculated to examine the relationships between telepressure as independent variable, detachment as mediator, and sleep quality and stress and strain as two separate dependent variables. Three control variables (age, gender, ICT use) were additionally included in the model. The software RStudio (Version 1.1.453) was used for all analyses. The results can be found in Figure 13.

Regarding Hypothesis 1b (*Telepressure, as ICT-specific demand, is negatively related to well-being*), it was found that telepressure was positively related to stress and strain (β = .15, p = .028) and negatively related to sleep quality (β = -.23,

p = .014) even after controlling for the control variables' effects, providing support for Hypothesis 1b. The control variable ICT use did not have a significant effect on any of the outcome variables. Concerning Hypothesis 3 (*Detachment mediates the relationship between ICT-specific demands and well-being*), the results showed that the significant total effects of telepressure on sleep quality as well as on stress and strain were partly explained by detachment: Telepressure was negatively related to detachment (β = -.31, *p* < .001). Detachment was negatively related to stress and strain (β = -.42, *p* < .001) and positively related to sleep quality (β = .24, *p* = .007). The indirect effect of telepressure on stress and strain via detachment (β = .14, *p* = .001, Confidence Interval (CI) [.056; .215]) was significant. The same held true for the effect of telepressure on sleep quality via detachment (indirect effect: β = -.07, *p* = .028, CI [- .129; -.007]). Therefore, detachment seems to partially mediate the relationship between telepressure and both well-being outcomes (sleep quality and stress and strain as reverse indicator), providing support for Hypothesis 3.

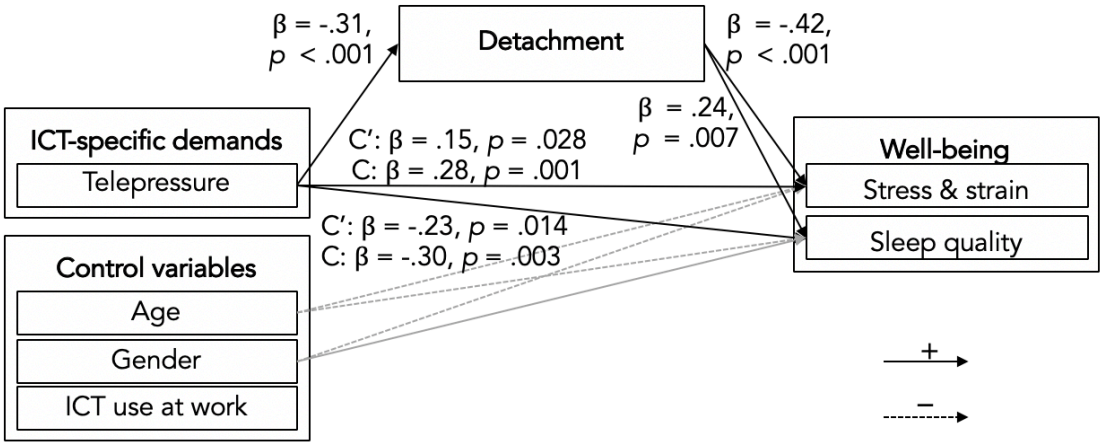

Figure 13. Structural equation model with relationships between telepressure as independent variable, detachment as mediator, and sleep quality and stress and strain as two separate dependent variables (Study 5); C' represents the direct effect of telepressure on stress and strain/sleep quality controlling for the effect of detachment; C represents the total effect of telepressure on stress and strain/sleep quality; βs represent standardised coefficients; Grey paths show effects of control variables; Gender as Dummy-coded variable: 0 = female, 1 = male.

5.6 Study 6 (Focus on Technostress Creators)

Chapter based on Pfaffinger, K. F., Reif, J. A. M., & Spieß, E. (2020a). *How are technology-specific demands related to well-being?*. [Submitted].

Study 6[13], an online survey conducted with 142 employees (Gender: female: *n* = 92, male: *n* = 50, Age: *M* = 37.46 years, *Min* = 21 years, *Max* = 64 years), focused on technostress creators, as ICT-specific demands, and examined their relationship with well-being, specifically stress and strain, engagement and satisfaction, and organisational commitment. Moreover, it was investigated how technostress inhibitors moderate these relationships in order to test Hypotheses 1a and 4:

Hypothesis 1a: Technostress creators, as ICT-specific demands, are negatively related to well-being (higher stress and strain, lower engagement and satisfaction, lower commitment).

Hypothesis 4: Technostress inhibitors moderate the relationship between ICT-specific demands (technostress creators) and well-being (stress and strain as reverse indicator, engagement and satisfaction, commitment). A high degree of inhibitors can reduce the negative effect of ICT-specific demands on well-being.

5.6.1 Measurement

ICT-specific demands: Technostress creators. 29 items covering the five aspects techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty by Ragu-Nathan et al. (2008) and additionally techno-induced role ambiguity as sixth aspect (Ayyagari et al., 2011) were used to examine technostress creators (Cronbach's α = .90, e.g., "I am forced by this technology to work much faster", Ragu-Nathan et al., 2008 and Ayyagari et al., 2011, items were answered on a 5-point Likert scale indicating the level of agreement ranging from 1 = *not at all* to 5 = *to a very great degree*).

[13] This study was conducted in scope of a master's thesis by Martina Gress.

Well-being: Stress and strain, engagement and satisfaction, and commitment. As in Study 5, stress and strain as well-being aspects were analysed and engagement and satisfaction as well as organisational commitment were additionally included as well-being indicators.

Stress and strain were measured using nine items of the scale, which was used in Study 5 (Cronbach's α = .89, items were answered on a 5-point Likert scale indicating the level of agreement (1 = *not at all*, 5 = *to a very great degree*)).

Engagement and satisfaction were assessed using six items addressing work engagement, team performance, and job satisfaction (Cronbach's α = .79, e.g., "So far I have achieved all my goals at work", Hoegl, Weinkauf, & Gemuenden, 2004, items were answered on a 5-point Likert scale indicating the level of agreement (1 = *not at all*, 5 = *to a very great degree*)).

Organisational commitment was measured with a 4-item scale by Felfe, Six, and Schmook (2002) (Cronbach's α = .92, e.g., "I am very proud to belong to this organization", items were answered on a 5-point Likert scale indicating the level of agreement (1 = *not at all*, 5 = *to a very great degree*)).

Technostress inhibitors. 12 items by Ragu-Nathan and colleagues (2008) covering the areas of facilitating literacy, provision of technical support, and facilitating involvement were used to assess technostress inhibitors as moderating third variable (Cronbach's α = .84, e.g., "Our organization provides end-user training before the introduction of new technology"). The items were answered on a 5-point Likert scale indicating the level of agreement (1 = *not at all*, 5 = *to a very great degree*).

Control variables. Age and gender were included as control variables as in Study 5. ICT use was not incorporated as this control variable did not have a significant effect on any well-being outcome in Study 5.

Like in Study 5, the scales were translated into German as the subjects were German speaking.

5.6.2 Results

A regression analysis was calculated for each dependent variable. All variables were mean-centred before creating interaction terms for the moderation, following Aiken and West's (1991) recommendation, in order to reduce multicollinearity (Srivastava et al., 2015).

According to the results (see Figure 14), technostress creators were positively related to stress and strain (β = .77, p < .001) and negatively related to engagement and satisfaction (β = -.29, p = .002) as well as commitment (β = -.51, p < .001), which provides evidence for Hypothesis 1a (*Technostress creators, as ICT-specific demands, are negatively related to well-being).* The interaction effect between technostress creators and inhibitors was significant for both of the positive outcomes, engagement and satisfaction (β = .33, p = .034) as well as commitment (β = .61, p = .014), but not for stress and strain, providing only partial support for Hypothesis 4 (*Technostress inhibitors moderate the relationship between ICT-specific demands and well-being).* This result indicates that the higher the level of technostress inhibitors, the smaller the negative impact of technostress creators on both of the positive well-being outcomes (engagement and satisfaction, commitment).

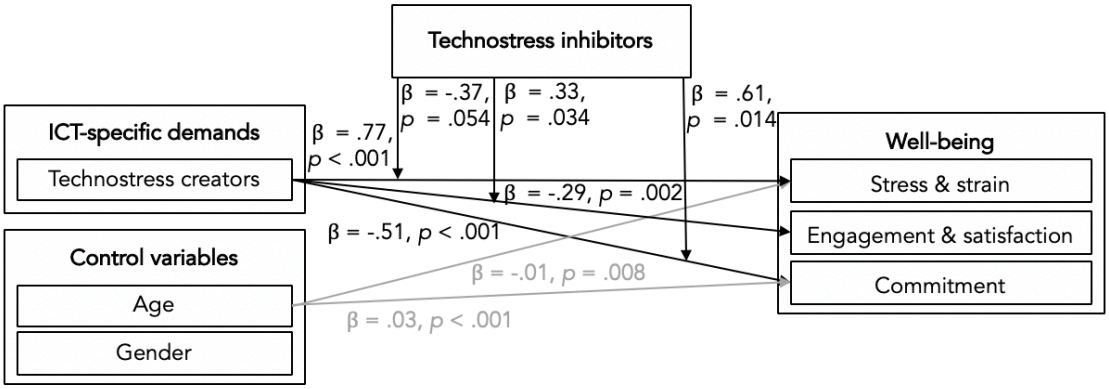

Figure 14. Results of regression analyses on technostress creators as independent variable, technostress inhibitors as moderator, and stress and strain, engagement and satisfaction, and commitment as three separate dependent variables (Study 6); Grey paths show effects of control variables; Gender as Dummy-coded variable: 0 = female, 1 = male.

5.7 Study 7 (Focus on Digitalisation Anxiety)

Study 7[14], an online survey conducted with 96 employees (Gender: female: *n* = 77, male: *n* = 18, gender not indicated: *n* = 1, Age: *M* = 22.07 years, *Min* = 17 years, *Max* = 62 years), focused on digitalisation anxiety, as ICT-specific demand, and its consequences on well-being (Hypothesis 1c). With regard to the well-being indicators, work-life-conflict and work-life-balance were additionally included as outcome variables. Apart from the main effect of digitalisation anxiety on well-being it was investigated how telepressure mediates this relationship in order to test Hypothesis 3. The following hypotheses therefore were tested in Study 7:

Hypothesis 1c: Digitalisation anxiety, as ICT-specific demand, is negatively related to well-being (higher stress and strain, lower engagement and satisfaction, higher work-life-conflict, lower work-life-balance).

Hypothesis 3: Detachment mediates the relationship between ICT-specific demands (digitalisation anxiety) and well-being (stress and strain as reverse indicator, engagement and satisfaction, work-life-conflict as reverse indicator, work-life-balance).

5.7.1 Measurement

ICT-specific demand: Digitalisation anxiety was measured with 35 items covering digitalisation anxiety on four different levels: general, self, interaction and leadership, and implementation (Cronbach's α = .96, e.g., "I am concerned about digital systems not being secure enough", Pfaffinger et al., 2019 and Pfaffinger, Reif, Huber, et al., 2020, items were answered on a 6-point Likert scale indicating the level of consent (1 = *do not agree at all*, 6 = *fully agree*)).

Well-being: Stress and strain, engagement and satisfaction, work-life-conflict, and work-life-balance. As in Studies 5 and 6, stress and strain as reverse indicator as well as engagement and satisfaction were analysed as outcome variables covering

[14] This study was conducted in scope of a bachelor's thesis by Bettina Tafertshofer.

several aspects of well-being. In addition, work-life-balance and work-life-conflict (reverse indicator) were included in the study as further well-being indicators targeting the relation between work and private life.

Stress and strain were measured with nine items of the scale, which was also used in Studies 5 and 6 (Cronbach's α = .86, e.g. "I feel exhausted", Haslam & Reicher, 2006, items were answered on a 5-point Likert scale indicating the level of agreement (1 = *not at all*, 5 = *to a very great degree*)).

Engagement and satisfaction were assessed by using the same six items as in Study 6 (Cronbach's α = .89, e.g. "So far I have achieved all my goals at work", Hoegl et al., 2004, items were answered on a 5-point Likert scale indicating the level of agreement (1 = *not at all*, 5 = *to a very great degree*)).

Work-life-conflict was measured with nine items (Cronbach's α = .88, e.g., "You find it difficult to fulfil your domestic obligations because you are constantly thinking about your work?", Geurts et al., 2005, items were answered on a 4-point Likert scale indicating the frequency how often the specified aspect happens (0 = *never*, 1 = *sometimes*, 2 = *frequently*, 3 = *always*)).

Work-life-balance was investigated with five items (Cronbach's α = .89, e.g., "How satisfied are you with the way you divide your time between work and personal or family life", Valcour, 2007, items were answered on a 5-point Likert scale indicating the level of satisfaction (1 = *very dissatisfied* to 5 = *very satisfied*)).

Detachment. The same 4-item scale by Sonnentag and Fritz (2007) as in Study 5 was used to measure detachment (Cronbach's α = .89, e.g., "I forget about work", items were answered on a 5-point Likert scale (1 = *do not agree at all*, 5 = *fully agree*)).

Control variables. ICT use at home and at work, working time, gender, and age were included as control variables in this study.

Since the participants of this study were German speaking, the scales again were translated into German.

5.7.2 Results

As in Study 5, a structural equation model was calculated to examine the relationships between digitalisation anxiety as independent variable, detachment as mediator, and stress and strain, engagement and satisfaction, work-life-conflict, and work-life-balance as well-being indicators and dependent variables. In addition, five control variables were included in the model (age, gender, ICT use at work, ICT use at home, working time). Again, the software RStudio (Version 1.1.453) was used for all analyses. The results can be found in Figure 15.

Regarding Hypothesis 1c (*Digitalisation anxiety, as ICT-specific demand, is negatively related to well-being*), only the relation between digitalisation anxiety and stress and strain was significant on an Alpha level of 5% ($\beta = .38$, $p = .009$). The effects of digitalisation anxiety on engagement and satisfaction ($\beta = -.22$, $p = .082$) and on work-life-conflict ($\beta = .22$, $p = .092$) were only significant on an Alpha level of 10%. Those results only provide partial support for Hypothesis 1c.

Concerning Hypothesis 3 (*Detachment mediates the relationship between ICT-specific demands and well-being*), the results show that the significant effects of digitalisation anxiety on stress and strain as well as engagement and satisfaction were not mediated by detachment. Although digitalisation anxiety was negatively related to detachment ($\beta = -.24$, $p = .039$) and detachment significantly related to work-life-conflict ($\beta = -.60$, $p = .012$) and work-life-balance ($\beta = .58$, $p < .001$), no indirect effect was significant on an Alpha level of 5%. The indirect effect of digitalisation anxiety via detachment on work-life-conflict was marginally significant ($\beta = -.14$, $p = .078$, CI [-.301; .016]), providing no support for Hypothesis 3.

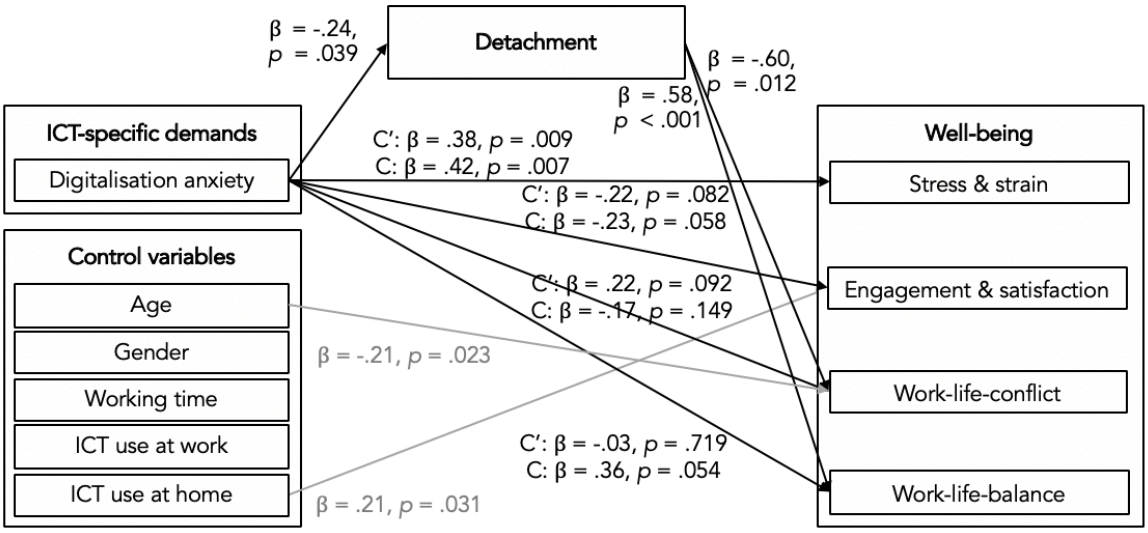

Figure 15. Structural equation model with relationships between digitalisation anxiety as independent variable, detachment as mediator, and stress and strain, engagement and satisfaction, work-life-conflict, and work-life-balance as dependent variables (Study 7); C' represents the direct effect of digitalisation anxiety on the dependent variables controlling for the effect of detachment; C represents the total effect of digitalisation anxiety on the dependent variables; βs represent standardised coefficients; Grey paths show effects of control variables; Gender as Dummy-coded variable: 0 = female, 1 = male.

5.8 Study 8 (Test of Holistic Model)

In Study 8[15], an online survey conducted with 293 employees, the holistic model was analysed: telepressure, technostress creators, and digitalisation anxiety as ICT-specific demands were examined, and the relationships between ICT-specific demands and employee well-being as well as productivity were tested. Well-being was operationalised with stress and strain (reverse indicator), engagement and satisfaction, sleep quality, and sleep quantity. In order to additionally examine

[15] This study was conducted in scope of a bachelor's thesis by Margarita Rashkova and a master's thesis by Melina Dengler. The sample was also used in Study 4 for the CFA of the DAS.

performance-oriented outcomes, productivity and innovation were included as well. Moreover, it was investigated how detachment mediates and how technostress inhibitors moderate the relationships between ICT-specific demands and well-being as well as performance. The hypotheses were therefore specified with regard to the three predictors: a = technostress creators as ICT-specific demands, b = telepressure as ICT-specific demand, and c = digitalisation anxiety as ICT-specific demand. All general hypotheses, which were tested, are listed below and for Hypothesis 1, the specifications are shown beneath as an example. A full overview including all specified hypotheses for Study 8 can be found in Annex E.

Hypothesis 1: ICT-specific demands are negatively related to well-being.

Hypothesis 1a: Technostress creators, as ICT-specific demands, are negatively related to well-being (higher stress and strain, lower engagement and satisfaction, lower sleep quality and quantity).

Hypothesis 1b: Telepressure, as ICT-specific demand, is negatively related to well-being (higher stress and strain, lower engagement and satisfaction, lower sleep quality and quantity).

Hypothesis 1c: Digitalisation anxiety, as ICT-specific demand, is negatively related to well-being (higher stress and strain, lower engagement and satisfaction, lower sleep quality and quantity).

Hypothesis 2: ICT-specific demands are negatively related to performance.

Hypothesis 3: Detachment mediates the relationship between ICT-specific demands and well-being.

Hypothesis 4: Technostress inhibitors moderate the relationship between ICT-specific demands and well-being: A high degree of inhibitors can reduce the negative effect of ICT-specific demands on well-being.

Hypothesis 5: Technostress inhibitors moderate the relationship between ICT-specific demands and performance: A high degree of inhibitors can reduce the negative effect of ICT-specific demands on performance.

Hypothesis 6: Technostress inhibitors moderate the relationship between ICT-specific demands and detachment: A high degree of inhibitors can reduce the negative effect of ICT-specific demands on detachment.

5.8.1 Measurement

ICT-specific demands: Telepressure, technostress creators, and digitalisation anxiety. Telepressure. The same scale with six items by Barber and Santuzzi (2015) as in Study 5 was used to measure telepressure (Cronbach's α = .86, e.g., "It's hard for me to focus on other things when I receive a message from someone", items were answered on a 5-point Likert scale (1 = *do not agree at all*, 5 = *fully agree*)).

Technostress creators were measured with 29 items, which were also used in Study 6, covering the six aspects techno-overload, techno-invasion, techno-complexity, techno-insecurity, techno-uncertainty, and techno-induced role ambiguity (Cronbach's α = .92, e.g., "I am forced by this technology to work much faster", Ragu-Nathan et al., 2008 and Ayyagari et al., 2011). The items were answered on a 5-point Likert scale indicating the level of agreement (1 = *not at all*, 5 = *to a very great degree*).

Digitalisation anxiety was measured with the same 35 items of the DAS, which were used in Study 7 (Cronbach's α = .96, e.g., "I am concerned about digital systems not being secure enough", Pfaffinger et al., 2019 and Pfaffinger, Reif, Huber, et al., 2020, items were answered on a 6-point Likert scale indicating the level of consent (1 = *do not agree at all*, 6 = *fully agree*)).

Well-being: Stress and strain, engagement and satisfaction, sleep quality, and sleep quantity. Stress and strain as reverse indicator, engagement and satisfaction, sleep quality, and sleep quantity were analysed as outcome variables covering several aspects of well-being.

Stress and strain were measured with the same 10 items, which were also used in Studies 5, 6, and 7 (Cronbach's α = .85, e.g. "I feel exhausted", Haslam & Reicher,

2006, items were answered on a 5-point Likert scale indicating the level of agreement (1 = *not at all*, 5 = *to a very great degree*)).

Engagement and satisfaction were assessed by using the same six items as in Studies 6 and 7 (Cronbach's α = .81, e.g. "So far I have achieved all my goals at work", Hoegl et al., 2004, items were answered on a 5-point Likert scale indicating the level of agreement (1 = *not at all*, 5 = *to a very great degree*)).

Sleep quality was measured with the same four items as in Study 5 (Cronbach's α = .77, e.g. "How often in the past month did you have trouble falling asleep?", Jenkins et al., 1988, items were answered on a 6-point Likert scale indicating the frequency of sleep problems (1 = *22-31 days*, 2 = *15-21 days*, 3 = *8-14 days*, 4 = *4-7 days*, 5 = *1-3 days*, 6 = *never*). Higher values therefore indicate a higher quality of sleep.

Sleep quantity was measured with one item ("How many hours of sleep did you get on average per night in the last week?", Gronover, 2018).

Performance: Productivity and innovation. Productivity as well as innovation were examined as outcome variables to measure performance.

Productivity. A scale by Tarafdar et al. (2007) with four items was used to measure self-rated productivity related to ICTs (Cronbach's α = .86, e.g., "Information and communications technologies help to improve the quality of my work", items were answered on a 5-point Likert scale (1 = *do not agree at all*, 5 = *fully agree*)).

Innovation was examined by using a scale by Welbourne, Johnson, and Erez (1998) with four items (Cronbach's α = .79, e.g., "I'm coming up with new ideas at work", items were answered on a 5-point Likert scale (1 = *do not agree at all*, 5 = *fully agree*)).

Detachment. The same 4-item scale by Sonnentag and Fritz (2007) as in Studies 5 and 7 was used to measure detachment (Cronbach's α = .82, e.g., "I forget about work", items were answered on a 5-point Likert scale (1 = *do not agree at all*, 5 = *fully agree*)).

Technostress inhibitors. The same 12 items by Ragu-Nathan and colleagues (2008) as in Study 6 were used to assess technostress inhibitors (Cronbach's α = .87, e.g., "Our organization provides end-user training before the introduction of new technology"). All items were answered on a 5-point Likert scale indicating the level of agreement (1 = *not at all*, 5 = *to a very great degree*).

Control variables. As age, gender, ICT use at work and at home, working time, and overtime have been found to affect well-being, sleep quality, or consequences of ICT use, they were included as control variables (e.g., Korpinen & Pääkkönen, 2009; Martin et al., 2001; Reyner & Horne, 1995; Thomée et al., 2007). Language was included as further control variable as the questionnaire was available in English and in German.

5.8.2 Sample

55.7% of the sample were women (Gender: female: *n* = 162, male: *n* = 129, no gender indicated: *n* = 2) and the mean age of participants was 33.22 years (*Min* = 18 years, *Max* = 68 years, no age indicated: *n* = 1). A regular working time of at least 10 hours per week was a prerequisite for participation and the mean weekly working time was 34.57 hours per week (*Min* = 10 hours per week, *Max* = 65 hours per week). Participants worked in different branches (consulting: *n* = 27, IT: *n* = 21, research: *n* = 19, services: *n* = 36, automotive: *n* = 26, culture: *n* = 8, administration: *n* = 17, education: *n* = 29, energy: *n* = 4, chemistry: *n* = 5, sales: *n* = 8, marketing: *n* = 22, insurance: *n* = 26, other: *n* = 45). Regarding the position, most participants were working as employees (employees: *n* = 252, supervisor: *n* = 34, other: *n* = 7). The questionnaire was answered in German (*n* = 207) as well as in English (*n* = 86).

5.8.3 Results

For testing Hypotheses 1, 2, and 3, a structural equation model was calculated to examine the relationships between the ICT-specific demands as independent variables, detachment as mediator, and well-being as well as productivity indicators as dependent variables. Seven control variables were also included in the model (age,

gender, ICT use at work and at home, working time, overtime, and language). Moderated regression analyses were calculated to test Hypotheses 4, 5, and 6. The software RStudio (Version 1.1.453) was used for all analyses.

5.8.3.1 Hypotheses 1 and 2: Main effects of ICT-specific demands

For testing Hypotheses 1 and 2, a structural equation model was calculated to examine the effects of all predictors on the outcome variables without taking into account the third variables as mediator or moderator. The results can be found in Figure 16.

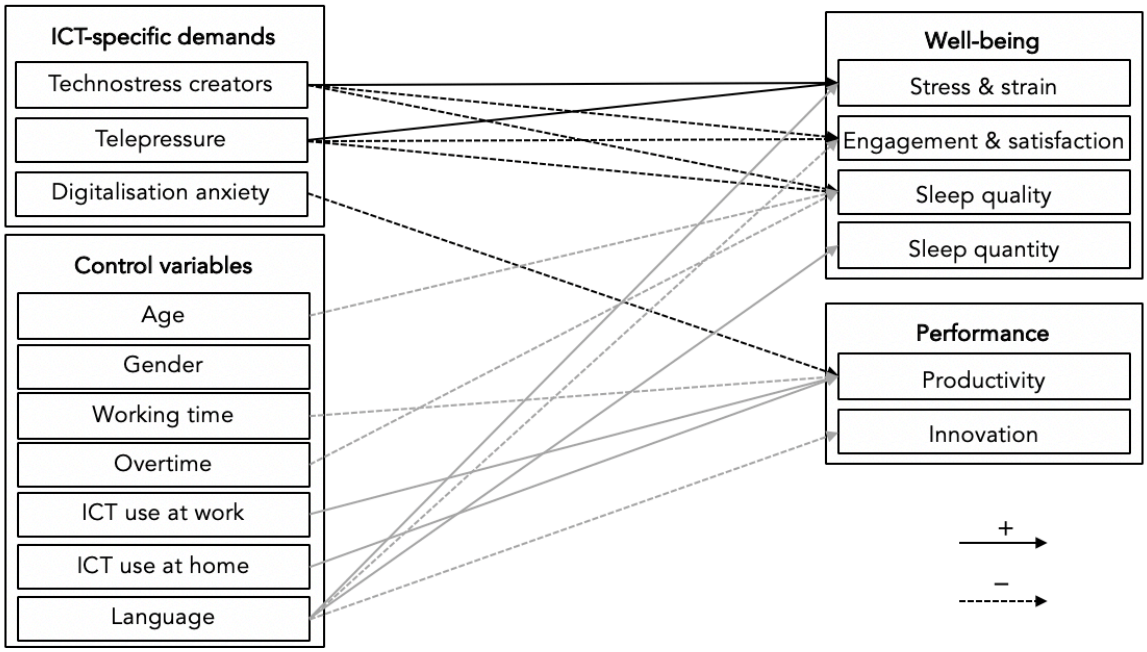

Figure 16. Structural equation model with relationships between ICT-specific demands as independent variables, control variables, and well-being as well as performance indicators as dependent variables; All paths are significant on an Alpha level of 5%; Grey paths show effects of control variables; Gender as Dummy-coded variable: 0 = female, 1 = male; Language as Dummy-coded variable: 0 = German version, 1 = English version.

For estimating the model fit, the thresholds suggested by Fuglseth and Sørebø (2014) were applied: insignificant χ^2 statistic with a *p*-value > .05, ratio of χ^2 to degrees of freedom < 3:1, *RMSEA* < .06, *CFI* > .90, *TLI* > .90, *SRMR* < .08. For the investigated model (χ^2 (5275) = 9708.914, $p < .001$, ratio χ^2 to degrees of freedom: 9708.914/5275 = 1.84, *RMSEA* = .054, *CFI* = .686, *TLI* = .676, *SRMR* = .078) three of the six thresholds were met (ratio χ^2 to degrees of freedom, *RMSEA*, and *SRMR*) so it was concluded that the proposed model shows an acceptable fit.

Hypothesis 1a (*Technostress creators, as ICT-specific demands, are negatively related to well-being*) was partially supported as technostress creators were positively related to stress and strain (β = .41, $p < .001$) and negatively related to engagement and satisfaction (β = -.33, $p = .005$) and sleep quality (β = -.23, $p = .017$). The effect on sleep quantity was not significant. Regarding Hypothesis 1b (*Telepressure, as ICT-specific demand, is negatively related to well-being*), telepressure was positively related to stress and strain (β = .26, $p < .001$) and negatively related to engagement and satisfaction (β = -.18, $p = .031$) and sleep quality (β = -.20, $p = .017$) even after controlling for the control variables' effects. As the effect of telepressure on sleep quantity was not significant, these results only provide partial support for Hypothesis 1b. No support was found for Hypothesis 1c (*Digitalisation anxiety, as ICT-specific demand, is negatively related to well-being*) as the effect of digitalisation anxiety on none of the well-being indicator was significant. To sum up, telepressure and technostress creators, as ICT-specific demands, seem to negatively affect employee well-being providing partly support for Hypothesis 1. Interestingly, no significant effect on any of the outcome variables was found for both control variables measuring ICT use (ICT use at home and at work). This finding implies that the use of ICT itself does not entail any negative consequences on the well-being of employees.

When analysing the consequences of ICT-specific demands on performance (Hypothesis 2), neither technostress creators (Hypothesis 2a) nor telepressure (Hypothesis 2b) were significantly related to any of the productivity outcome variables but a significant negative relation between digitalisation anxiety and productivity was

detected (β = -.33, $p < .001$). Hypothesis 2c (*Digitalisation anxiety as ICT-specific demand is negatively related to performance*) therefore was only partially supported. Hypothesis 2 assuming a negative effect of ICT-specific demands on performance therefore only partially holds true for the effect of digitalisation anxiety on (self-rated) productivity.

5.8.3.2 Hypothesis 3: Mediating effect of detachment

For testing Hypothesis 3 (*Detachment mediates the relationship between ICT-specific demands and well-being*), three individual structural equation models – one for the mediation effect of detachment on the relation between each of the predictors and all outcome variables – were calculated. In all structural equation models three out of six fit indices met the thresholds by Fuglseth and Sørebø (2014) (insignificant χ^2 statistic with a *p*-value > .05, ratio of χ^2 to degrees of freedom < 3:1, *RMSEA* < .06, *CFI* > .90, *TLI* > .90, *SRMR* < .08) and the model fits therefore were considered as acceptable. The results of the three structural equation models indicate significant relations between detachment and all of the predictor variables (Hypothesis 3a[16]: detachment – technostress creators: β = -.33, $p < .001$; Hypothesis 3b [17] : detachment – telepressure: β = -.28, $p < .001$; Hypothesis 3c [18] : detachment– digitalisation anxiety: β = -.21, $p = .006$), but detachment was not related to any of the outcome variables, which also is a precondition for a mediation effect (e.g., Hayes, 2013). Therefore, Hypothesis 3 has to be rejected.

[16] Fit of the structural equation model for testing Hypothesis 3a: $\chi^2(5690) = 10380.482$, $p < .001$, Ratio χ^2 to degrees of freedom: 10380.482/5690 = 1.82, *RMSEA* = .053, *CFI* = .683, *TLI* = .673, *SRMR* = .077.

[17] Fit of the structural equation model for testing Hypothesis 3b: $\chi^2(5690) = 10389.103$, $p < .001$, Ratio χ^2 to degrees of freedom: 10389.103/5690 = 1.83, *RMSEA* = .053, *CFI* = .683, *TLI* = .672, *SRMR* = .079.

[18] Fit of the structural equation mode for testing Hypothesis 3c: $\chi^2(5690) = 10395.451$, $p < .001$, Ratio χ^2 to degrees of freedom: 10395.451/5690 = 1.83, *RMSEA* = .053, *CFI* = .682, *TLI* = .672, *SRMR* = .078.

5.8.3.3 Hypotheses 4, 5, and 6: Moderating effect of technostress inhibitors

Moderated regressions were calculated to investigate whether technostress inhibitors moderate the relation between predictors and outcome variables in order to test Hypotheses 4, 5, and 6. The recommendation to mean-centre all predictor variables before creating interaction terms for the moderation by Aiken and West's (1991) was met in order to reduce multicollinearity (Srivastava et al., 2015). In every regression, one focal predictor was investigated for which the moderating effect of technostress inhibitors was examined. Additionally, the two other predictors as well as all control variables from the previous structural equation models were included.

Regarding Hypothesis 4 (*Technostress inhibitors moderate the relationship between ICT-specific demands and well-being*), no significant interaction effects were found between technostress inhibitors and the predictor variables for any well-being indicator as outcome variable.

For Hypothesis 5 (*Technostress inhibitors moderate the relationship between ICT-specific demands and performance*), the interaction effects in the three regressions predicting productivity were significant (Figure 17).

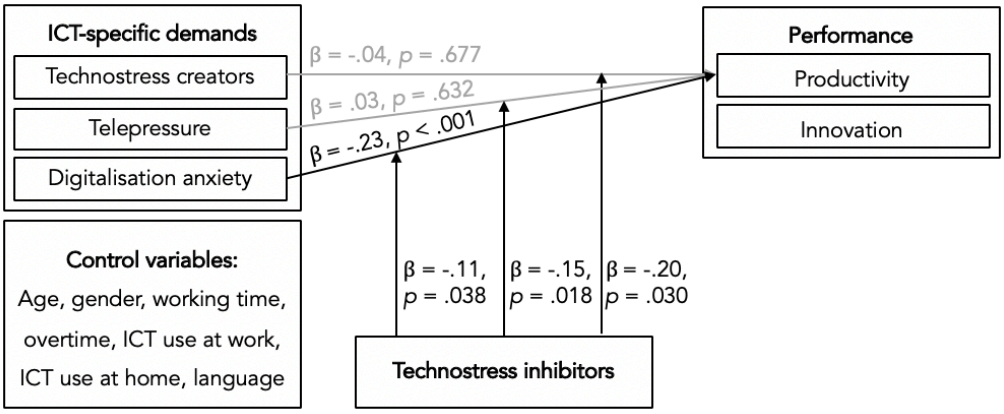

Figure 17. Summary of results of individual regression analyses on telepressure, technostress creators, and digitalisation anxiety as independent variables, technostress inhibitors as moderator, and productivity and innovation as two separate dependent variables; Grey paths are not significant on an Alpha level of 5%.

The negative coefficient of the interaction effects seems to contradict Hypothesis 5. High levels of technostress inhibitors seem to be more beneficial for low levels of ICT-specific demands and in the case of high perceived specific demands, even higher levels of technostress inhibitors obviously cannot buffer the negative effect on productivity or are even disadvantageous (see also Figures 18, 19, and 20).

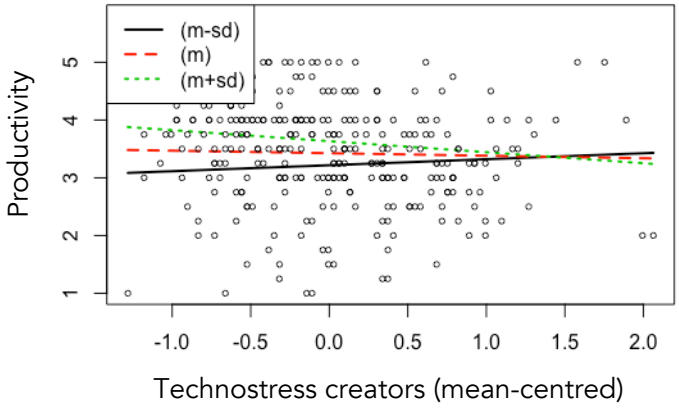

Figure 18. Plot showing slopes for the effect of technostress creators on productivity for different levels of technostress inhibitors (1 *SD* below mean value, mean value, 1 *SD* above mean value).

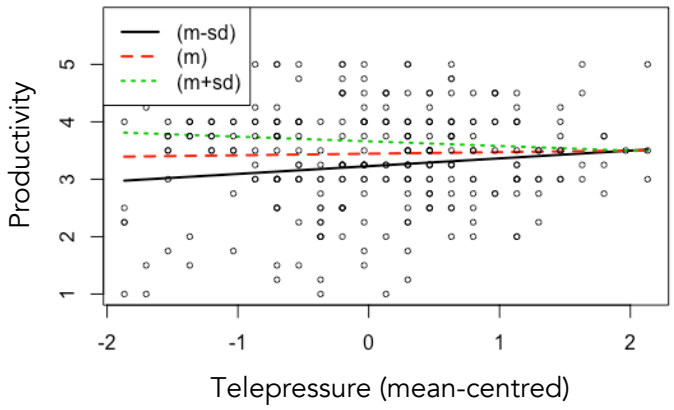

Figure 19. Plot showing slopes for the effect of telepressure on productivity for different levels of technostress inhibitors (1 *SD* below mean value, mean value, 1 *SD* above mean value).

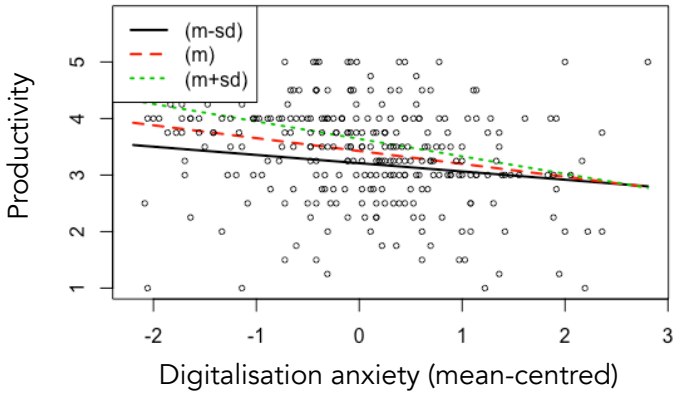

Figure 20. Plot showing slopes for the effect of digitalisation anxiety on productivity for different levels of technostress inhibitors (1 *SD* below mean value, mean value, 1 *SD* above mean value).

For Hypothesis 6 (*Technostress inhibitors moderate the relationship between ICT-specific demands and detachment*), the interaction effect of technostress inhibitors and technostress creators was significant for predicting detachment (see Figure 21). High levels of technostress inhibitors seem to buffer the effect of technostress creators on detachment, which provides evidence for Hypothesis 6. High levels of technostress inhibitors are especially beneficial for people reporting high levels of technostress creators as the relation between technostress creators and detachment is less negative for higher levels of technostress indicators compared to lower levels of technostress inhibitors (see Figure 22).

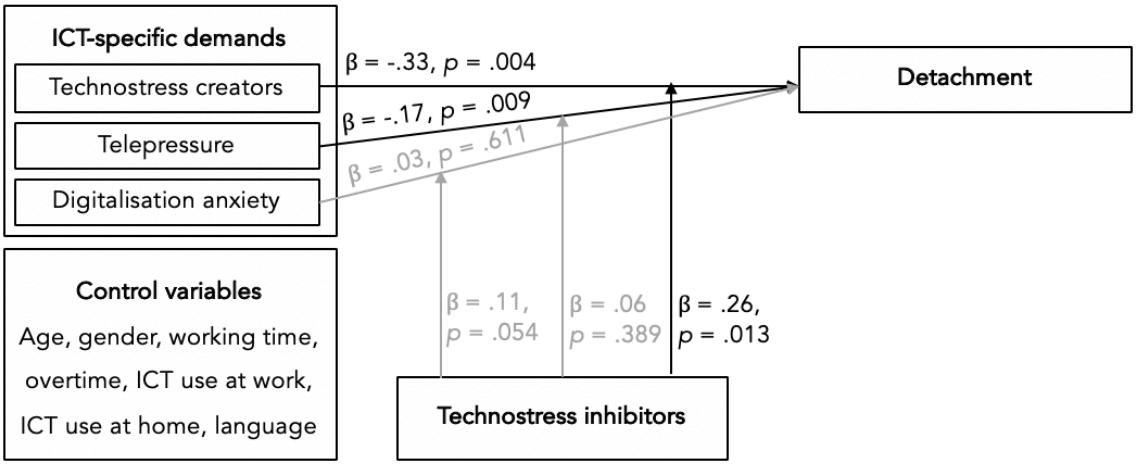

Figure 21. Summary of results of individual regression analyses on telepressure, technostress creators, and digitalisation anxiety as independent variables, technostress inhibitors as moderator, and detachment as dependent variable; Grey paths are not significant on an Alpha level of 5%.

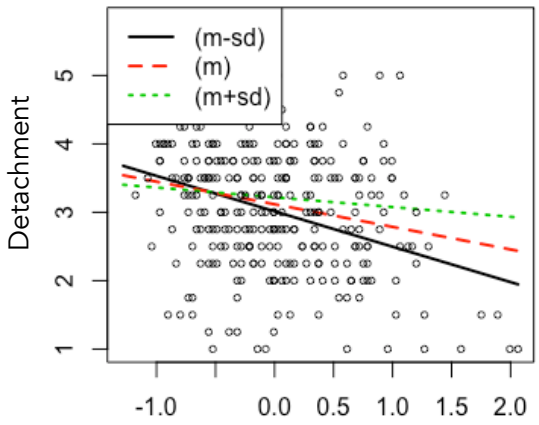

Figure 22. Plot showing slopes for the effect of technostress creators on detachment for different levels of technostress inhibitors (1 *SD* below mean value, mean value, 1 *SD* above mean value).

5.9 Discussion

This chapter's studies investigated the effects of technostress creators, telepressure, and digitalisation anxiety, as forms of ICT-specific demands, on well-being and performance in four studies, along with the mechanisms that might explain these relationships. Table 7 gives an overview of the hypotheses, the studies in which they were tested, and the corresponding results.

The results of Studies 5 and 8 showed that ICT use itself was unrelated to the well-being indicators, and in Study 7 even a positive effect of ICT use at home on engagement and satisfaction was found. This suggests that employers should support their employees in better managing ICT use rather than decreasing the use of these technologies. As proposed, negative consequences of different types of ICT-specific demands on well-being and performance were found across all studies.

Table 7

Overview of hypotheses for Studies 5-8, the studies they were tested in, and the corresponding results

	Study 5 (Telepressure)	Study 6 (Technostress creators)	Study 7 (Digitalisation anxiety)	Study 8 (Holistic model)
H1: Main effect of ICT-specific demands on well-being				
H1a: Technostress creators as ICT-specific demands		x		x (only for stress and strain, engagement and satisfaction, and sleep quality)
H1b: Telepressure as ICT-specific demand	x			x (only for stress and strain, engagement and satisfaction, and sleep quality)
H1c: Digitalisation anxiety as ICT-specific demand			x (only for stress and strain)	x
H2: Main effect of ICT-specific demands on performance				
H2a: Technostress creators as ICT-specific demands				x
H2b: Telepressure as ICT-specific demand				x
H2c: Digitalisation anxiety as ICT-specific demand				x (only for productivity)

(continued)

	Study 5 (Telepressure)	Study 6 (Technostress creators)	Study 7 (Digitalisation anxiety)	Study 8 (Holistic model)
H3: Mediating effect of detachment on main effect of ICT-specific demands on well-being	x		x (only on 10% Alpha Level)	x
H4: Moderating effect of technostress inhibitors on main effect of ICT-specific demands on well-being		x (only for engagement and satisfaction and commitment)		x
H5: Moderating effect of technostress inhibitors on main effect of ICT-specific demands on performance				x (only for productivity)
H6: Moderating effect of technostress inhibitors on main effect of ICT-specific demands on detachment				x (only for technostress creators)
Well-being indicators	Stress and strain (R), sleep quality	Stress and strain (R), engagement and satisfaction, commitment	Stress and strain (R), engagement and satisfaction, work-life-conflict (R), work-life-balance	Stress and strain (R), engagement and satisfaction, sleep quality, sleep quantity
Performance indicators				Productivity, innovation

Note. x indicates that the hypothesis was tested in the corresponding study; Green indicates that the hypothesis was fully supported by the study's results; Orange indicates that the hypothesis was only partially supported with an explanation in brackets for which variables the hypothesis was supported; Red indicates that the hypothesis was not supported by the results of the studies; H = Hypothesis; R = Reverse indicator.

5.9.1 Theoretical implications

The results of the previously described studies have several theoretical implications: First, the results confirm the applicability of general models explaining stress and well-being to new forms of job demands. Although many of these theories have already existed for several decades, they also seem to apply to new, modern forms of stressors and demands.

Second, the findings provide further empirical support for the effect of ICT-specific demands on well-being: In Study 5, previous findings on the effects of telepressure on engagement and sleep quality and the mediating effect of detachment (Barber & Santuzzi, 2015; Santuzzi & Barber, 2018) were replicated. In Study 6, the effect of technostress creators on satisfaction as well as the moderating effect of technostress inhibitors, which were found by Ragu-Nathan and colleagues (2008), were replicated. Although technostress inhibitors had a moderating effect on the relationship between technostress creators and both of the positive well-being outcomes, this effect was insignificant for stress and strain. A possible explanation might be that the inhibiting factors included in the survey (social support, helpdesk, trainings, or involvement in implementation) refer to emotion-oriented coping strategies aimed at improving one's feelings about technostress creators rather than problem-focused coping strategies aimed at actually solving problems and thus also reducing stress and strain (Baker & Berenbaum, 2007; Lazarus, 1991). An organisational culture, which clarifies expectations towards employees regarding accessibility and the use of ICTs, as well as the provision of support and ICT training when implementing new technologies could be possible moderators for the effect of ICT-related demands on stress (Berg-Beckhoff et al., 2017; Milligan, 2016; Wang et al., 2008). In Study 8 the findings on negative main effects of technostress creators and telepressure on well-being were also replicated for the well-being indicators stress and strain, engagement and satisfaction, as well as sleep quality.

Third, existing findings regarding the negative effects of ICT-specific demands on well-being were extended by including and combining several distinct aspects of

well-being. Grant, Christianson, and Price's (2007) recommendation was followed to consider well-being as a multi-dimensional construct and therefore several well-being indicators (sleep quality, sleep quantity, stress and strain, engagement and satisfaction, commitment, work-life-balance, and work-life-conflict) were included in the studies. The fact that a negative effect of ICT-specific demands on nearly all of the well-being indicators studied was found (apart from sleep quantity and work-life-conflict) extends existing findings, which focused on specific well-being indicators. Existing findings were additionally extended by additionally taking into account digitalisation anxiety as new ICT-specific demand in Studies 7 and 8.

Fourth, further theoretical considerations with regard to the effects of the third variables detachment and technostress inhibitors on the relation between ICT-specific demands and well-being and performance indicators need to be employed due to mixed empirical findings. Concerning the mediating effect of detachment (Hypothesis 3), mixed results were found in the studies: Study 5 provides evidence for a mediating effect of detachment on the relation between telepressure as ICT-specific demand and the two well-being indicators stress and strain as well as sleep quality. The mediating effect of detachment in Study 7 on the relation between digitalisation anxiety as ICT-specific demand on work-life-conflict was only marginally significant on an Alpha level of 10% providing only partial support for this hypothesis. In Study 8, which tested the holistic research model, no evidence for any mediating effect was found. With regard to the moderating effect of technostress inhibitors on the relation between ICT-specific demands on well-being (Hypothesis 4) evidence was found in Study 6 for technostress creators as predictors and positive well-being indicators (engagement and satisfaction, commitment) as outcome variables but not in Study 8. The moderating effect of technostress inhibitors on the relation between ICT-specific demands on performance (Hypothesis 5) was only empirically supported in Study 8 for the relation between digitalisation anxiety and productivity. Contrary to the expectations, the coefficient for the interaction effect was negative, which indicates that higher levels of technostress inhibitors further increase the negative effect of ICT-

specific demands on productivity. The conducted simple slope analysis revealed that high levels of technostress inhibitors seem to be more beneficial for lower levels of digitalisation anxiety but that this effect does not work for high levels of digitalisation anxiety, where more or less no difference in the productivity was found for different levels of perceived technostress inhibitors. This finding suggests that increasing technostress inhibitors is still beneficial, but that this effect specifically works for employees with lower levels of digitalisation anxiety. Study 8 also provides evidence for the moderating effect of technostress inhibitors on the main effect of ICT-specific demands (specifically technostress creators) on detachment (Hypothesis 6), which indicates that higher levels of technostress inhibitors buffer the negative effect of technostress creators on detachment. Generally, those findings indicate that technostress inhibitors as moderator are especially beneficial for buffering negative effects of ICT-specific demands on positive well-being or performance outcomes but fail to buffer the consequences of ICT-specific demands on negative outcome variables. This empirical conclusion should be further examined in future studies.

5.9.2 Practical implications

The results – even if they are mixed and not completely definite – regarding the mediating effect of detachment and the moderating effect of technostress inhibitors suggest ideas for interventions, which might help employees deal with ICT-specific demands in order to reduce their negative consequences. These interventions should target both the individual and the organisational level in order to help employees cope with new kinds of ICT-specific job demands (Pfaffinger, Reif, Spieß, Witte, et al., 2018):

Firstly, interventions on an organisational level to increase technostress inhibitors could be implemented: Hurtienne, Stilijanow, and Junghanns (2014) suggested various organisational strategies to enhance technostress inhibitors, such as providing suitable support resources, reducing administrative tasks, fostering self-education and

training, decreasing the density and speed of communication via ICT systems, and recognising employees and their efforts.

Secondly, measures on the individual or organisational level could be taken to facilitate detachment. On an individual level, it has been proposed that setting limits to work-related ICTs is beneficial for disengagement from work and recovery processes (Barber & Jenkins, 2014). This so-called boundary-setting can be achieved by consciously switching off notifications for work-related messages when leaving work. Establishing after-work routines like doing sports also could help employees distract themselves from work-related thoughts. Hülsheger and colleagues (2014) demonstrated that a short daily planning intervention helping employees identify unfulfilled tasks and goals at work and plan how, when, and where they will be completed (Masicampo & Baumeister, 2011) can positively affect detachment. Interventions on the organisational level might include measures to reduce role stress, e.g. communication policies defining the use of CC in e-mails, which could help employees determine whether they are supposed to respond to a given e-mail or not (Ayyagari et al., 2011; Tarafdar et al., 2007). Furthermore, supervisors should clearly communicate expectations concerning employees' availability and responsiveness outside of official working hours, which can help avoid the occurrence of telepressure (Ayyagari et al., 2011). Such measures can also support employees in dealing with the insecurity of not knowing what is expected and how to behave. As mindfulness at work is positively related to psychological detachment, mindfulness trainings could also be part of organisational or individual interventions (Hülsheger et al., 2014).

5.9.3 Limitations and future research

The studies did not take a longitudinal approach, so it was not possible to take time effects into account. However, the hypotheses are based on a theoretical rationale, which justifies the assumptions regarding the order of effects. Future research should examine how telepressure, technostress creators, and digitalisation anxiety evolve over time and determine whether they represent a short-term adaptive response,

which decreases as soon as an individual gets used to this pressure, or whether they are stable over time. Personal characteristics might also influence well-being at work as well as the effects of telepressure, technostress creators, and digitalisation anxiety on well-being. Specific personality traits (agreeableness, neuroticism, and openness to experience) were identified as predictors of technostress creators (Krishnan, 2017) and some personality traits can also moderate the relation between technostress creators and outcomes in a positive way (e.g., the influence of technostress creators on job burnout is less strong for people with higher extraversion levels, Srivastava et al., 2015).

According to Maxwell, Cole, and Mitchel (2011) as well as Maxwell and Cole (2007), the possibility exists that although cross-sectional data implies a significant indirect mediation effect, the true longitudinal effect is zero, which also entails biased hypotheses testing. This holds true for full as well as partial mediation. It therefore is necessary to interpret the findings with regard to this issue and to avoid conclusions on causal effects. Causal effects necessarily need to be tested in further studies, especially with regard to the development of interventions aiming at increasing detachment in order to influence the effect ICT-specific job demands on well-being. So far, the mediating effect of detachment has been found in cross-sectional as well as in longitudinal designs (Sonnentag & Fritz, 2015). Ten Brummelhuis and Bakker (2012) found detachment as mediator for the negative relation between work-related and household tasks as well as the positive relationship between social, low-effort, and physical activities and vigour on the following day. Von Thiele Schwarz (2011) examined the inability to withdraw from work, which can be seen as negative form of detachment. He found a partial mediating effect of inability to withdraw from work on the relationship between job demands and fatigue as well as next-day recovery with a time lag of six months. Those results show that the mediating effect of detachment was detected for different time lags (cross-sectional design without time lag, one day as well as six months). These findings provide evidence for the existence of the mediating effect of detachment.

Although the sample in Study 8 consisted of German- as well as English-speaking participants, cultural differences were not taken into account in the conducted studies. General cultural values have been found to affect the stress process and also ICT-specific demands (Glazer & Gasser, 2016; Krishnan, 2017) and their effect on the relation to well-being should be further investigated in future studies. Countries also differ in their digital readiness (Cisco, 2018), which could entail differences in the perception of ICT-specific demands and their consequences on well-being and productivity. Future research therefore should be encouraged to delve deeper into cross-cultural studies and research questions.

Future research should also include further control variables, which might influence the consequences of ICT use. Additionally, positive or functional thinking about work during periods of recovery can be beneficial for employees (e.g., Binnewies, Sonnentag, & Mojza, 2009). Hence, the content of work-related thoughts should be examined as potential moderator with effects on well-being. Organisational culture is another aspect that could be targeted in future research as this also has been described as beneficial or disadvantageous for well-being and the consequences of ICT-specific demands (Berg-Beckhoff et al., 2017; Spruell, 1987; Wang et al., 2008).

5.10 Conclusion

Technostress creators, telepressure, and digitalisation anxiety have become increasingly relevant due to digitalisation and need to be taken into account in working life and research because they can negatively affect employee well-being and performance. The four studies in this chapter show how technostress inhibitors can reduce the negative effects of ICT-specific job demands on well-being (engagement and satisfaction, commitment), and how detachment can partly explain the relationship between those demands and well-being (stress and strain, sleep quality). Consequently, impulses for developing interventions, which aim at increasing inhibiting factors among employees and fostering detachment from work have to be developed.

Due to the negative consequences of ICT-specific demands on well-being and performance, it is crucial to develop and examine the effectivity of interventions aiming at buffering those negative consequences and enhancing employee well-being in a digitalised and digitalising work environment.

6. Consequences of Digitalisation-related, App-based Interventions on Well-being

Chapter based on Pfaffinger, K. F., Reif, J. A. M., & Spieß, E. (2020b). *Consequences of digitalisation-related, app-based interventions on employee well-being*. [To be submitted].

In order to not only analyse correlative relationships and descriptively assess the consequences of ICT-specific demands, this chapter deals with interventions that could help to cope with those demands and examines their effect, which addresses Research Question 3 (*What can be done to buffer negative consequences of ICT-specific demands?*). Generally, it is called for research on the effectivity of interventions aiming at reducing stress and enhancing well-being and recovery of employees (Tetrick & Winslow, 2015). Due to digitalisation and its consequences on the way people work, communicate, and live, it is crucial to take into account those new developments when investigating stress and health management interventions (Richardson, 2017; Sonnentag & Fritz, 2015). Atanasoff and Venable (2017) also demanded the need to develop strategies that enable employees to cope with the effects of technostress. Even Lazarus (1991) already claimed that modifying coping processes have to be analysed when society changes.

6.1 Introduction

Chapter 1.2 already described how digitalisation and ICTs can have both beneficial and negative consequences: Positive consequences range from higher flexibility with regard to the location and time of work, possible improvements for employees' work-life-balance, increases in productivity, or time savings due to the elimination of commuting for home-office workers (e.g., Eurofound and the International Labour Office, 2017). At the same time, digitalisation comes along with negative effects and scholars even write about new technologies as "double-edged sword" (Milligan,

2016, p. 32) or mention "increasing concerns about the 'dark side' of technologies and their negative impacts on levels of individual well-being" (O'Driscoll et al., 2010, p. 270). Increasing expectations about the accessibility and productivity of employees, extended working hours, higher levels of work-home conflict, and impairments for mental health have been found as negative effects (Eurofound and the International Labour Office, 2017; O'Driscoll et al., 2010; Salanova, Grau, Cifre, & Llorens, 2000).

In order to make use of the positive opportunities of digitalisation, it is crucial to find ways how risks and negative side effects can be reduced and what measures can be taken to ease negative consequences on employee well-being. This chapter therefore examines, whether digitalisation-related app-based interventions can improve employee well-being and the user's perception of ICT-specific demands.

6.2 Consequences of ICTs

As it was already described, traditional stress and recovery models can be used to explain the emergence of stress with regard to ICTs and many models specifically describing the consequences of digitalisation, ICTs, and new technologies even build on traditional models such as the Job Demands-Resources Model (Bakker & Demerouti, 2007), the Transactional Theory of Stress (Lazarus, 1991), or the Job Demands-Control Model (Karasek, 1979, 2011), which consider stressors or job demands as causes of stress and negative well-being. There are also models explaining how technostress as technology-specific form of stress can evolve and what consequences it has, e.g. the Conceptual Model for Understanding Technostress by Ragu-Nathan and colleagues (2008), which presumes a negative influence of technostress on job satisfaction and commitment.

Digitalisation and ICTs can be a source of new demands such as technostress creators (Ragu-Nathan et al., 2008) or telepressure (Barber & Santuzzi, 2015), which already was described in Chapter 3. Yun et al. (2012) examined the characteristics of smartphones, which are used for work and private purposes, and found that although

they provide opportunities for higher flexibility and productivity, they can intensify the workload and blur boundaries between work and home domain. Especially the implementation of new technologies, which is also part of digitalisation, is critical for employee well-being: Knani (2013) conducted an exploratory study using a qualitative approach to analyse the effect of implementing a new technology at a higher educational institution and found increases in perceived job demands, stress, exhaustion, absenteeism, and presenteeism among the users.

At the same time, digitalisation and ICTs can provide opportunities for new resources and coping strategies (e.g., higher flexibility regarding place and time of work, automation of dangerous or strenuous tasks, Cox & Fletcher, 2014; IG Metall, 2015).

It can therefore be concluded that digitalisation and ICTs come along with new demands, which might be disadvantageous for employee well-being, but at the same time offer opportunities for resources and possible coping strategies.

6.3 Interventions

Due to the demanding environment of employees, it is necessary to conduct research on the effectivity of interventions aiming at reducing stress and enhancing well-being and recovery (Tetrick & Winslow, 2015). As this environment is continuously changing as a result of technological advances, those new developments also have to be taken into account (e.g., Richardson, 2017; Sonnentag & Fritz, 2015). While in Chapter 4.2.3 interventions regarding digitalisation anxiety were already described, which were derived from the qualitative interviews in Study 1a, this chapter focuses on interventions targeting well-being and ICT-specific demands in general.

6.3.1 General stress management interventions

There exists a lot of research on general stress management interventions aiming at reducing employee stress at work and enhancing their well-being and stress management interventions have been found to be beneficial for well-being (e.g.,

Glazer & Gasser, 2016). Although these interventions are not specifically focused on technostress and ICT-specific demands, some findings will be shortly introduced in the following sections as they also provide a general framework to understand how such interventions can take effect.

There are several conceptual frameworks explaining how such interventions can work theoretically. Three approaches by Lazarus (1991), Demerouti (2015), and Ivancevich, Matteson, Freedman, and Phillips (1990) will shortly be introduced.

According to Lazarus (1991), there are three main strategies for reducing stress in the workplace: The first strategy is changing the conditions of work. By doing so, the conditions should become less stressful or counterproductive for effective coping behaviour. Changing conditions might be helpful for some employees but possibly even impair the situation for others (e.g., ambitious environment is motivative for some employees, but overly competitive for others) as the perception of stressors can vary between individuals. The second strategy is to help employees to cope more effectively. This could especially be helpful for employees having difficulties to adapt. Due to the need to individually modify trainings when using this strategy, it might be difficult for organisations to implement them. At the same time, this could be a reason for the failure of some management strategies, which see all employees as equal, because they do not meet the individual needs of the employees. The third strategy is called transactional strategy and aims at identifying stressful relationships within the work setting on a group as well as on an individual level. After identifying those relationships, they should be changed based on relational findings. In this strategy, the person or group and work are considered as single unit and possible measures could be e.g. new role assignments to increase person-environment fit.

Demerouti (2015) summarised different strategies, which are used by individuals to diminish the consequences of demanding work. Firstly, people tend to use coping, recovery, and compensation strategies to reduce consequences of work stress. Secondly, job crafting strategies can be used, which aim at changing the characteristics of jobs so that work becomes less stressful. Thirdly, the creation of

boundaries between work and non-work can help to actively detach and recover from work.

Ivancevich and colleagues (1990) provided a framework to differentiate various types of general stress management interventions depending on the part of the stress process on which they draw on: The interventions can either focus on stressors ("reducing the intensity or number of stressors" (p. 252) e.g., through training of skills), the cognitive appraisal of stressors ("help employees to modify their appraisal of a potentially stressful situation" (p. 253) e.g., through cognitive modification), or coping strategies ("help employees to cope more effectively with the consequences of stress" (p. 253) e.g., through meditation).

A lot of empirical research has been conducted on the effectiveness of stress management interventions: Gordon and colleagues (2018) examined the impact of job crafting interventions and found that they were beneficial for well-being (work-engagement, exhaustion, and health) and performance. Hahn, Binnewies, Sonnentag, and Mojza (2011) investigated the consequences of a recovery training program targeting psychological detachment from work, relaxation, mastery experiences, and control during off-job time and found significant increases in recovery experiences and sleep quality, and a reduction in perceived stress and state negative affect. Demerouti, van Eeuwijk, Snelder, and Wild (2011) also discovered that assertiveness as well as psychological capital were increased by a personal effectiveness training, which aimed at individual changes in cognitions and behaviour.

Many interventions or trainings have quite a long duration, which makes them difficult to implement and time-consuming to complete. However, Luthans, Avey, Avolio, Norman, and Combs (2006) examined the effectiveness of a micro-intervention with a duration between one and two hours aiming at increasing individuals' psychological capital. Their intervention specifically targets the development of hope, optimism, confidence/efficacy, and resilience and they indeed found a significant increase of psychological capital in the intervention group.

It can be concluded that various categories of interventions drawing on different parts of the stress process exist and that the effectiveness of various types of interventions on the stress and well-being level of individuals has been confirmed in several studies. With regard to the consequences, this chapter specifically focuses on enhancing the well-being of employees. Due to the multi-dimensional character of the well-being construct including psychological, physical, and social aspects (e.g., Grant et al., 2007), general aspects of well-being (stress and strain, engagement and satisfaction), recovery (detachment), and ICT-specific well-being indicators (technostress creators, digitalisation anxiety, IT resilience) are considered as consequences.

6.3.2 Effectiveness of interventions related to ICTs

Lazarus (1991) already stated that "[i]t is important to consider how the sources of stress and the coping process change as society changes" (p. 6). As digitalisation and the ongoing spread of ICTs can be seen as current mega trend affecting the way we live, work, and communicate, the consequences also need to be taken into account when considering stress management interventions. As new stressors result from the digitalisation, they also have to be considered when developing stress management interventions. Glazer and Gasser (2016) also demanded that "innovative digital and computer-mediated stress management programs" (p. 471) should be investigated in future research in order to incorporate technological advancements in stress management interventions.

Some companies already have reacted to the consequences of ICTs and established specific applications or took measures to cope with those new developments: Daimler (2014) introduced a "Mail on holiday" application, which is a specific out of office note. It automatically deletes e-mails, which are received during vacation, informs the sender about this fact, and names a substitute person who can be contacted alternatively. According to the HR executive, this application aims at facilitating relaxation during vacation as employees do not feel an obligation to read

work-related e-mails and enables a more relaxed start after vacation with a clean desk and an empty e-mail postbox, which is supposed to be emotionally relieving. In an article in the magazine "Mitbestimmung" [participation] by the Hans Böckler Stiftung (2014) similar measures by other automotive companies were described: At Volkswagen the e-mail server for work smartphones of employees is shut down half an hour after the end of official working hours. After positive feedback at the beginning, critical reactions occurred as well, as the amount of work is not reduced by this measure but only postponed. At BMW a new company agreement has been set up regulating that employees can record telework in their work time account and then compensate it with leisure time. This increases the temporal flexibility of employees and still gives them the opportunity to officially report hours worked at home. Trade unions (e.g., IG Metall, 2015) call for the definition of remote work as regular work and for an official right to not be available during coordinated non-working hours (which is already in place at BMW, where remote work is defined as regular work time and employees have a right to not be available during coordinated non-working hours). They also highlight the importance of a dialogue between supervisors and employees in coordinating availability and non-availability.

Although there only exists few empirical research on interventions aiming at decreasing negative reactions of employees to ICTs and increasing their ICT-related skills and knowledge (O'Driscoll et al., 2010), some scholars already conducted studies in this field and described different training possibilities, which could help to deal with ICT-specific demands.

The provision of support (from management as well as colleagues) when implementing new technologies was suggested as a way to prevent or reduce technostress (Berg-Beckhoff et al., 2017; Bruque, Moyano, & Eisenberg, 2008).

Leung (2011) found that boundary management skills, which can help to deal with negative spillover effects, can be trained. This is specifically necessary as spillover effects are increasingly becoming relevant due to new technologies and the continuous accessibility of employees for work-related messages. With regard to ICT-

specific demands and their consequences on well-being, boundary management skills should be considered as content for stress management trainings. Brivio and colleagues (2018) criticised that many interventions focusing on ICT-specific demands have been compensative instead of preventive and described positive technology as a way to prevent technostress and foster well-being. The underlying scientific approach, which has been proven to be very effective in causing positive transformation, is called positive psychology (e.g., Seligman & Csikszentmihalyi, 2000). Riva, Banos, Botella, Wiederhold, and Gaggioli (2012) proposed a combination of the opportunities of new technologies and the aims of positive psychology. They defined this so-called positive technology as "the scientific and applied approach to the use of technology for improving the quality of our personal experience" (Riva et al., 2012, p. 70). According to them, technology can be used to enhance positive emotions ("hedonic level", p. 72), to promote engagement and self-empowerment ("eudaimonic level", p. 72), and to promote social integration and connectedness ("social and interpersonal level", p. 74). With regard to the emotional quality on the hedonic level, they also described how anxiety can be reduced by general ICT trainings and the development of a culture of ICT use.

The fact that many traditional interventions are based on in-person trainings reduces the flexibility of participants to take part in such interventions, as they have to be physically present at the location of the training. ICTs can offer solutions for this and provide ways for a digital delivery of interventions independently of a location or specific time, which makes it easier for users to complete such trainings. First studies have found beneficial consequences of ICT-based interventions, which also provides support for the effectiveness of such digital trainings (e.g., Torp et al., 2008).

Due to the digitalisation it is necessary to take into account ICT-specific demands and consequences in general stress management interventions and preliminary evidence indicates that such trainings can be effective and beneficial for employee well-being (e.g., Hülsheger, Feinholdt, & Nübold, 2015; O'Driscoll et al., 2010).

6.3.3 Specific types of interventions

The approach of the study described in this chapter therefore is to preventively help people to cope with ICT-related demands and stressors by providing them with ICT-based exercises and interventions. In the following section, specific types of interventions and corresponding empirical findings will be introduced, which also have been used in Study 9.

6.3.3.1 Meditation intervention

According to a meta-analysis by Richardson and Rothstein (2008), meditation is among the most frequently used types of interventions. Meditation, relaxation, or deep-breathing interventions are described as ways to create a physiological state, which is contrary to stress and therefore beneficial for participants. For meditation, participants are instructed to either focus their attention and thoughts on one specific object or idea or to observe their environment in a distant way without engaging in it. Relaxation aims at controlling and releasing the tension of muscles and for breathing exercises participants are asked to consciously breathe deeply (Richardson & Rothstein, 2008). Meditation interventions are especially widespread in Eastern cultures, but Western approaches also include similar relaxation strategies (Glazer & Gasser, 2016).

Meditation has positive consequences on general well-being such as decreased anxiety and a more positive mood and feeling of well-being (Bellarosa & Chen, 1997). Frew (1974) documented an increase in job satisfaction and job performance among employees, who were actively engaging in transcendental meditation (two periods of 15-20 minutes per day). In his study, meditators also reported reduced turnover intentions and better interpersonal relationships. With regard to technostress as ICT-specific form of stress, Ennis (2005) stated that "relax, breathe, and stretch - that really does help" (p. 12).

Several intervention programs including mindfulness or meditation trainings have been investigated previously and a variety of positive consequences on well-

being were found. Kersemaekers and colleagues (2018) examined the effect of a workplace mindfulness training program named "WorkingMind" and detected improvements in measures of burnout, perceived stress, mindfulness, well-being, team cooperation, and productivity. Their intervention consisted of a two day-training and additional eight 2.5 hours sessions and was mainly designed as in-person training with groups of 12 to 25 participants. In addition, there were eight app-based audio recordings encouraging participants to practice on their own. Participants were asked to practice mindfulness for at least 10 minutes per day and there was a variety of formal and informal meditation practices included in the training (e.g., mindfulness meditation, walking meditation, body scan). Additionally, participants were asked to practice mindfulness in everyday life. Psychoeducational components were also part of the training to educate participants about the neurobiological response to stress and relaxation, the functioning of attentional networks, and the neurobiological foundations for emotions and resilience. Tang and colleagues (2007) conducted a longitudinal study in which participants were randomly assigned to a control group and an intervention group, which received five days of 20 minutes integrative training on meditation practice. The intervention group reported lower levels of negative feelings (anxiety, anger, fatigue, and depression) and even a significant decrease in stress-related cortisol and an increase in the physiological immune reaction were discovered.

Although many scholars investigated the effects of long-term meditation and extensive trainings, positive effects also have been found for shorter or on-the-spot interventions: Hülsheger et al. (2015) conducted a study examining the effects of a short mindfulness intervention and found positive consequences on sleep quality and duration, but not on psychological detachment. Hafenbrack (2017) examined on-the-spot mindfulness interventions, "in which an individual induces a state of mindfulness when it is needed in a specific workplace situation" (p. 118). They found that participating in such interventions can have both positive and negative consequences. Participants of such interventions reported less escalation of commitment, fewer

counterproductive workplace behaviours, altered performance in negotiations (improvements due to better self-regulation as well as impairments due to reduced anger, which might sometimes be beneficial) but also a lower motivation to achieve goals. The decrease in motivation was explained by the fact that mindfulness might promote a higher focus on the current status and less thinking about the future (Hafenbrack, 2016, 2017). They described three conditions for a successful on the spot meditation: Firstly, people need to be aware of the problem situation (e.g., being overly stressed). Secondly, people need to know about mindfulness as a tool. Hafenbrack (2017) considered physical awareness meditation as appropriate for on-the-spot meditation as it can help people to induce awareness. The last and third condition is the execution of the intervention.

Meditation exercises can improve well-being as they can be seen as recovery strategy, which was described by Demerouti (2015) as strategy to cope with work-related stress. As meditation can be seen as coping strategy helping people to deal with consequences of stress, it can also be considered as stress management intervention according to the framework by Ivancevich and colleagues (1990). Due to the positive consequences of mindfulness and meditation trainings on various indicators of well-being (reduction of self-rated stress and physiological stress measures, reduction of anxiety, better quality and longer duration of sleep, higher job satisfaction), which were found in previous studies, the following hypotheses are assumed:

Hypothesis 1: There will be a significant increase in the level of well-being of participants in the meditation intervention group compared to participants in the control group.

Hypothesis 1a: There will be a significant increase in the level of well-being (lower stress and strain, higher engagement and satisfaction) of participants in the meditation intervention group compared to participants in the control group.

Hypothesis 1b: There will be a significant increase in the level of recovery (higher detachment) of participants in the meditation intervention group compared to participants in the control group.

Hypothesis 1c: There will be a significant increase in the level of ICT-specific well-being (lower technostress creators, lower digitalisation anxiety, higher IT resilience) of participants in the meditation intervention group compared to participants in the control group.

6.3.3.2 Cognitive-behavioural intervention

Cognitive restructuring aims at educating people about the role of their own thoughts and emotions in the stress management process (Bellarosa & Chen, 1997). It is based on the assumption that emotions such as stress have a cognitive factor, which can be cognitively influenced and changed. Participants are supposed to learn about their personal style of thinking (e.g., negative thoughts), how this affects their behaviour, and how negative or irrational thoughts can be substituted by positive or rational ones. With regard to the stress process, specifically cognitions about stressful situations are of interest as changing the thoughts about such situations might also entail positive changes about the situation's appraisal and the corresponding stress level. Cognitive-behavioural strategies were mentioned by Glazer and Gasser (2016) as typical Western approaches for stress management interventions aimed at changing a person's way of thinking in a way, which is beneficial to cope with stress.

Although relaxation interventions were found to be used most frequently in a meta-analysis on general occupational stress management intervention by Richardson and Rothstein (2008), the largest effectivity gains were found for cognitive-behavioural interventions.

Positive effects of cognitive-behavioural interventions on mental health and work-related variables have been found e.g. by Bond and Bunce (2000), who examined an acceptance and commitment therapy, which was focused on enhancing the ability of participants to cope with work-related strain, as well as an innovation

promotion program aimed at helping individuals to identify and then modify sources of work-related strain. Self-efficacy is another factor that might be beneficial for technology acceptance and stress resulting from the use of ICTs. Shariatkhah, Farajzadeh, and Khazaee (2017) detected advantageous effects of their training of cognitive-behavioural stress management (eight two-hour sessions) on the stress level of participants. Chen et al. (2009) found that a resource workshop aiming at developing means efficacy, perceived control, and social support prior to the introduction of new technologies can buffer negative effects on IT satisfaction and exhaustion. A cognitive-behavioural intervention might also help people to become aware of means efficacy and perceived control.

Van Wingerden, Bakker, and Derks (2016) discovered that their job-demands-resources intervention, which consisted of three training sessions aiming at increasing personal resources and job crafting, positively affects work engagement and self-rated job performance. In one exercise of the training, participants were asked to learn to accept the past, appreciate the present, and consider the future as source of opportunities, which can also be seen as some kind of cognitive reappraisal.

The previously mentioned interventions did not specifically focus on ICTs, but Beas and Salanova (2006) conducted a study, which investigated the relationship between different levels of self-efficacy (generalised, professional, and computer self-efficacy), psychological well-being, and ICT training in a sample of ICT workers. Their study suggests that high levels of self-efficacy are beneficial for effectively dealing with stressors. They also found that only exposing people to computers does not increase self-efficacy, which might provide support for the need to apply more profound trainings (possibly also including cognitive reappraisal) in order to increase self-efficacy related to computers and ICTs.

In the cognitive-behavioural intervention participants are supported in reconsidering their experiences with ICTs and consequently changing their opinion on new technologies, which can be seen as job crafting strategy, which was suggested by Demerouti (2015) as strategy to cope with work stressors. As this type of

intervention is related to the cognitive appraisal of stressors it can also be considered as stress management intervention following the framework by Ivancevich and colleagues (1990) and therefore should have a beneficial effect on stress and well-being. Due to the positive consequences of cognitive-behavioural interventions on several well-being indicators (reduction of stress, higher work engagement and self-rated job performance, improved mental health), which previously have been found, the following hypotheses are derived:

Hypothesis 2: There will be a significant increase in the level of well-being of participants in the cognitive-behavioural intervention group compared to participants in the control group.

Hypothesis 2a: There will be a significant increase in the level of well-being (lower stress and strain, higher engagement and satisfaction) of participants in the cognitive-behavioural intervention group compared to participants in the control group.

Hypothesis 2b: There will be a significant increase in the level of recovery (higher detachment) of participants in the cognitive-behavioural intervention group compared to participants in the control group.

Hypothesis 2c: There will be a significant increase in the level of ICT-specific well-being (lower technostress creators, lower digitalisation anxiety, higher IT resilience) of participants in the cognitive-behavioural intervention group compared to participants in the control group.

6.3.3.3 Informational intervention

The development of competences in a specific area is among the interventions that were suggested by Ennis (2005) to reduce technostress. This can also be achieved by informational interventions providing knowledge on a certain topic (e.g., Gerhardt et al., 2016). Education and learning were mentioned as prerequisites for realising the potential of new technologies (Foresight Mental Capital and Wellbeing Project, 2008) and ICT literacy was listed as a basic skill among core work-related skill sets by the

World Economic Forum (2016), which also illustrates the need to develop this skill. It can be therefore concluded that an informational intervention aiming at providing information about ICTs and their use can increase well-being and decrease the perceived level of stress of participants. Additionally, ideas and suggestions for boundary management were included in the informational intervention, which therefore can be seen as strategy to create boundaries in order to prevent burnout, which was suggested by Demerouti (2015).

Informational support provided through advice, knowledge, or information on a certain topic has been found to be one possible form of supportive communication aiming at enhancing the well-being of another person (e.g., MacGeorge, Samter, & Gillihan, 2005). A review by Gerhardt et al. (2016) also revealed positive effects of informational interventions on various outcome types (mental and cognitive outcomes, emotional and motivational outcomes, interpersonal outcomes, work-related behaviour). As knowledge and education seem to be relevant for coping with ICT-related stressors, it can be assumed that the informational intervention is effective with regard to the participants' well-being and stress level:

Hypothesis 3: There will be a significant increase in the well-being level of participants in the informational intervention group compared to participants in the control group.

Hypothesis 3a: There will be a significant increase in the level of well-being (lower stress and strain, higher engagement and satisfaction) of participants in the informational intervention group compared to participants in the control group.

Hypothesis 3b: There will be a significant increase in the level of recovery (higher detachment) of participants in the informational intervention group compared to participants in the control group.

Hypothesis 3c: There will be a significant increase in the level of ICT-specific well-being (lower technostress creators, lower digitalisation anxiety, higher

IT resilience) of participants in the informational intervention group compared to participants in the control group.

6.4 Methods

An app-based study (Study 9)[19] was conducted in which participants were randomly assigned to one of four groups: meditation intervention, cognitive-behavioural intervention, informational intervention, and control group.

6.4.1 Sample

In total, 120 participants completed the initial and final survey, which were answered prior to and after the intervention period. Participants, who did not use the app at all (n = 19) as well as participants who missed more than three interventions (informational: n = 2, cognitive-behavioural n = 3, meditation: n = 1) were excluded. The final sample therefore consisted of 95 participants (control group: n = 28, cognitive-behavioural intervention: n = 22, meditation intervention: n = 23, informational intervention: n = 22). The majority of the sample was female (70.5%) and the mean age was 30.5 years (*Min* = 18 years, *Max* = 62 years). Participants worked in different branches (consulting: n = 17, IT: n = 10, research: n = 3, services: n = 13, automotive: n = 5, administration: n = 11, education: n = 11, energy: n = 2, chemistry: n = 1, other: n = 22). Employment was a prerequisite for participation and the mean working time was 34.0 hours per week (*Min* = 12 hours, *Max* = 50 hours). Participants reported different types of employment (employees: n = 63, self-employed: n = 3, working students: n = 12, interns: n = 9, other: n = 8).

[19] Study 9 was conducted in scope of a university seminar (Lehr-Forschungs-Projekt) in the Master program Economic, Organisational, and Social Psychology at the Ludwig-Maximilians-Universität München. Participating students: Clara Stegmaier, Laura Weidner, Vera Eger, & Amelie Hinrichs.

6.4.2 Procedure

After having signed up for the study, people received their individual participation code via e-mail as well as an introduction for downloading the app[20] for the study. They were asked to log in to the app with their individual code in order to start the study. On day 1, participants received a link to the initial questionnaire, which they had to complete online. On day 2, a reminder to complete the initial questionnaire was sent at 4 pm and the first intervention took place at 6 pm. On every intervention day, participants received a push notification at 6 pm on their mobile phone asking them to open the app and follow the instructions. There were three consecutive reminders after 30 minutes, 1.5 and 2.5 hours and it was possible to complete the intervention within six hours. Afterwards, the intervention was categorised as missed. The interventions took place on days 2, 4, 6, 8, 10, and 12. On day 13, participants were asked to complete the final questionnaire online and a reminder for this was sent on day 14. Figure 23 illustrates an overview of the study procedure.

Procedure of study:
Day 1: Initial questionnaire (online)
Day 2: Reminder for initial questionnaire and first intervention
Day 4: Second intervention
Day 6: Third intervention
Day 8: Fourth intervention
Day 10: Fifth intervention
Day 12: Sixth intervention
Day 13: Final questionnaire (online)
Day 14: Reminder for final questionnaire

Figure 23. Overview of the study procedure.

[20] Screenshots of the app can be found in Annex F.

As already described, participants were assigned to one of four groups: three intervention groups and one control group.

1. Meditation intervention. The meditation intervention consisted of a short definition of mindfulness at the beginning combined with a link to a video with a guided meditation, which the participants should go through (Minddrops, 2019).[21] Participants were also asked whether they completed the exercise (yes, partly, no) and in the case of partly or not, why they just partly or not finished it.

2. Cognitive-behavioural intervention. In the cognitive-behavioural intervention, participants were asked to state three positive experiences, which occurred on this day in association with the use of new technologies (mobile phones, computer, etc.) ("Please fill in your first/second/third positive experience that occurred to you today"[22]). They were instructed that these experiences can appear usual (e.g., "I have quickly answered an e-mail") or can be of high importance for them (e.g., "I have learnt a new computer software"). The experiences can but do not necessarily have to be directly related to their work. Afterwards, participants were asked to state why this positive experience happened to make them further think about this experience ("Why did the first/second/third positive experience with new technologies happen?"[23]). They also had to state whether they were able to answer the questions (yes, partly, no) and in the case of partly or no, why they were just able to partly/not answer the questions.

3. Informational intervention. In the informational intervention, participants received one statement per intervention with information that can be helpful for dealing with technology-related demands. They were also asked to rate whether the information was helpful (yes, partly, no) and in the case of partly or not, why it was just

[21] The video, which was provided on a public video platform, was deleted and reuploaded during the study period. Therefore, the affected participants received an e-mail containing the new link.
[22] Original German instruction: „Trage im folgenden Feld bitte das erste/zweite/dritte positive Erlebnis ein, das Dir heute passiert ist."
[23] Original German instruction: „Warum kam es zu dem ersten/zweiten/dritten positiven Ereignis mit neuen Technologien?"

partly or not helpful. Exemplary statements[24] were "Setting oneself personal goals concerning the use of technical tools (e.g. not checking work-related messages before 8 am in the morning) can help to reduce stress and increase well-being." or "Did you know that most of the mobile phones have a 'Do not disturb'-feature? During leisure time activating this feature (especially for messages related to work) can lead to an improved ability to detach from work. This can improve your mood and decrease tiredness."

4. Control group. Participants in this group only received four questions on work, stress, well-being, and detachment in the app during the intervention period.

After the end of the study, all participants were asked whether they want to receive information about the other groups after the study to comply with the requirement of equally treating all participants and avoiding advantages for some participants due to their assignment to a specific intervention group.

6.4.3 Measurement

An overview of all scales and items, which were used in this study, can be found in Annex D.

6.4.3.1 Online questionnaire

Well-being: Stress and strain and engagement and satisfaction. As well-being is described as a multi-dimensional construct including psychological, physical, and social aspects (e.g., Grant et al., 2007), stress and strain as negative and engagement and satisfaction as positive well-being indicators were integrated in the questionnaires.

Stress and strain. 11 items covering several aspects of stress and strain, which were already used in previous studies (Studies 5, 6, 7, and 8) were integrated in the questionnaires (initial questionnaire: Cronbach's α = .90, final questionnaire:

[24] All statements can be found in Annex G.

Cronbach's α = .91). All items were answered on a 5-point Likert scale indicating the level of agreement (1 = *do not agree at all*, 5 = *fully agree*).

Engagement and satisfaction. Six items, which were also used in Studies 6, 7, and 8 for measuring engagement and satisfaction, were also included in the questionnaires (initial questionnaire: Cronbach's α = .80, final questionnaire: Cronbach's α = .84). All items were answered on a 5-point Likert scale indicating the level of agreement (1 = *do not agree at all*, 5 = *fully agree*).

Recovery: Detachment. In order to investigate recovery, the questionnaires contained four items on detachment (see also Studies 5 and 8, initial questionnaire: Cronbach's α = .89, final questionnaire: Cronbach's α = .92, e.g., "I forget about work", Sonnentag & Fritz, 2007), which is seen as crucial aspect helping employees to recover from job demands and which is positively related to aspects of well-being such as mental health (Wendsche & Lohmann-Haislah, 2017).

ICT-specific well-being: Technostress creators, digitalisation anxiety, IT resilience. As the intervention was focused on technology and technostress, items on ICT-specific well-being, namely technostress creators and digitalisation anxiety as negative indicators and IT resilience as positive indicator were integrated as well.

Technostress creators. In the questionnaires, 25 items on technostress creators (see also Studies 6 and 8) were included (initial questionnaire: Cronbach's α = .89, final questionnaire: Cronbach's α = .92, Ragu-Nathan et al., 2008 and Ayyagari et al., 2011, items were answered on a 5-point Likert scale indicating the level of agreement (1 = *do not agree at all*, 5 = *fully agree*)).

Digitalisation anxiety. In the questionnaires, 35 items of the DAS, which was introduced in Chapter 4.3 and which was also used in Studies 7 and 8, were part of the questionnaire (initial questionnaire: Cronbach's α = .94, final questionnaire: Cronbach's α = .96, Pfaffinger et al., 2019 and Pfaffinger, Reif, Huber, et al., 2020) covering the aspects general (15 items, e.g., "I am concerned about digital systems not being secure enough"), self (8 items, e.g., "I worry that I won't be able to keep up due to digitalisation"), interaction and leadership (7 items, e.g., "I am afraid that a

robot could be my next coworker due to digitalisation"), and implementation (5 items, e.g., "I am concerned about digitalisation as employees are not incorporated in the changes"). The items were answered on a 6-point Likert scale indicating the level of agreement (1 = *not correct at all*, 6 = *totally correct*).

IT resilience. Additionally, 30 items on IT resilience by Klesel, Narjes, and Niehaves (2018) were part of the questionnaires (initial questionnaire: Cronbach's α = .90, final questionnaire: Cronbach's α = .91, e.g. "In situations where stress is caused by technology in general or technology use, I tend to bounce back quickly", items were answered on a 5-point Likert scale indicating the level of agreement (1 = *do not agree at all*, 5 = *totally agree*)).

Control variables. Age, gender, nationality, type of employment, sector, and weekly working hours were also examined in the initial questionnaire. Since participants of this study were German speaking, all scales, which were originally in English, were translated into German.

6.4.3.2 App

On intervention days, the app also tracked whether participants were working on the specific day ("Did you work today?", answered with yes or no). Additionally, single items on stress ("Stress means a situation in which a person feels tense, restless, nervous or anxious or is unable to sleep at night because his/her mind is troubled all the time. Do you feel this kind of stress these days?", Elo, Leppänen, & Jahkola, 2003), detachment ("To what extent have you been able to mentally detach from your work today in your leisure time?", based on Sonnentag & Fritz, 2007), and satisfaction with life ("To what extent do you agree with the following statement: All in all, I am satisfied with my life", based on Diener, Emmons, Larsen, & Griffin, 1985) were included in the app. The questions were all answered on a 5-point Likert scale indicating the level of agreement ranging from 1 = *not at all* to 5 = *to a very great degree*.

6.4.4 Data analysis

Due to the multilevel structure of the data (different points of time nested in persons) multilevel hierarchical analyses were calculated to examine the effectiveness of the interventions.

Separate analyses were calculated for each intervention group and compared to the control group. For each dependent variable, time (for dependent variables from questionnaires: 0 = *initial questionnaire* as pre-intervention measure, 1 = *final questionnaire* as post-intervention measure; for dependent variables from app: 0, 1, 2, 3, 4, 5 for the six measurement points in the app) and group (0 = *intervention group*, 1 = *control group*) as predictors and age (grand-mean-centred) and gender as control variables were included. An overview of the variables included in the analyses can be found in Figure 24. Random intercept and fixed slopes models were calculated and the recommendation to keep the model as simple as possible and identifiable in spite of the small sample was complied with (e.g., Kass et al., 2016).

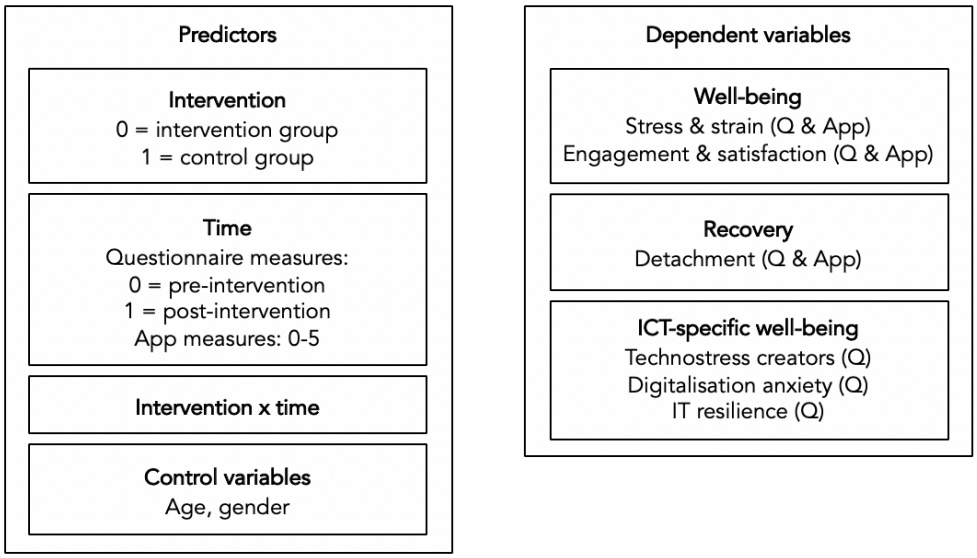

Figure 24. Overview of variables included in the analyses; Q = variable measured in the questionnaires; App = variable measured with one item in the app.

Due to the fact that the power to detect cross-level interactions in multilevel designs has been found to be low as parameter reliability might be reduced (Mathieu, Aguinis, Culpepper, & Chen, 2012; Snijders & Bosker, 1999), the suggestion of other scholars to apply a higher Alpha level of 10% for testing cross-level interaction effects was incorporated (Hülsheger et al., 2015; Yeo & Neal, 2004). In spite of possible consequences on the type 1 and type 2 errors, a more liberal Alpha level has been described to be rational for early research in new fields, which holds true for the field of research of this study (Mathieu et al., 2012). After conducting the multilevel analysis, simple slopes analyses were used to further investigate the effects of time for the different groups.

6.5 Results

The results of the conducted analyses will be reported in the following sections.

6.5.1 Descriptive results

The descriptive results are depicted in Table 8.

6.5.2 Meditation intervention (Hypothesis 1)

The findings for the meditation group are depicted in Tables 9 and 10. With regard to Hypothesis 1, the interaction effect of time and condition was significant on an Alpha level of 10% for detachment measured in the questionnaire (coef. = -.368, p = .064) and for satisfaction measured in the app (coef. = -.057, p = .069). This means that the slope of time is significantly lower for the control group than for the intervention group and that the increase in satisfaction and detachment over time is significantly higher in the intervention group compared to the control group. Simple slope analysis showed for detachment that the slope of time for the intervention group also significantly differs from 0 (coef. = .250, p = .086) whereas the slope of time for the control group does not. The same holds true for satisfaction (coef. = .041, p = .065). The findings provide support for Hypothesis 1b (*There will be a significant increase in the level of recovery (higher detachment) of participants in the meditation intervention group compared to participants in the control group*) and partly support Hypothesis 1a (*There will be a significant increase in the level of well-being (higher engagement and satisfaction) of participants in the meditation intervention group compared to participants in the control group*). It can therefore be concluded that the meditation intervention seems to increase the detachment (measured in the questionnaires) and satisfaction (measured in the app) of users.

Table 8

Descriptive results of variables in the online questionnaires

	1	2	3	4	5	6	7	8	9	10	11	12
1 Stress t1	.90											
2 Stress t2	.87**	.91										
3 Satisfaction t1	-.65**	-.54**	.80									
4 Satisfaction t2	-.62**	-.64**	.73**	.84								
5 Detachment t1	-.48**	-.49**	0.18	0.16	.89							
6 Detachment t2	-.53**	-.63**	.21*	.38**	.74**	.92						
7 Technostress Creators t1	.57**	.54**	-.42**	-.40**	-.51**	-.51**	.89					
8 Technostress Creators t2	.52**	.63**	-.44**	-.48**	-.48**	-.57**	.82**	.92				
9 Digital Anxiety t1	.35**	.35**	.,21*	-.30**	-.27**	-.35**	.42**	.36**	.94			
10 Digital Anxiety t2	.30**	.35**	.,21*	-.35**	-.27*	-.34**	.38**	.41**	.85**	.96		
11 IT Resilience t1	-.59**	-.50**	.54**	.53**	.35**	.38**	-.58**	-.54**	-.53**	-.45**	.90	
12 IT Resilience t2	-.55**	-.57**	.44**	.53**	.38**	.48**	-.51**	-.57**	-.54**	-.58**	.85**	.91
M	2.22	2.28	3.53	3.57	3.13	3.24	2.25	2.30	3.00	3.03	3.57	3.65
SD	.76	.79	.58	.63	.96	1.02	.49	.54	.74	.81	.44	.46
N	92	95	92	95	92	95	92	95	92	95	92	95

Note. The diagonal line of the correlation table shows the scales' Cronbach's Alpha value as measure for the scales' internal reliability; t1 = pre-intervention questionnaire, t2 = post-intervention questionnaire, *M* = Mean Value, *SD* = Standard Deviation, *N* = Number of answers. ** $p < .01$, * $p < .05$.

Table 9

Multilevel models predicting outcome variables measured in the initial and final questionnaire for comparison of meditation group and control group

	Detachment (Q)	Stress (Q)	Digital Anxiety (Q)	Techno-stress (Q)	IT Resilience (Q)	Satisfaction (Q)
Fixed effects						
Intercept	3.817***	1.663***	2.631***	2.078***	3.851***	3.527***
Gender	-.685**	.573**	.436*	.150	-.374***	-.045
Age	-.008	.002	.011	-.003	-.005	.009
Time	.250*	.060	-.038	-.002	.112**	.144
Condition	-.189	.365	.200	.162	-.074	-.093
Time x Condition	-.368*	-.079	.071	.047	-.067	-.207
Random effects						
Intercept	.543	.530	.572	.264	.173	.246
Residual	.234	.086	.101	.054	.030	.134

Note. N = 100 observations nested in 50 groups (participants); Q = measured in the initial and final questionnaire; Condition: 0 = intervention group, 1 = control group; Time: 0 = pre-intervention, 1 = post-intervention. *** $p < .01$, ** $p < .05$, * $p < .10$.

Table 10

Multilevel models predicting outcome variables measured in the app for comparison of meditation group and control group

	Detachment (App)	Stress (App)	Satisfaction (App)
Fixed effects			
Intercept	4.195***	2.269***	4.061***
Gender	-.466**	.467	-.362
Age	-.016**	.003	.003
Time	-.034	-.046	.041**
Condition	-.116	.068	-.061
Time x Condition	-.046	.057	-.057*
Random effects			
Intercept	.190	.491	.487
Residual	.829	.454	.175

Note. N = 262 observations nested in 49 groups (participants); Condition: 0 = intervention group, 1 = control group; Time: 0-5. *** $p < .01$, ** $p < .05$, * $p < .10$.

6.5.3 Cognitive-behavioural intervention (Hypothesis 2)

Tables 11 and 12 show the results for the cognitive-behavioural group. With regard to Hypothesis 2, the interaction effect of time and condition was significant on an Alpha level of 10% for stress measured in the app (coef. = .100, p = .057). This means that the slope of time is significantly higher for the control group than for the intervention group and that the decrease in stress over time is significantly higher in the intervention group compared to the control group. Simple slope analysis showed that the slope of time for the intervention group also significantly differs from 0 (coef. = -.089, p = .020) whereas the slope of time for the control group does not. The findings provide partly evidence for Hypothesis 2a (*There will be a significant increase in the level of well-being (lower stress and strain) of participants in the cognitive-behavioural intervention group compared to participants in the control group*). Consequently, the cognitive-behavioural intervention seems to decrease the participants' stress level measured in the app.

Table 11

Multilevel models predicting outcome variables measured in the initial and final questionnaire for comparison of cognitive-behavioural intervention group and control group

	Detachment (Q)	Stress (Q)	Digital Anxiety (Q)	Techno-stress (Q)	IT Resilience (Q)	Satisfaction (Q)
Fixed effects						
Intercept	3.478***	1.938***	2.583***	2.050***	3.700***	3.563***
Gender	-.505*	.464**	.340	.132	-.251**	-.054
Age	-.019**	.007	.012	.003	-.008*	-.002
Time	.202	.040	.136	.137*	.115*	.017
Condition	.023	.174	.323	.193	-.018	-.102
Time x Condition	-.314	-.064	-.107	-.092	-.066	-.081
Random effects						
Intercept	.529	.551	.479	.206	.143	.251
Residual	.257	.064	.121	.049	.040	.112

Note. N = 96 observations nested in 48 groups (participants); Q = measured in the initial and final questionnaire; Condition: 0 = intervention group, 1 = control group; Time: 0 = pre-intervention, 1 = post-intervention. *** $p < .01$, ** $p < .05$, * $p < .10$.

Table 12

Multilevel models predicting outcome variables measured in the app for comparison of cognitive-behavioural intervention group and control group

	Detachment (App)	Stress (App)	Satisfaction (App)
Fixed effects			
Intercept	3.953***	2.583***	4.176***
Gender	-.346	.193	-.532**
Age	-.020**	.005	-.005
Time	.019	-.089**	.031
Condition	.035	-.024	-.032
Time x Condition	-.102	.100*	-.046
Random effects			
Intercept	.262	.419	.469
Residual	.840	.492	.199

Note. N = 251 observations nested in 47 groups (participants); Condition: 0 = intervention group, 1 = control group; Time: 0-5. *** $p < .01$, ** $p < .05$, * $p < .10$.

6.5.4 Informational intervention (Hypothesis 3)

In Tables 13 and 14 the results for the informational intervention group are shown. With regard to the hypotheses on the informational intervention, the interaction effect of time and condition was significant on an Alpha level of 5% for stress measured in the questionnaire (coef. = -.229, p = .030). This means that the slope of time is significantly lower for the control group than for the intervention group. Interestingly, the simple slope analysis showed that in the intervention group, the stress level increased (slope time: coef. = .198, p = .013). The findings therefore contradict Hypothesis 3a (*There will be a significant increase in the level of well-being (lower stress and strain) of participants in the informational intervention group compared to participants in the control group*) and it seems that the provision of information was stressful for participants.

Table 13

Multilevel models predicting outcome variables measured in the initial and final questionnaire for comparison of informational intervention group and control group

	Detachment (Q)	Stress (Q)	Digital Anxiety (Q)	Techno-stress (Q)	IT Resilience (Q)	Satisfaction (Q)
Fixed effects						
Intercept	3.032***	1.844***	2.840***	2.258***	3.808***	3.714***
Gender	-.083	.243	.306	.039	-.143	.028
Age	.004	-.006*	.013	-.005	.003	.014*
Time	.048	.198**	-.052	.051	.045	.096
Condition	.084	.468*	.093	.075	-.232	-.348*
Time x Condition	-.143	-.229**	.080	-.010	.009	-.157
Random effects						
Intercept	.594	.564	.383	.209	.187	.267
Residual	.205	.061	.075	.047	.038	.105

Note. N = 96 observations nested in 48 groups (participants); Q = measured in the initial and final questionnaire; Condition: 0 = intervention group, 1 = control group; Time: 0 = pre-intervention, 1 = post-intervention. *** $p < .01$, ** $p < .05$, * $p < .10$.

Table 14

Multilevel models predicting outcome variables measured in the app for comparison of informational intervention group and control group

	Detachment (App)	Stress (App)	Satisfaction (App)
Fixed effects			
Intercept	3.669***	2.511***	4.006***
Gender	-.305	.101	-.139
Age	-.012	-.006	.002
Time	-.005	.032	-.012
Condition	.275	.134	-.186
Time x Condition	-.076	-.022	-.003
Random effects			
Intercept	.199	.356	.452
Residual	.958	.482	.186

Note. N = 256 observations nested in 47 groups (participants); Condition: 0 = intervention group, 1 = control group; Time: 0-5. *** $p < .01$, ** $p < .05$, * $p < .10$.

6.5.5 Exploratory analyses

In addition, it was exploratively examined whether participants, who only answered the initial questionnaire but did not complete the final questionnaire and therefore dropped out of the study, significantly differed from the participants, who completed both questionnaires. Especially with regard to the findings in the informational intervention, which seemed to increase the stress level, it could be a possibility that participants, who were already very stressed at the beginning of the study, did not complete the study as the ongoing reminders and requests to open the app were further stressors for them and participating in the study was too time consuming for them. T-tests were calculated to compare the two groups with regard to their levels of stress, satisfaction, detachment, technostress creators, digital anxiety, age, working hours, and IT resilience in the initial questionnaire but no significant differences were found.

6.6 Discussion

In Study 9 beneficial consequences of the meditation as well as cognitive-behavioural intervention were found: detachment and satisfaction were increased through the meditation intervention and the stress level was decreased through the cognitive-behavioural intervention. This generally provides evidence for the possibility to improve well-being of employees through low-dose app-based interventions. The provision of information within the informational intervention seemed to be stressful for participants, which also hints at the need to further examine which types of interventions are beneficial for employees and which measures could even impair their situation.

Interestingly, the cognitive-behavioural intervention reduced stress measured in the app but not in the general stress level measured in the questionnaire. The tendency for stress measured in the questionnaire even goes in the opposite direction: although no effects were significant, the slope for time in the experimental group was .040 and the slope of time for the control group (interaction effect time x

condition) was -.064 lower. This finding indicates that – at least from a descriptive perspective – as opposed to the experimental group there is a decrease in stress for the control group. It needs to be emphasised that no effects were significant and therefore it is not possible to interpret this result, but this finding should be further examined in future studies. In the app, stress was measured directly after the intervention, which is in line with other studies in which the measurement took place shortly after the intervention (e.g., Rasquin, van de Sande, Praamstra, & van Heugten, 2009; van Mersbergen, 2012). One possible explanation for the finding regarding the lower time slope for the control group could be that the intervention maybe entailed short-term consequences, which did not maintain for a longer period of time and therefore no effect was found in the end questionnaire as this took place at least one day after the last intervention. In order to also entail long-term consequences in the general stress level it could be necessary to continue the intervention for a longer period of time or increase its strength and dose.

Furthermore, apart from the positive effect on detachment and satisfaction, no stress reducing effect of the mindfulness intervention was found in Study 9. This contradicts prior findings on beneficial effects on negative well-being aspects (e.g., Tang and colleagues, 2007). The intervention seems to foster positive feelings but does not entail a decrease in negative feelings such as stress. Those findings might be in line with the proposed effect of job resources in the Job Demands-Resources Model by Bakker and Demerouti (2007) in which the motivational process describes how job resources can potentially increase work engagement and performance (see also Chapter 2.2).

As the interventions aimed at reducing ICT-specific demands and their consequences, a positive effect of the intervention on ICT-specific well-being aspects (technostress creators, digitalisation anxiety, or IT resilience) was hypothesised, which was not found in Study 9. This could be due to the fact that all ICT-specific well-being indicators were only assessed in the initial and end questionnaire but not in the interventions every two days. The positive effect of the meditation intervention was

also just found for satisfaction measured in the app (indicating a short-term effect) but not in the questionnaires (indicating no long-term effect). Future studies therefore should also include ICT-specific well-being measures in the app interventions to also investigate possible short-term effects. Nevertheless, it seems that it was possible to take effect on the general well-being of the participants through the ICT-specific interventions.

Contrary to the hypotheses, the informational intervention seemed to be counterproductive for the intervention group as the stress level even increased through the intervention and the slope of the control group was significantly lower than the slope of the intervention group (indicating that in the control group the stress level decreased significantly different from the intervention group). One possible explanation could be that the informational intervention further contributed to the participants' stressors and demands. Information overload as very common stressor (Wohlers & Hombrecher, 2016) could have been increased through the informational intervention as this intervention also consisted of information. Participants might rather need advice on how to cope with information and not more information, even if this information was intended to be helpful and supportive. The informational intervention therefore has to be redesigned for future studies in order to make it more beneficial and supportive. Milligan (2016) suggested practical measures (e.g., turning off online messaging tools when not at work, answering e-mails after work only on computers, but not on smartphones) that can help people to set boundaries, which was also described as beneficial for well-being (e.g., Demerouti, 2015). More practical measures like that could be used as informational statements for future studies as they might be more action-oriented and feasible for employees.

"Digital Detox" has been recently termed as popular trend describing a conscious renunciation of the use of technological devices (e.g., Kutsche, 2020). Possibly, the study was generally counterproductive for such efforts as participants had to use their mobile phones to take part in the study. The exposure to ICTs therefore might have been negative and stressful for participants. Previous research

also found that in some cases, computer training can be associated with negative consequences for well-being (e.g., Salanova et al., 2000).

Nevertheless, the findings of Study 9 provide first empirical support for beneficial consequences of an app-based meditation as well as a cognitive-behavioural intervention on several well-being indicators. Due to the fact that the intervention was very low dosed, time-saving, and flexible for participants, this could provide hints for future interventions aiming at reducing negative consequences of ICT-specific demands on the well-being of employees, which are cost-efficient and easy to use and implement.

6.6.1 Limitations

The study contained several limitations, which have to be taken into account when analysing and interpreting the results.

Firstly, only subjectively rated measures were included in the study. Tang, Hölzel, and Posner (2015) criticised that stress reducing effects of mindfulness trainings mostly have been found for self-rated stress measures. According to them, the findings for physiological indicators (e.g., cortisol level) of stress are less consistent. Therefore, it could be interesting to include objective physiological measures in future studies to further examine biological consequences of the interventions. Riedl et al. (2012) found that technostress through IT problems such as a system breakdown also comes along with higher cortisol levels, which could be investigated as physiological and objectively measurable outcome variable.

Secondly, the sample size of $n = 95$ was quite small due to the difficulty to recruit participants for a longitudinal study and the high effort, which is related to taking part in such a study. From 198 participants, who completed the initial survey, only 120 also finished the final survey, indicating a drop-out rate from 39.39%. Additionally, people who did not use the app and therefore were not able to be affected by the interventions had to be excluded, which entailed a further reduction of the sample size. The time frame to complete the individual interventions was limited to six hours.

After this time frame, the intervention was considered as missed and this also might have made it hard for participants to diligently participate in every single intervention. The interventions should be tested in bigger samples in future studies and it could be an idea to also collaborate with organisations allowing their employees to participate in the study within their working hours.

Thirdly, technical problems also have to be seen as limitations. As the app sent notifications to remind participants of the individual interventions in the app it was necessary that participants allowed those reminders in their settings, but it was not possible to control whether all participants actually did this. Some participants also mentioned technical issues with these reminders. Additionally, the link to the video, which was used for the meditation intervention, changed during the study period and participants, who were currently participating in the study, were informed via e-mail about the new link. In this case it was also not possible to track whether they actually used the new link and completed the meditation exercise.

Fourthly, very small effects were found and using the higher Alpha level of 10% entails a higher risk to find an effect although there is no effect in truth. In such cases, the null hypothesis is rejected although it is true (Gravetter & Wallnau, 2009). However, due to the already mentioned difficulty to detect cross-level interactions in multilevel designs and the fact that the study was conducted in a new field of research, an Alpha level of 10% seemed appropriate for this study (Hülsheger et al., 2015; Mathieu et al., 2012; Snijders & Bosker, 1999; Yeo & Neal, 2004).

Fifthly, the short duration of the study (two weeks) also needs to be considered as limitation and also as possible reason why not more or larger effects were found. It could be interesting to examine how the further development of the investigated variables would be, if the study period was longer.

In spite of the limitations, the exploratory focus of the study and the results provide hints for theoretical implications, for future study designs, and also for practical interventions. Furthermore, this study took into account some of the recommendations for future studies mentioned by Glazer and Gasser (2016),

specifically the inclusion of a control group, the existence of a strong theoretical background for the effectivity of the interventions, and the request to precisely describe the intervention to make it replicable for other scholars.

6.6.2 Theoretical implications

The findings on the meditation intervention (beneficial effect on detachment measured in the questionnaire and satisfaction measured in the app) are in line with prior findings on positive consequences of meditation or mindfulness interventions (e.g., Bellarosa & Chen, 1997; Frew, 1974; Hafenbrack, 2017; Kersemaekers et al., 2018). The findings of Hülsheger et al. (2015), who did not discover an effect of a short mindfulness intervention on psychological detachment, were extended as such an effect was found in Study 9.

The findings on the positive effect of the cognitive-behavioural intervention on the stress level are in line with prior findings by Bond and Bunce (2000) as well as findings mentioned in the meta-analysis by Richardson and Rothstein (2008).

The results on the counterproductive effect of the informational intervention contradict prior findings on positive effects of education e.g. by Kersemaekers and colleagues (2018), whose training also included psychoeducational components and who found positive effects of their training on well-being. Nevertheless, there are also scholars reporting mixed or no significant findings on informational interventions: In a review by Gerhardt et al. (2016), there was only a small number of significant effects for informational interventions compared to other interventions (mindfulness, cognitive-behavioural interventions) and some effects also indicated the reverse direction, which also goes in line with the findings of this study. Rogers and Barber (2019) investigated the consequences of an educational intervention on telepressure, technology engagement, and sleep and also were not able to find any significant effect. Their assumed explanation was that the behaviour of people suffering from telepressure does not depend on missing awareness of the problem or information about it, but on other reasons. Jones and Bodie (2014) introduced the person-centred

theory of supportive communication, which could be seen as possible explanation for the counterproductive effect that was found as they highlight the necessity to take into account the feelings and needs of the communication partner. Maybe the informational statements in the app should have been chosen more individualised in order to ensure a match with the real needs of the individual users.

Other possible explanations for mixed findings could be mediating or moderating effects, which were not investigated in this study. Possible third variables influencing the effectiveness of meditation as tool to reduce stress and enhance well-being are relaxation, mastery, and detachment as mediators, and intrinsic motivation as moderator (van Hooff & Baas, 2013).

6.6.3 Practical implications

The findings of this study provide empirical support for the effectiveness of a low-dose app-based mindfulness or cognitive-behavioural intervention, which can be used for trainings aiming at enhancing employee well-being and reducing negative consequences of ICT-specific demands.

Various scholars call for a combination of various components in trainings and stress management interventions. Beas and Salanova (2006) recommended that such trainings should include a variety of components, which are consistent with theoretical cues for self-efficacy building such as enactive mastery, coaching, and encouragement. Consequently, the interventions of this meditation and cognitive-behavioural exercises should be combined with other forms of training, which could be beneficial for a multi-component stress management training.

There are also other resources and coping mechanisms that were found to be effective for coping with stress, which can hardly be provided through an app e.g. social support (e.g., Knani, 2013) or a supportive organisational culture (e.g., Bruque et al., 2008; Milligan, 2016; Wang et al., 2008). The interventions of this study were purely app-based and therefore characterised as being very low-dosed without any in-person contacts. These interventions therefore can only be seen as addition to

holistic stress and health management concepts, which also include in-person trainings.

Nevertheless, the findings on the cognitive-behavioural or meditation interventions and the beneficial consequences on detachment, satisfaction, and stress provide first empirical hints for their effectivity and imply that it makes sense to include them.

Furthermore, interventions on an individual level are not enough and they need to be combined with organisational level interventions (e.g., Tetrick & Winslow, 2015). Milligan (2016) described the change of the organisational culture regarding working hours in an American based tax preparation company. While the culture was very work- and presenteeism-oriented at the beginning, there was a shift to a more employee and collaboration friendly culture with a goal-oriented reward system enabling more flexible working hours. This culture shift entailed better retention rates and a higher efficiency in the company. Milligan (2016) also mentioned some other companies, which have established similar measures (e.g., extending parental leave opportunities, offering remote working options, flexible working times and even unlimited vacation). Wang et al. (2008) found that an organisational culture of innovation as well as the extent of power centralisation influence the level of technostress: The extent of power centralisation as well as an organisational culture of innovation both seem to be positively related to the level of employee technostress. According to them, innovation oriented organisational cultures are characterised by more frequent technological changes, which can be seen as causes for technostress. Power centralisation might increase technostress by reducing possibilities to take part in decision-making processes about the introduction and implementation of new technologies. This lack of control, which was also described as possible reason for digitalisation anxiety in Chapter 4.2, might entail a perceived inability to cope with ICT-specific demands and therefore cause higher technostress levels. Interventions focusing on ICT-specific demands consequently might be especially important and relevant for more centralised or innovative organisations.

The four-level model of health-promoting leadership by Spieß and Stadler (2016) also shows how leadership can generally impact the well-being and health of employees on four levels: (1) goal and task orientation, (2) employee orientation, (3) organisation of work and organisational processes, and (4) creation of health-promoting management and organisational structure. This model also offers examples for possible health-promoting actions and measures on different levels such as the involvement and participation of employees or the creation of health consciousness. Those interventions also could be adapted with regard to new demands resulting from digitalisation and the model could provide a framework for deriving leadership actions to further promote well-being.

Yun et al. (2012) dealt with the "[u]se of job-provided or personally owned smartphones at work and at home" (p. 121), also described as office-home smartphones. According to them, the organisational atmosphere as well as a type of peer pressure encouraging separation of personal life from work can help to decrease work-to-life conflict (which has been found to be a powerful antecedent of job stress). They concluded that organisations can decrease negative effects of office-home smartphones by promoting an organisational culture supporting the segmentation of work and attempting to minimise work-to-life conflict and its consequences. Milligan (2016) also highlighted the responsibility of organisations to ensure time for relaxation and recovery for their employees and suggested measures such as banning e-mails (or at least sending and receiving them) during specific time frames, time-trackers, which allow employees to monitor their vacation time, or conversations to encourage people, who never take some time off, to make use of their vacation time. Ensuring that employees know what is expected, setting examples at the top management level (e.g., avoiding to send e-mails very late or early or during weekends or vacation time, taking time off), and including discussions about taking time off in the annual performance talks could be further useful organisational examples (Milligan, 2016). Tetrick and Winslow (2015) reported growing evidence for the fact that organisational interventions, especially when combined with individual-level interventions, can be

quite effective in promoting a positive and healthy work environment. It could therefore be beneficial to include ICT-specific interventions such as the app-based meditation or cognitive-behavioural interventions, which were used in Study 9, in holistic organisational stress and health management concepts and it would be interesting to examine the incremental effect of app-based trainings as addition to existing stress management interventions.

Trinczek (2011) highlighted the fact that flexibility is subjective and might not be the best option for everybody. Management by objectives (supervisors and employees jointly set a goal and the way to reach the goal is up to the employee) as form of subjectivation of work is welcomed by some employees, who are motivated by the possibility to work in a self-organised way, but other employees might have problems with it and favour a more structured and predefined work. There might also be a tendency for self-exploitation associated with this way of management. As it is the case with flexibility, it also could be necessary or beneficial to further adapt the interventions and individualise them to align them with the individual needs and expectations of employees. Milligan (2016) also requested to "[b]e flexible about flexibility" (p. 36) as the meaning of and wish for flexibility might vary between employees. The flexibility coming along with app-based interventions could be advantageous for some employees, but others might favour more structured interventions. This also calls for the combination of several training approaches from which employees can select and choose individually. The interventions, which were tested in this study, can be part of such a support offer targeting people, who want to flexibly incorporate stress management components in their everyday life.

Generally, it also has to be noted that organisational interventions can be hard to implement if employees are spending less time at their workplace due to higher flexibility regarding the location of work (Cox & Fletcher, 2014). As digitalisation enables such a higher local flexibility for work, the scope of influence for organisations to manage organisational safety and health at work is reduced if employees spend less time at their official workplace within the organisation (Cox & Fletcher, 2014).

App-based interventions therefore could be effective ways for organisations to keep in touch with their employees and to provide them with stress management interventions.

6.7 Conclusion

In general, it is necessary to react to digitalisation, which is accompanied by new demands calling for new forms of stress management and interventions. Therefore, new interventions, which also take into account those new developments, have to be developed and tested empirically. In the previously introduced study, a first approach for an app-based intervention was investigated and the findings indicate that in spite of the short study period, the meditation and cognitive-behavioural interventions seem to be beneficial for employee well-being. Nevertheless, the interventions need to be further examined in order to find explanations for mixed findings and also for the counterproductive effect of the informational intervention.

Organisations only have a limited scope of action and stress management interventions always also require the motivation and engagement of employees themselves. As a result of the increasing tendency for flexible forms of works (e.g., home-office or telework), the scope of action for organisations might further decrease and more remote forms of stress management interventions will become necessary. The app-based interventions, which have been tested, therefore could be a possible way to reach employees with stress management measures although they are not personally present in the office. Of course, low-dosed interventions have to be combined with other forms of interventions (e.g., in-person trainings, individual coachings, or organisational interventions) to ensure an effective organisational holistic stress and health management concept that is beneficial for all employees.

7. General Discussion

The following chapter serves as a general discussion, putting the different studies and findings into context and relating them to each other.

7.1 Summary of Main Findings

In Chapter 1, digitalisation as a concept was defined, the underlying technological developments were presented, and some examples further illustrating what digitalisation can look like and new business models that can result from it were provided. Additionally, positive and negative consequences of digitalisation in various areas (society, work, well-being, interactions and communication) were introduced on a general level. Building upon the outlined consequences of digitalisation for stress and well-being, Chapter 2 introduced the stress concepts that provide the theoretical foundation for this dissertation's hypotheses and empirical studies.

7.1.1 Research Question 1: What demands are related to digitalisation?

Combining recent digitalisation-related developments with traditional stress models, Chapter 3 introduced technostress creators and telepressure as two existing concepts for ICT-specific demands, which can have negative consequences for well-being and stress. As it is important to keep measures for negative feelings related to digitalisation up to date and take current technological advancements into consideration, digitalisation anxiety was conceptualised as a new construct in Chapter 4 based on a qualitative interview study (Study 1a). In addition, a scale to quantitatively measure the newly introduced digitalisation anxiety construct was developed and validated (Studies 1b, 1c, 2, 3, and 4).

7.1.2 Research Question 2: What consequences do ICT-specific demands have for well-being?

Chapter 5 empirically investigated the consequences of digitalisation and the corresponding demands. First, a research model was developed based on the previously described stress models and ICT-specific demands, and hypotheses were derived from this research model. Apart from the negative main effect of ICT-specific demands on well-being and performance, the model also contained assumptions on possible effects of third variables (moderating effect of technostress inhibitors and mediating effect of detachment), which could provide suggestions for interventions and mechanisms of effect. This model and the associated hypotheses were empirically tested in several studies (Studies 5, 6, 7, and 8). Negative consequences of technostress creators, telepressure, and digitalisation anxiety were found for several well-being indicators, including engagement and satisfaction, and commitment, and also for productivity as performance indicator. Detachment seems to play a mediating role by partly explaining the relationship between ICT-specific demands (especially telepressure) and specific well-being indicators (stress and strain, sleep quality). Technostress inhibitors seem to buffer negative consequences of ICT-specific demands (technostress creators, digitalisation anxiety) for positive well-being indicators, productivity, and detachment. Consequently, interventions aimed at increasing technostress inhibitors among employees as supportive factors and fostering detachment from work should be developed, investigated, and implemented into the working environment. Since some findings were not consistent across all studies and not found for all ICT-specific demands or well-being indicators, there is room for further examination of the research model.

7.1.3 Research Question 3: What can be done to buffer negative consequences of ICT-specific demands?

As a result of the negative consequences of ICT-specific demands found in Chapter 5, Chapter 6 focused on interventions aimed at reducing these negative effects. An app-

based intervention was developed to enhance employees' well-being and reduce the negative consequences of ICT-specific demands, which was investigated in Study 9. The meditation and cognitive-behavioural interventions were found to have positive effects on several well-being indicators (stress, satisfaction, detachment). Although these findings must be further examined in order to resolve and clarify reasons for the mixed findings, they allow us to draw theoretical as well as practical conclusions for future research and practical stress management interventions.

7.2 Limitations

Apart from the limitations already discussed in the individual chapters, some general aspects will be discussed in this section, which have to be taken into account when interpreting and generalising the studies' results.

This dissertation focused on three constructs considered illustrative of ICT-specific demands: technostress creators, telepressure, and the newly developed construct digitalisation anxiety. Of course, digitalisation is accompanied by a wide range of other demands and conceptualisations of negative reactions that also could and should be further investigated, including e.g. technostrain or technoaddiction (e.g., Salanova et al., 2013). In addition, traditional stressors such as time pressure or multitasking might become even more relevant as a result of digitalisation but are not new or ICT-specific. These traditional stressors could also be further examined to determine how traditional stressors and their effects might change as a result of digitalisation.

All studies considered mostly subjective outcome variables, which were assessed via self-ratings. Alongside these, objectively measurable physiological variables such as levels of stress hormones such as cortisol should be investigated, as research has shown that technostress resulting from IT problems such as a system breakdown can be accompanied by higher cortisol levels (e.g., Riedl et al., 2012). Additionally, self-ratings (especially with regard to performance and productivity) should be

supplemented by ratings by others to provide a more objective assessment and avoid self-serving biases, which may distort the self-ratings (Campbell & Sedikides, 1999).

Primarily online questionnaires were used due to their ability to quickly reach a large number of participants and to quantitatively test the hypotheses. Combining different methods in a multimethod approach can be advantageous as it reduces the weaknesses and limitations of each individual method (Brewer & Hunter, 1989). Although in most of the studies online questionnaires were employed in order to reach as many participants as possible, qualitative interviews were also conducted to conceptualise digitalisation anxiety and develop the corresponding scale in Study 1a. Moreover, Study 9 made use of an app, which can also be also seen as a slightly different method, as it contained a more experimental approach with an intervention and not just consisted of a questionnaire. Due to the fact that this dissertation's superordinate topic is digitalisation, it actually made sense to use digital forms of measurements. Nevertheless, it could be interesting to investigate possible differences when using other methods such as paper-and-pencil questionnaires, qualitative diary studies or in-person experiments.

A further aspect that needs to be taken into account is that digitalisation anxiety and technostress creators were considered both as ICT-specific demands and as well-being indicators. Job demands have been described as aspects that "require sustained physical and/or psychological (cognitive and emotional) effort or skills" (Bakker & Demerouti, 2007, p. 312). Based on this definition, digitalisation anxiety can also be seen as a demand, as worries and concerns related to digitalisation require effort. Digitalisation anxiety was therefore examined as an ICT-specific demand in Studies 5, 6, 7, and 8. At the same time, anxiety as a negative feeling of tension can also be considered as a well-being indicator and was treated as such in Study 9. The same is true for the technostress creator scale by Ragu-Nathan and colleagues (2008) and Ayyagari et al. (2011). This scale assesses different aspects of technology, which can be seen as stressors, but the aggregated outcome technostress, as a specific form of stress, is also related to well-being. This distinction is not a contradiction, but makes

sense given the studies' different foci and the perspectives taken. When technostress creators are examined in the aggregate, they can be seen as the sum of ICT-specific demands. The two scales can be used to assess various aspects and dimensions of technostress creators (techno-overload, techno-invasion, techno-complexity, techno-insecurity, techno-uncertainty, techno-induced role ambiguity) or digitalisation anxiety triggers (general, interaction and leadership, self, implementation) and at the same time be seen as indicators for a holistic feeling resulting from the combination of the different stressors or triggers.

Another important aspect, which must be mentioned, is that the research model in Chapter 5 was not tested in a longitudinal study, making it hard to derive conclusions from the studies about causal effects. There are critical discussions about whether mediation effects can be tested in cross-sectional studies and what can be concluded from such studies about potential causal relations between the investigated variables (e.g., Maxwell & Cole, 2007; Maxwell et al., 2011). Based on the theoretical foundation of the mediating hypotheses, the studies' findings can be interpreted as suggesting the existence of such effects. However, to causally confirm these effects, the hypotheses will need to be tested in longitudinal studies.

7.3 Strengths

Despite the limitations that were previously mentioned, this dissertation also encompasses several strengths. In particular, the newly introduced concept of digitalisation anxiety is based on qualitative interviews, indicating that it relates to people's current feelings and opinions, and had behavioural consequences. Developing a scale to measure digitalisation anxiety allows for quantitative investigations of hypotheses concerning digitalisation anxiety and therefore also facilitates the examination of mechanisms of effects, which could provide input for interventions or measures to prevent or reduce digitalisation anxiety and its negative consequences. The concept can also be incorporated into existing stress models to

update them by integrating new stressors and developments resulting from digitalisation.

The investigation of several forms of ICT-specific demands, including more general forms such as technostress creators as well as more specific types such as telepressure, can be seen as a further strength. Moreover, by combining existing constructs with the newly developed digitalisation anxiety construct, this research can also contribute to existing theories by confirming their applicability or providing suggestions for updates (e.g., expanding them to include digitalisation anxiety).

Moreover, Study 9, as an app-based intervention study, can be considered one of the first empirical investigations of the consequences of such low-dose digital interventions. Despite the fact that participation involved very little effort and time expenditure, beneficial effects were found for employees' well-being, indicating that stress management interventions can be conducted using cost- and time-efficient means such as apps.

Additionally, the number of studies conducted and the total sample sizes allowed for a thorough investigation of the topic and a more detailed examination of the hypotheses and research questions.

It was also possible to incorporate some calls by other scholars for methodological and theoretical improvements in future research. For example, Study 9 took into account Glazer and Gasser's (2016) requests to consider digital stress management interventions, include a control group, provide a theoretical rationale, and precisely describe the intervention to make it replicable.

7.4 Theoretical Implications

This dissertation's findings contribute to existing research and theories in several ways:

Firstly, the findings provide evidence that traditional models of stress such as the Transactional Theory of Stress by Lazarus (1991) or the Job Demands-Resources Model by Bakker and Demerouti (2007) also hold true for the new stressors and demands investigated in this dissertation.

Secondly, the dissertation's results confirm previous empirical findings while also expanding them with regard to digitalisation anxiety as a new ICT-specific demand. It was further possible to provide evidence for effects that other scholars had hypothesised but were unable to confirm empirically (e.g., the effect of an app-based intervention on psychological detachment, Hülsheger et al., 2015).

Thirdly, the conducted analyses suggest the necessity of empirically developing a new concept for negative feelings related to digitalisation, as previous concepts were characterised by several weaknesses. The new digitalisation anxiety construct meets all of the identified demands and can therefore be integrated into existing theoretical models and further investigated in future studies. The scale also allows for further tests of existing theoretical models.

Fourthly, the findings of the qualitative studies and participants' remarks in open comment fields within the quantitative questionnaires indicated that there also is a strong need to develop a positive counterpart to digitalisation anxiety, which could be termed digitalisation optimism, for example. This also corresponds to remarks by Tarafdar, Cooper, and Stich (2019), who noted that people can evaluate ICT characteristics as either a challenge or a threat. Therefore, the experience of technostress can vary between people. They further argued that technostress is not necessarily negative but can also have positive effects (e.g., on effectiveness) and that a more positive perspective on technostress should also be investigated. Building upon Selye (1974), who also differentiated between (positive and challenging)

eustress and (negative and threatening) distress, Tarafdar et al. (2019) conceptualised techno-eustress as "[h]ow and why individuals appraise IS [Information Systems] as challenging or thrilling, experience consequent 'good' stress, and are faced with positive outcomes" (p. 14). Likewise, Martínez-Córcoles et al. (2017) developed a two-sided construct involving both positive expectations (termed technophilia) as well as fear and negative feelings (termed technophobia). Inoculation Theory, originally developed by McGuire (1961a, b) to strengthen people's beliefs by providing counterarguments, could be another possible framework for dealing with digitalisation and the corresponding demands and consequences. The theory originally aimed at strengthening beliefs by providing people with counterarguments. According to this theory, making people aware of possible negative consequences of a phenomenon in advance (e.g., possible negative societal consequences, job insecurity) can help them prepare for these consequences and develop arguments or compensatory measures prior to the actual occurrence of the phenomenon. Thus, it is reasonable to apply this approach also to ICT-specific demands and negative digitalisation-related consequences in order to make people aware of them and provide them with possible measures for facing them.

7.5 Practical Implications

The findings of the studies making up this dissertation can provide input for interventions to enhance employee well-being in times of digitalisation and to buffer negative consequences of ICT-specific demands for well-being and productivity. Three possible intervention paths can be considered: Firstly, technostress inhibitors seem to buffer negative consequences of ICT-specific demands and are positively related to well-being in general. Increasing such factors (e.g., providing a helpdesk, trainings, or ensuring social support among colleagues) can be beneficial for employee well-being in times of digitalisation and corresponding changes and technological advancements at the workplace. Secondly, detachment has been found to be beneficial for employee well-being and recovery, especially in times in which

the increasing use of mobile working arrangements has blurred the boundaries of work. Therefore, employees should be supported in developing individual detachment strategies such as meditation, after-work exercise sessions, or specific behavioural measures at home (e.g., only working from a specific desk at home). Thirdly, the app-based intervention developed for and empirically tested in Study 9 provides a first example of what a digital intervention tool could look like and could be integrated into organisational stress and health management concepts.

Practical implications with regard to digitalisation anxiety were already introduced in Chapter 4.4.2. They were derived from the qualitative interview statements in order to address the identified digitalisation anxiety triggers. Of course, possible negative societal consequences, which were also named as triggers of digitalisation anxiety, are hard to avoid. Nevertheless, intervention possibilities on an organisational and individual level can be integrated and applied. Digitalisation and ICT systems can be designed in a way that helps to reduce ICT-specific demands such as information overload and employees can be trained and equipped with the necessary knowledge and skills to face digitalisation-related challenges. Tarafdar et al. (2019) also called for ICT systems to be designed in a way that fosters techno-eustress and eliminates or reduces techno-distress. The Foresight Mental Capital and Wellbeing Project (2008) also already highlighted the importance of continuous learning for realising the potential of new technologies and preventing a "digital divide" (p. 27), which describes the fact that people from lower socioeconomic strata are less likely to have internet access than people from professional or managerial backgrounds. Therefore, providing equal qualification and training opportunities for all members of society is crucial – particularly with regard to address the identified societal triggers of digitalisation anxiety.

Cascio and Montealegre (2016) focused on factors influencing the adoption and implementation of workplace technologies, a critical aspect of digitalisation that was also found to be relevant in the interviews in Study 1a, where the implementation of digitalisation was named as a potential anxiety trigger. According to Cascio and

Montealegre (2016), new technologies should be simple and intuitive to use. Self-efficacy (Bandura, 1997) is a further aspect that matters for the adoption of new technologies and can help to reduce anxieties if the new technology evokes a feeling of competence in users. New technologies also should be economical with respect to possible competitive advantages. If an organisation or an individual perceives that using a new technology will convey possible advantages, it is more likely to be implemented. Furthermore, social factors are an issue with regard to the acceptance of new technologies and peer pressure or positive usage experiences by friends or other close ties can promote the acceptance and adoption of a new technology.

Trinczek (2011) highlighted the fact that flexibility is subjective and might not be the best option for everybody. Therefore, whether flexibility with regard to the location and time of work, which is frequently mentioned as a positive opportunity resulting from digitalisation and related technological advancements, is considered as advantage or disadvantage depends on employees' perceptions and needs. The same holds true for management by objectives, in which supervisors and employees jointly set a goal, while how to reach the goal is up to the employee. This form of subjectivation of work is welcomed by some employees, who are motivated by the opportunity to work in a self-organised way, but others might have problems with it and favour a more structured, externally defined approach (Trinczek, 2011). A tendency for self-exploitation might even be associated with this type of management (Trinczek, 2011). Therefore, organisations should offer such (digital) opportunities or organisational interventions to employees, who want to make use of them, but they should not be imposed on the workforce.

In order to deal with the changing environment, a lifelong learning mindset is necessary and must be fostered and established. Leopold et al. (2018) emphasise that a lifelong and agile learning mindset but also new labour policies are necessary to take full advantage of the positive opportunities associated with digitalisation. According to them, it is specifically necessary to provide employees with the necessary skills that will allow them to participate in the future job market.

Generally, it can be inferred that neither the exclusive use of new digital technologies nor a firm attachment to the "old" or traditional way of working or communicating is ideal. Instead, the two should be combined using a "best of both" approach. With regard to communication, a possible solution is to combine traditional and new forms of communication. Kouzmin and Korac-Kakabadse (2000) highlighted the necessity to combine IT-mediated communication with personal contacts and dialogues. According to them, supervisors should exploit the advantages of new technologies by using them as a supplement to but not replacement for in-person dialogues, again highlighting the need to combine traditional and modern forms of communication and training. As previously described, technologies can be a source of new resources. The increasing capabilities of computers and ongoing technological developments have created tools that can simplify and facilitate work processes. Kokkalis et al. (2013) described an e-mail program called "EmailValet" as another example of combining digital technologies and human workforce. This program helps create to-do lists based on e-mail content using crowdsourced human assistants. Using this assistant can help to increase the number of completed tasks and the program therefore provides a positive example of combining new technologies with traditional human forms of work (Kokkalis et al., 2013).

7.6 Final Conclusion

Digitalisation must be seen as an opportunity. However, a crucial societal challenge is to structure the corresponding changes and advancements in a humane way that allows people to participate and make use of the resulting opportunities and ensures a work environment that is suitable and supportive for all employees. Although new forms of occupational stressors and stress will occur, there are also ways to counteract them, which can be seen as a positive outlook.

With regard to this dissertation's research questions, it can be stated that digitalisation does create demands, but that it at the same time comes along with positive aspects and resources (Research Question 1). In general, ICT-specific

demands are negatively related to well-being (Research Question 2), but there are also ways to buffer these negative consequences (Research Question 3), such as strengthening detachment, fostering technostress inhibitors, or making use of app-based interventions.

In line with the quote by Stewart Brand --

"Once a new technology rolls over you, if you're not part of the steamroller, you're part of the road." (Stewart Brand as cited by Tarafdar et al., 2011, p. 113)

-- I hope that this dissertation can help to prepare for the introduction of new technologies at the workplace and support people to rather be part of or even control the steamroller, or to at least avoid having anybody be part of the road.

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Annex

Table A1

Items, descriptives, factor loadings, and communalities resulting from the exploratory factor analysis

Item (English version)	Item (German version)	Factor loadings				*M*	*SD*	Communalities after extraction
		1	2	3	4			
I am concerned about digital systems not being secure enough.	Es bereitet mir Sorgen, dass digitale Systeme nicht sicher genug sind.	.840	-.270	-.079	.054	4.21	1.42	.435
I am afraid that humanity will become dependent on technology due to digitalisation.	Es macht mir Angst, dass die Menschheit infolge der Digitalisierung von Technologie abhängig wird.	.812	-.041	.059	-.092	4.00	1.64	.598
As a result of digitalisation I am increasingly afraid of hacker attacks.	Infolge der Digitalisierung habe ich zunehmend Angst vor Hacker-Angriffen.	.801	-.242	.115	-.172	4.01	1.42	.413
I am afraid that surveillance will increase due to digitalisation.	Mir macht es Angst, dass die Überwachung durch die Digitalisierung zunimmt.	.794	.069	-.279	-.021	4.18	1.58	.467
I am afraid that in a digital world technology will be used against humans.	Ich habe Angst, dass in einer digitalisierten Welt Technologie gegen den Menschen eingesetzt wird.	.773	-.027	.100	-.050	3.61	1.61	.632
I am afraid of a lack of control due to digitalisation.	Ich habe Angst vor einem Kontrollverlust infolge der Digitalisierung.	.721	.285	-.175	-.007	3.38	1.62	.694
I am concerned about how the increasing amount of data due to digitalisation will be used.	Mir bereitet es Sorgen, wie die durch Digitalisierung steigende Menge an Daten genutzt wird.	.687	.135	-.130	-.089	4.08	1.61	.441

(continued)

Item (English version)	Item (German version)	Factor loadings 1	2	3	4	*M*	*SD*	Communalities after extraction
I am afraid of digitalisation as I will become dependent on technology.[4]	Ich habe vor der Digitalisierung Angst, weil ich durch diese selbst von Technologie abhängig werde.[4]	.679	-.007	.317	-.132	3.39	1.51	.710
I am afraid of a new extent of criminality which is made possible by the use of digital technology.	Ich habe Angst vor einem neuen Ausmaß an Kriminalität, das durch den Einsatz digitaler Technologien ermöglicht wird.	.676	-.260	.263	-.058	4.08	1.47	.437
I am concerned that society will change as a result of digitalisation.[2]	Ich befürchte, dass sich durch die Digitalisierung unsere Gesellschaft verändert.[2]	.641	-.106	-.146	.032	4.71	1.24	.261
I am concerned that the human working force will be replaced due to digitalisation.	Es macht mir Angst, dass die menschliche Arbeitskraft infolge der Digitalisierung ersetzt werden könnte.	.628	.149	.222	-.259	3.15	1.47	.621
I am afraid of the unpredict< consequences of digitalisation.[4]	Ich habe vor den unabsehbaren Folgen der Digitalisierung Angst.[4]	.609	.308	-.147	.153	3.28	1.70	.737
I am concerned about digitalisation as it entails consequences on many aspects of life.	Mir bereitet die Digitalisierung Sorgen, weil sie Auswirkungen auf viele Bereiche des Lebens hat.	.564	.265	.113	-.044	3.26	1.62	.698

(continued)

Item (English version)	Item (German version)	Factor loadings 1	2	3	4	*M*	*SD*	Communalities after extraction
I am concerned about the human needs not being taken into account sufficiently in the implementation of digitalisation.	Ich mache mir Sorgen, dass die Bedürfnisse des Menschen bei der Umsetzung der Digitalisierung nicht ausreichend berücksichtigt werden.	.548	.056	.007	.201	4.05	1.53	.530
I am afraid that people will trust technology more than humans due to digitalisation.	Es macht mir Angst, dass infolge der Digitalisierung der Technologie mehr vertraut wird als Menschen.	.529	-.058	.281	.026	3.40	1.53	.509
I am afraid of a too strong trust in the proper functioning of technology in a digitalised world.	Mir macht es Angst, dass in einer digitalisierten Welt zu sehr auf das Funktionieren der Technik vertraut wird.	.498	-.007	.174	.151	3.94	1.43	.514
I am afraid of digitalisation as it seems inevitable to me.[3]	Mir macht die Digitalisierung Angst, weil sie mir unumgänglich erscheint.[3]	.493	.330	.090	-.048	2.69	1.56	.650
In a digitalised world I am worried about technology setting the pace for work.[3]	In einer digitalisierten Welt befürchte ich, dass die Technik das Arbeitstempo vorgibt.[3]	.486	-.096	.323	-.021	3.38	1.43	.428
I am concerned about which role humans will play in a digitalised world.[3]	Ich mache mir Sorgen, welche Rolle der Mensch in einer digitalisierten Welt spielt.[3]	.477	-.014	.310	.150	3.18	1.42	.641

(continued)

Item (English version)	Item (German version)	Factor loadings 1	2	3	4	*M*	*SD*	Communalities after extraction
I am afraid of digitalisation as I see risks in the technological progress.	Ich habe Angst vor der Digitalisierung, weil ich Risiken im technologischen Fortschritt sehe.	.475	.246	.074	.126	3.06	1.51	.652
I am concerned that technology will be used in more and more fields due to digitalisation.[3]	Mir bereitet es Sorgen, dass infolge der Digitalisierung mehr Technologie in immer mehr Bereichen eingesetzt wird.[3]	.472	.373	.067	.038	2.76	1.54	.733
I am afraid of new digital technologies as I consider them as unpredictable.[3]	Ich habe Angst vor neuen digitalen Technologien, weil ich diese für unberechenbar halte.[3]	.452	.337	.106	.054	2.92	1.50	.711
I am afraid of the society being controlled by artificial intelligence due to digitalisation.	Ich habe Angst, dass die Gesellschaft infolge der Digitalisierung von künstlicher Intelligenz gesteuert wird.	.444	.110	.181	.036	2.72	1.52	.471
I am afraid that some parts of society cannot keep up with the changes resulting from digitalisation.[1,2]	Ich habe Angst, dass ein Teil der Gesellschaft durch die Veränderungen der Digitalisierung nicht mehr mithalten kann.[1,2]	.359	.075	.006	.120	3.88	1.28	.249
I am afraid that humans will become more and more similar to robots due to digitalisation.[1]	Ich habe die Sorge, dass durch die Digitalisierung Menschen mehr wie Roboter werden.[1]	.331	.170	.324	-.011	2.52	1.37	.528

(continued)

Item (English version)	Item (German version)	Factor loadings 1	2	3	4	*M*	*SD*	Communalities after extraction
I am afraid of digitalisation as it is implemented too fast.[1]	Ich habe Angst vor der Digitalisierung, weil diese zu schnell umgesetzt wird.[1]	.317	.143	.220	.276	3.14	1.46	.634
I worry about digital technology not working reliably.[1,2]	Ich befürchte, dass digitale Technik nicht zuverlässig funktioniert.[1,2]	.268	.210	.059	.142	3.42	1.20	.338
I worry that I won't be able to keep up due to digitalisation.	Ich befürchte, dass ich selbst durch die Digitalisierung nicht mehr mithalten kann.	-.194	1.092	.005	-.172	2.33	1.34	.811
I worry that I will be overwhelmed by the developments in the digitalised world.	Ich befürchte, dass ich von den Entwicklungen in der digitalisierten Welt überfordert werde.	-.100	1.088	-.002	-.153	2.51	1.43	.910
I am afraid that I won't be able to understand new processes in the digital world.	Ich habe Angst, dass ich neue Prozesse in der digitalen Welt nicht verstehe.	-.168	1.039	.064	-.077	2.59	1.42	.872
I am concerned that I am expected to quickly understand new processes in the digital world.	Mir macht es Sorgen, dass von mir erwartet wird, neue Prozesse in der digitalen Welt schnell zu verstehen.	-.031	.806	.196	-.088	2.57	1.39	.782
I am skeptical about the use of digital technology at work.	Ich stehe dem Einsatz neuer digitaler Technologien bei meiner Arbeit skeptisch gegenüber.	.016	.639	.131	-.005	2.47	1.46	.552

(continued)

Item (English version)	Item (German version)	Factor loadings 1	2	3	4	*M*	*SD*	Communalities after extraction
I am afraid of the ongoing technological progress in a digital world.[3]	Mir macht der stetige technologische Fortschritt in der digitalen Welt Angst.[3]	.316	.606	.074	-.082	2.53	1.56	.763
I am afraid of digitalisation as I feel helplessly exposed to it.	Ich habe vor der Digitalisierung Angst, weil ich mich dieser hilflos ausgesetzt fühle.	.107	.578	.228	-.022	2.28	1.40	.677
I worry that digitalisation will not facilitate my work.	Ich befürchte, dass die Digitalisierung meine Arbeit nicht erleichtert.	.050	.537	-.005	.152	2.94	1.53	.437
I am distressed by the fact that the whole world of work is changing as a result of digitalisation.[3]	Es bereitet mir Sorgen, dass sich die gesamte Arbeitswelt durch die Digitalisierung verändert.[3]	.425	.509	-.147	.049	2.84	1.31	.638
I am afraid of digitalisation as it constitutes a change.[3]	Mir macht die Digitalisierung Angst, weil sie eine Veränderung darstellt.[3]	.499	.506	-.229	-.001	2.49	1.27	.620
I worry that digital technology is not user friendly.	Ich befürchte, dass digitale Technologie nicht benutzerfreundlich ist.	-.046	.503	.160	.143	2.71	1.29	.451
I am afraid of working with new digital technologies due to the worry to make a mistake.[4]	Ich habe Angst vor der Arbeit mit neuen digitalen Technologien, weil ich befürchte, etwas falsch zu machen.[4]	-.367	.399	.763	-.003	2.32	1.30	.711

(continued)

Item (English version)	Item (German version)	Factor loadings 1	2	3	4	*M*	*SD*	Communalities after extraction
I am afraid that a robot could be my next coworker due to digitalisation.	Es macht mir Angst, dass infolge der Digitalisierung ein Roboter mein nächster „Kollege“ sein könnte.	.046	-.004	.739	-.118	2.05	1.39	.518
I am afraid of being personally blamed for technical problems.	Ich habe Angst, für technische Probleme persönlich verantwortlich gemacht zu werden.	-.081	.029	.692	.118	2.45	1.46	.518
I am afraid of having more virtual than real contact to others as a result of digitalisation.[2]	Ich habe Angst, dass ich infolge der Digitalisierung mehr virtuellen als reellen Kontakt zu anderen habe.[2]	.208	-.178	.596	-.001	2.98	1.49	.393
I am feeling anxiety about the future due to digitalisation as I perceive a threat to my workplace due to it.	Mir bereitet die Digitalisierung Zukunftsängste, weil ich meinen Arbeitsplatz dadurch bedroht sehe.	-.263	.269	.566	.064	1.99	1.21	.408
I worry that I will face communication problems due to digital communication.	Ich befürchte, dass ich durch die digitale Kommunikation Verständigungsprobleme haben werde.	-.080	.217	.550	.025	2.44	1.41	.451
I am afraid that the work of humans will be less valued as a result of digitalisation.	Ich habe Angst, dass die Arbeit von Menschen infolge der Digitalisierung weniger wertgeschätzt wird.	.259	-.097	.523	.106	3.03	1.44	.502

(continued)

Item (English version)	Item (German version)	Factor loadings 1	2	3	4	*M*	*SD*	Communalities after extraction
I am frightened by digitalisation as I sense a pressure of change at the workplace due to it.[3]	Mir macht die Digitalisierung Angst, weil ich durch diese an meinem Arbeitsplatz einen Veränderungsdruck spüre.[3]	-.066	.386	.499	.041	2.28	1.32	.615
I worry that ongoing availability will be expected of me due to digitalisation.[3]	Ich befürchte, dass infolge der Digitalisierung dauerhafte Verfügbarkeit/ Erreichbarkeit von mir erwartet wird.[3]	.454	-.174	.489	-.250	3.68	1.52	.402
I am afraid that I will be other-directed by technology due to digitalisation.	Ich habe Angst, dass ich infolge der Digitalisierung von Technik fremdbestimmt werde.	.288	.030	.488	.090	2.93	1.47	.615
I am afraid of digitalisation as there are problems especially in the beginning/ transformation phase.[3]	Mir macht die Digitalisierung Angst, weil gerade in der Anfangs-/Übergangsphase mehr Probleme auftreten.[3]	.001	-.002	.484	.426	3.30	1.40	.600
I am afraid of being replaced by younger and better educated employees due to digitalisation.	Ich habe Angst, infolge der Digitalisierung von jüngeren, besser ausgebildeten Mitarbeitern ersetzt zu werden.	.077	.244	.447	-.051	2.17	1.34	.448
In a digitalised world I am afraid of technical problems.[5]	In einer digitalisierten Welt habe ich Angst vor technischen Problemen.[5]	.101	.231	.425	.071	3.09	1.46	.522

(continued)

Item (English version)	Item (German version)	Factor loadings 1	2	3	4	*M*	*SD*	Communalities after extraction
I am afraid of feeling increasingly stressed by digitalisation.[3]	Ich habe Angst, dass ich mich durch die Digitalisierung zunehmend gestresst fühle.[3]	.393	.051	.408	-.164	3.52	1.63	.473
I am afraid of digitalisation as the technologies behind it are hardly comprehensible.[3]	Ich habe Angst vor der Digitalisierung, weil die Technologien dahinter nur schwer begreifbar sind.[3]	.193	.309	.344	.097	3.02	1.51	.656
I worry that my pace of work needs to increase due to digitalisation.[1]	Ich befürchte, dass durch die Digitalisierung mein Arbeitstempo steigen muss.[1]	.193	.245	.295	-.004	2.79	1.42	.421
I am afraid that there is no sound concept for the implementation of digitalisation.	Mir macht es Angst, dass es kein gutes Konzept für die Umsetzung der Digitalisierung gibt.	-.029	-.009	-.125	.933	3.63	1.50	.751
I worry about employees not being trained enough for the use of digital technology.[4]	Ich befürchte, dass Mitarbeiter im Umgang mit digitaler Technik nicht ausreichend geschult werden.[4]	-.329	-.152	.259	.764	3.87	1.43	.473
I am concerned about digitalisation being managed in a bad way.[4]	Ich habe die Befürchtung, dass die Digitalisierung schlecht gemanagt wird.[4]	.110	-.090	-.560	.692	3.88	1.28	.464

(continued)

Item (English version)	Item (German version)	Factor loadings 1	2	3	4	*M*	*SD*	Communalities after extraction
I worry that the technology which is necessary for the implementation of digitalisation is not available for all fields.[3]	Ich befürchte, dass die für die Umsetzung der Digitalisierung notwendige Technologie noch nicht für alle Bereiche verfügbar ist.[3]	-.104	-.233	.384	.689	3.63	1.47	.549
I am afraid that many questions related to digitalisation have not been clarified yet.	Mir macht es Angst, dass viele Fragen der Digitalisierung noch nicht geklärt sind.	.231	.002	-.055	.661	3.54	1.56	.617
I am afraid that digitalisation is managed by unexperienced people.[2]	Ich habe Angst, dass die Digitalisierung von unerfahrenen Personen gesteuert wird.[2]	.053	-.182	-.264	.638	3.70	1.32	.318
I am concerned about the appropriate education of future generations in a digital world.	Ich mache mir Sorgen um die passende Ausbildung zukünftiger Generationen in der digitalen Welt.	.014	.012	.111	.576	3.36	1.54	.422
I am afraid as there is no digitalisation strategy at my work place.[2]	Ich habe Angst, weil es an meinem Arbeitsplatz keine Digitalisierungsstrategie gibt.[2]	-.192	.187	.039	.564	2.65	1.61	.342
I am concerned about digitalisation as employees are not incorporated in the changes.	Die Digitalisierung bereitet mir Sorgen, weil Mitarbeiter in die Veränderung nicht miteinbezogen werden.	.077	-.034	.140	.530	3.48	1.35	.405

(continued)

Item (English version)	Item (German version)	Factor loadings 1	2	3	4	*M*	*SD*	Communalities after extraction
I worry about the occurrence of chaos due to digitalisation.	Ich befürchte, dass durch die Digitalisierung ein Chaos entsteht.	.135	.185	.070	.447	3.00	1.45	.500
I am afraid that many things will become confusing due to digitalisation.[1]	Ich habe Angst, dass infolge der Digitalisierung vieles unübersichtlicher wird.[1]	.119	.344	.053	.386	3.18	1.49	.577
I worry that digitalisation will split society.[1,2]	Ich befürchte, dass die Digitalisierung die Gesellschaft spaltet.[1,2]	.228	.243	-.081	.346	3.31	1.25	.414
I worry about some people being socially excluded as a result of digitalisation.[1,2]	Ich befürchte, dass manche Menschen durch die Digitalisierung gesellschaftlich ausgegrenzt werden.[1,2]	.243	.151	.099	.245	3.93	1.31	.382

Note. Method of extraction: Maximum Likelihood; Method of rotation: Promax with Kaiser-normalization; Rotation is converged in 8 iterations; Reasons for exclusion of item: [1] loading too small (< .40); [2] communality too small (<.40); [3] highest loading not twice as high as second highest loading; [4] second highest loading on other factor >.30; [5] distribution with two modi; Items in grey were not included in the final DAS scale; Descriptives, factor loadings, and communalities refer to the German version of the DAS. Abbreviations: *M* = Mean Value; *SD* = Standard Deviation.

Annex B – DAS Scale (English Version)

General

1. I am concerned about digital systems not being secure enough.
2. I am afraid that humanity will become dependent on technology due to digitalisation.
3. As a result of digitalisation I am increasingly afraid of hacker attacks.
4. I am afraid that surveillance will increase due to digitalisation.
5. I am afraid that in a digital world technology will be used against humans.
6. I am afraid of a lack of control due to digitalisation.
7. I am concerned about how the increasing amount of data due to digitalisation will be used.
8. I am afraid of a new extent of criminality which is made possible by the use of digital technology.
9. I am concerned that the human working force will be replaced due to digitalisation.
10. I am concerned about digitalisation as it entails consequences on many aspects of life.
11. I am concerned about the human needs not being taken into account sufficiently in the implementation of digitalisation.
12. I am afraid that people will trust technology more than humans due to digitalisation.
13. I am afraid of a too strong trust in the proper functioning of technology in a digitalised world.
14. I am afraid of digitalisation as I see risks in the technological progress.
15. I am afraid of the society being controlled by artificial intelligence due to digitalisation.

Self

16. I worry that I won't be able to keep up due to digitalisation.
17. I worry that I will be overwhelmed by the developments in the digitalised world.
18. I am afraid that I won't be able to understand new processes in the digital world.
19. I am concerned that I am expected to quickly understand new processes in the digital world.
20. I am skeptical about the use of digital technology at work.
21. I am afraid of digitalisation as I feel helplessly exposed to it.
22. I worry that digitalisation will not facilitate my work.
23. I worry that digital technology is not user friendly.

Interaction and leadership

24. I am afraid that a robot could be my next coworker due to digitalisation.
25. I am afraid of being personally blamed for technical problems.
26. I am feeling anxiety about the future due to digitalisation as I perceive a threat to my workplace due to it.
27. I worry that I will face communication problems due to digital communication.
28. I am afraid that the work of humans will be less valued as a result of digitalisation.
29. I am afraid that I will be other-directed by technology due to digitalisation.
30. I am afraid of being replace by younger and better educated employees due to digitalisation.

Implementation

31. I am afraid that there is no sound concept for the implementation of digitalisation.
32. I am afraid that many questions related to digitalisation have not been clarified yet.
33. I am concerned about the appropriate education of future generations in a digital world.
34. I am concerned about digitalisation as employees are not incorporated in the changes.
35. I worry about the occurrence of chaos due to digitalisation.

Annex C – DAS Scale (German Version)

Allgemein

1. Es bereitet mir Sorgen, dass digitale Systeme nicht sicher genug sind.
2. Es macht mir Angst, dass die Menschheit infolge der Digitalisierung von Technologie abhängig wird.
3. Infolge der Digitalisierung habe ich zunehmend Angst vor Hacker-Angriffen.
4. Mir macht es Angst, dass die Überwachung durch die Digitalisierung zunimmt.
5. Ich habe Angst, dass in einer digitalisierten Welt Technologie gegen den Menschen eingesetzt wird.
6. Ich habe Angst vor einem Kontrollverlust infolge der Digitalisierung.
7. Mir bereitet es Sorgen, wie die durch Digitalisierung steigende Menge an Daten genutzt wird.
8. Ich habe Angst vor einem neuen Ausmaß an Kriminalität, das durch den Einsatz digitaler Technologien ermöglicht wird.
9. Es macht mir Angst, dass die menschliche Arbeitskraft infolge der Digitalisierung ersetzt werden könnte.
10. Mir bereitet die Digitalisierung Sorgen, weil sie Auswirkungen auf viele Bereiche des Lebens hat.
11. Ich mache mir Sorgen, dass die Bedürfnisse des Menschen bei der Umsetzung der Digitalisierung nicht ausreichend berücksichtigt werden.
12. Es macht mir Angst, dass infolge der Digitalisierung der Technologie mehr vertraut wird als Menschen.
13. Mir macht es Angst, dass in einer digitalisierten Welt zu sehr auf das Funktionieren der Technik vertraut wird.
14. Ich habe Angst vor der Digitalisierung, weil ich Risiken im technologischen Fortschritt sehe.
15. Ich habe Angst, dass die Gesellschaft infolge der Digitalisierung von künstlicher Intelligenz gesteuert wird.

Selbst

16. Ich befürchte, dass ich selbst durch die Digitalisierung nicht mehr mithalten kann.
17. Ich befürchte, dass ich von den Entwicklungen in der digitalisierten Welt überfordert werde.
18. Ich habe Angst, dass ich neue Prozesse in der digitalen Welt nicht verstehe.
19. Mir macht es Sorgen, dass von mir erwartet wird, neue Prozesse in der digitalen Welt schnell zu verstehen.
20. Ich stehe dem Einsatz neuer digitaler Technologien bei meiner Arbeit skeptisch gegenüber.
21. Ich habe vor der Digitalisierung Angst, weil ich mich dieser hilflos ausgesetzt fühle.
22. Ich befürchte, dass die Digitalisierung meine Arbeit nicht erleichtert.
23. Ich befürchte, dass digitale Technologie nicht benutzerfreundlich ist.

Interaktion und Führung

24. Es macht mir Angst, dass infolge der Digitalisierung ein Roboter mein nächster „Kollege" sein könnte.
25. Ich habe Angst, für technische Probleme persönlich verantwortlich gemacht zu werden.
26. Mir bereitet die Digitalisierung Zukunftsängste, weil ich meinen Arbeitsplatz dadurch bedroht sehe.
27. Ich befürchte, dass ich durch die digitale Kommunikation Verständigungsprobleme haben werde.
28. Ich habe Angst, dass die Arbeit von Menschen infolge der Digitalisierung weniger wertgeschätzt wird.
29. Ich habe Angst, dass ich infolge der Digitalisierung von Technik fremdbestimmt werde.
30. Ich habe Angst, infolge der Digitalisierung von jüngeren, besser ausgebildeten Mitarbeitern ersetzt zu werden.

Implementierung

31. Mir macht es Angst, dass es kein gutes Konzept für die Umsetzung der Digitalisierung gibt.
32. Mir macht es Angst, dass viele Fragen der Digitalisierung noch nicht geklärt sind.
33. Ich mache mir Sorgen um die passende Ausbildung zukünftiger Generationen in der digitalen Welt.
34. Die Digitalisierung bereitet mir Sorgen, weil Mitarbeiter in die Veränderung nicht miteinbezogen werden.
35. Ich befürchte, dass durch die Digitalisierung ein Chaos entsteht.

Annex D – Scales for the Questionnaires

IT anxiety scale (ITAS)

(López-Bonilla & López-Bonilla, 2012; translated by Huber, 2019; used in Study 2c)

Table D1
Items of the ITAS

I feel apprehensive about using information technologies (ITs)	Ich habe Bedenken, Informationstechnologien (ITs) zu benutzen.
Technological information sounds like confusing jargon to me	Technologische Informationen hören sich für mich wie Kauderwelsch an.
I have avoided ITs because it is unfamiliar to me	Ich habe ITs vermieden, weil sie mir nicht vertraut sind.
I hesitate to use ITs for fear of making mistakes I cannot correct	Ich zögere, ITs zu benutzen aus Angst vor Fehlern, die ich nicht korrigieren kann.
ITs do not scare me at all	ITs machen mir überhaupt keine Angst.
Working with ITs would make me very nervous	Die Arbeit mit ITs würde mich sehr nervös machen.
I do not feel threatened when others talk about ITs	Ich fühle mich nicht bedroht, wenn andere über ITs sprechen.
I feel aggressive and hostile towards ITs	Ich bin ITs gegenüber aggressiv und feindselig gestimmt.
ITs make me feel uncomfortable	ITs verursachen bei mir ein unangenehmes Gefühl.
I get a sinking feeling when I think of trying to use ITs	Ich bekomme ein flaues Gefühl, wenn ich daran denke, zu versuchen ITs zu verwenden.
ITs make me feel uneasy	ITs verursachen bei mir ein unbehagliches Gefühl.
ITs make me feel confused	ITs verursachen bei mir ein Gefühl der Verwirrung.

Penn State Worry Questionnaire (PSWQ)

(German version by Glöckner-Rist & Rist, 2014; used in Study 2c)

Table D2

Items of the German version of the PSWQ

Instruction: Below is a series of statements. Please indicate how typical these statements are for you. Please tick only one box per statement and do not leave out any statements. Answer every question as spontaneously as possible without thinking twice. This is not a test, meaning there are no wrong or right answers.	Instruktion: Im Folgenden sehen Sie eine Reihe von Aussagen. Bitte geben Sie an, wie typisch diese Aussagen für Sie sind. Kreuzen Sie bitte pro Aussage nur ein Kästchen an und lassen Sie keine Aussage aus. Antworten Sie möglichst spontan auf jede Frage, ohne lange zu überlegen. Dies ist kein Test, das heißt es gibt weder falsche noch richtige Antworten.
If I don't have enough time to do everything, I don't worry about it.	Wenn ich nicht genug Zeit habe, alles zu erledigen, mache ich mir darüber keine Sorgen.
My worries grow over my head.	Meine Sorgen wachsen mir über den Kopf.
I don't tend to worry about things. (R)	Ich neige nicht dazu, mir über Dinge Sorgen zu machen. (R)
Many situations worry me.	Viele Situationen machen mir Sorgen.
I know I shouldn't be worried, but there's nothing I can do about it.	Ich weiß, ich sollte mir keine Sorgen machen, aber ich kann nichts dagegen machen.
When I'm under pressure, I worry a lot.	Wenn ich unter Druck stehe, mache ich mir viel Sorgen.
I'm always worried about something.	Über irgendetwas mache ich mir immer Sorgen.
I find it easy to dispel worried thoughts.	Mir fällt es leicht, sorgenvolle Gedanken zu vertreiben.
As soon as I finish a task, I start worrying about what else I have to do everywhere.	Sobald ich eine Aufgabe beendet habe, fange ich an, mir überall das Sorgen zu machen, was ich sonst noch tun muss.
I never worry about anything. (R)	Ich mache mir nie über etwas Sorgen. (R)
If there is nothing more I can do in a matter, I don’t worry about it anymore.	Wenn ich in einer Angelegenheit nichts mehr tun kann, mache ich mir auch keine Sorgen mehr darüber.
I've always been someone who worries a lot	Ich war schon immer jemand, der sich viel Sorgen macht
I notice that I was worried about some things.	Mir fällt auf, dass ich mir über einiges Sorgen gemacht habe.
Once I start to worry, I can't stop.	Wenn ich erst einmal anfange, mir Sorgen zu machen, kann ich nicht mehr damit aufhören.
I'm worried all the time.	Ich mache mir die ganze Zeit über Sorgen.
I worry about projects until they are completely done.	Ich mache mir über Vorhaben solange Sorgen, bis sie komplett erledigt sind.

Techno-insecurity subscale of the technostress scale (TINS)

(Tarafdar et al., 2007; translated by Huber, 2019; used in Study 2c)

Table D3
Items of the TINS

I feel constant threat to my job security due to new technologies.	Ich fühle meinen Job ständig durch neue Technologien bedroht.
I do not share my knowledge with my coworkers for fear of being replaced.	Ich muss meine Fähigkeiten ständig auf den neuesten Stand bringen, um nicht ersetzt zu werden.
I have to constantly update my skills to avoid being replaced.	Ich werde von Kollegen mit aktuelleren technologischen Kompetenzen bedroht.
I am threatened by coworkers with newer technology skills.	Ich teile mein Wissen nicht mit meinen Kollegen aus Angst, ersetzt zu werden
I feel there is less sharing of knowledge among coworkers for fear of being replaced.	Ich habe das Gefühl, dass weniger Wissen unter Kollegen geteilt wird, aus Angst, ersetzt zu werden.

Technostress creators

(used in Studies 6, 8, and 9)

Table D4

Items measuring technostress creators

Techno-overload		
I am forced by this technology to work much faster.	Ich bin durch neue Technologien gezwungen, schneller zu arbeiten.	Ragu-Nathan et al. (2008)
I am forced by this technology to do more work than I can handle.	Ich bin durch neue Technologien gezwungen, mehr Arbeit zu erledigen, als ich bewältigen kann.	Ragu-Nathan et al. (2008)
I am forced by this technology to work with very tight time schedules.	Aufgrund neuer Technologien bin ich gezwungen, zeitlich eng getaktet zu arbeiten.	Ragu-Nathan et al. (2008)
I am forced to change my work habits to adapt to new technologies	Ich bin gezwungen, meine Arbeitsgewohnheiten an neue Technologien anzupassen.	Ragu-Nathan et al. (2008)
I have a higher workload because of increased technology complexity.	Ich habe aufgrund der steigenden Komplexität neuer Technologien eine höhere Arbeitsbelastung.	Ragu-Nathan et al. (2008)
IT creates many more requests, problems, or complaints in my job than I would otherwise experience	Neue Technologien schaffen mehr Anfragen, Probleme oder Beschwerden in meinem Job, als ich ohne sie haben würde.*	Ayyagari et al. (2011)
I feel pressured due to IT	Ich fühle mich durch neue Technologien unter Druck gesetzt.*	Ayyagari et al. (2011)
Techno-invasion		
I spend less time with my family due to this technology.	Aufgrund neuer Technologien verbringe ich weniger Zeit mit meiner Familie.	Ragu-Nathan et al. (2008)
I have to be in touch with my work even during my vacation due to this technology.	Durch neue Technologien muss ich auch während meines Urlaubs mit der Arbeit in Kontakt sein.	Ragu-Nathan et al. (2008)
I have to sacrifice my vacation and weekend time to keep current on new technologies.	Ich muss meine Urlaubszeit und Wochenenden dafür opfern, um mich über neue Technologien auf dem Laufenden zu halten.	Ragu-Nathan et al. (2008)
I feel my personal life is being invaded by this technology.	Ich habe das Gefühl, dass neue Technologien in mein Privatleben eindringen.	Ragu-Nathan et al. (2008)
Using IT blurs boundaries between my job and my home life	Durch das Anwenden neuer Technologien verwischt die Grenze zwischen meinem Berufs- und Privatleben.*	Ayyagari et al. (2011)

(continued)

Techno-complexity		
I do not know enough about this technology to handle my job satisfactorily.	Ich weiß nicht genügend über neue Technologien, um meine Arbeit zufriedenstellend erledigen zu können.	Ragu-Nathan et al. (2008)
I need a long time to understand and use new technologies.	Ich brauche lange, um neue Technologien zu verstehen und anzuwenden.	Ragu-Nathan et al. (2008)
I do not find enough time to study and upgrade my technology skills.	Ich finde nicht genug Zeit, um mir technologische Fähigkeiten anzueignen und sie zu erweitern.	Ragu-Nathan et al. (2008)
I find new recruits to this organization know more about computer technology than I do.	Ich finde, dass neue Mitarbeiter in dieser Organisation mehr über neue Technologien wissen als ich.	Ragu-Nathan et al. (2008)
I often find it too complex for me to understand and use new technologies.	Ich finde es oft zu komplex, neue Technologien zu verstehen und anzuwenden.	Ragu-Nathan et al. (2008)
Techno-insecurity		
I feel constant threat to my job security due to new technologies.	Ich habe durchgehend das Gefühl, dass mein Arbeitsplatz durch neue Technologien bedroht ist.	Ragu-Nathan et al. (2008)
I do not share my knowledge with my coworkers for fear of being replaced.	Ich teile mein Wissen nicht mit meinen Kollegen aus Angst, ich könnte ersetzt werden.	Ragu-Nathan et al. (2008)
I have to constantly update my skills to avoid being replaced.	Ich muss meine technologischen Fähigkeiten ständig auf dem Laufenden halten, um zu vermeiden, dass man mich ersetzt.	Ragu-Nathan et al. (2008)
I am threatened by coworkers with newer technology skills.	Ich fühle mich durch Kollegen mit aktuelleren Technologiekenntnissen bedroht.	Ragu-Nathan et al. (2008)
I feel there is less sharing of knowledge among coworkers for fear of being replaced.	Ich habe das Gefühl, dass die Kollegen weniger Wissen teilen aus Angst, sie könnten ersetzt werden.	Ragu-Nathan et al. (2008)
Techno-uncertainty		
There are always new developments in the technologies we use in our organization.	Bei den Technologien, die wir in unserer Organisation verwenden, gibt es laufend neue Entwicklungen.	Ragu-Nathan et al. (2008)
There are constant changes in computer software in our organization.	In unserer Organisation gibt es laufend Änderungen hinsichtlich der Computersoftware.*	Ragu-Nathan et al. (2008)

(continued)

There are constant changes in computer hardware in our organization.	In unserer Organisation gibt es laufend Änderungen hinsichtlich der Computerhardware.	Ragu-Nathan et al. (2008)
There are frequent upgrades in computer networks in our organization.	In unserer Organisation gibt es häufig Upgrades von Computernetzwerken.	Ragu-Nathan et al. (2008)
Techno-induced role ambiguity		
I am unsure what to prioritize: dealing with IT problems or my work activities.	Ich bin mir unsicher, ob ich mich vorrangig mit den Problemen durch neue Technologien oder mit meinen eigentlichen Arbeitsaufgaben beschäftigen soll.	Ayyagari et al. (2011)
I cannot allocate time properly for my work activities because my time spent on IT-activities varies.	Ich kann meine Arbeitszeit nicht richtig einteilen, weil ich nie genau abschätzen kann, wie viel Zeit ich für den Umgang mit neuen Technologien benötige.	Ayyagari et al. (2011)
Time spent resolving IT problems takes time away from fulfilling my work responsibilities.	Die Zeit, die ich mit der Lösung von Problemen durch neue Technologien verliere, fehlt mir dann für das Bearbeiten meiner eigentlichen Arbeitsaufgaben.	Ayyagari et al. (2011)

Note. Items marked with * were not included in Study 9.

Telepressure

(Barber & Santuzzi, 2015; used in Studies 5 and 8)

Table D5

Items measuring telepressure

Preoccupation	
It's hard for me to focus on other things when I receive a message from someone.	Es fällt mir schwer, mich auf andere Dinge zu fokussieren, wenn ich eine Nachricht von jemandem erhalte.
I can concentrate better on other tasks once I've responded to my messages.	Ich kann mich besser auf andere Aufgaben konzentrieren, sobald ich meine Nachrichten beantwortet habe.
I can't stop thinking about a message until I've responded.	Ich kann nicht aufhören über eine Nachricht nachzudenken bis ich geantwortet habe.
Urge	
I feel a strong need to respond to others immediately.	Ich fühle ein starkes Bedürfnis anderen sofort zu antworten.
I have an overwhelming feeling to respond right at that moment when I receive a request from someone.	Ich habe ein überwältigendes Gefühl im selben Moment zu antworten, wenn ich eine Anfrage von jemandem erhalte.
It's difficult for me to resist responding to a message right away.	Es fällt mir schwer zu widerstehen sofort auf eine Nachricht zu antworten.

Technostress inhibitors

(Ragu-Nathan et al., 2008; used in Studies 6 and 8)

Table D6
Items measuring technostress inhibitors

Literacy facilitation	
Our organization emphasizes teamwork in dealing with new technology-related problems.	Unsere Organisation betont, dass wir uns bei technologiebezogenen Problemen im Team gegenseitig weiterhelfen sollen.
Our organization encourages knowledge sharing to help deal with new technology.	Unsere Organisation fördert den Wissensaustausch, damit wir besser mit neuen Technologien umgehen können.
Our organization provides end-user training before the introduction of new technology.	Unsere Organisation bietet (Anwender-) Trainings an, bevor neue Technologien eingeführt werden.
Our organization fosters a good relationship between IT department and end users.	Unsere Organisation fördert ein gutes Verhältnis zwischen der IT-Abteilung und den Anwendern.
Our organization provides clear documentation to end users on using new technologies.	Unsere Organisation bietet den Anwendern klare Dokumentationen zur Verwendung neuer Technologien an.
Technical support provision	
Our end-user help desk does a good job of answering questions about technology.	Unser Helpdesk macht bei der Beantwortung von technologischen Fragen einen guten Job.
Our end-user help desk is well staffed by knowledgeable individuals.	Unser Helpdesk ist mit kompetenten Mitarbeitern besetzt.
Our end-user help desk is easily accessible.	Unser Helpdesk ist gut erreichbar.
Our end-user help desk is responsive to end-user requests.	Unser Helpdesk beantwortet Anfragen der Anwender zügig.
Involvement facilitation	
Our end users are encouraged to try out new technologies.	Anwender werden bei uns dazu ermutigt, neue Technologien auszuprobieren.
Our end users are consulted before introduction of new technology.	Anwender werden bei uns vor der Einführung neuer Technologien zu Rate gezogen.
Our end users are involved in technology change and/or implementation.	Anwender werden bei uns bei der Umsetzung oder Änderung neuer Technologien mit einbezogen.

Detachment

(Sonnentag & Fritz, 2007; used in Studies 5, 7, 8, and 9)

Table D7
Items measuring detachment

I forget about work.	In meiner Freizeit vergesse ich die Arbeit.
I don't think about work at all.	In meiner Freizeit denke ich überhaupt nicht an die Arbeit.
I distance myself from my work.	In meiner Freizeit gelingt es mir, mich von meiner Arbeit zu distanzieren.
I get a break from the demands of work.	In meiner Freizeit gewinne ich Abstand zu meinen beruflichen Anforderungen.

Engagement and satisfaction

(used in Studies 6, 7, 8, and 9)

Table D8
Items measuring engagement and satisfaction

At my job, I feel strong and vigorous.	Beim Arbeiten fühle ich mich fit und tatkräftig.	Schaufeli & Bakker (2003)
I am proud of the work that I do.	Ich bin stolz auf meine Arbeit.	Schaufeli & Bakker (2003)
Time flies when I am working.	Bei der Arbeit vergeht die Zeit wie im Flug.	Schaufeli & Bakker (2003)
So far I have achieved all my goals at work.	Bis jetzt habe ich alle meine Ziele bei der Arbeit erreicht.	Hoegl et al. (2004)
I am satisfied with my work performance to this point.	Ich bin zufrieden mit meiner Arbeitsleistung.	Hoegl et al. (2004)
All in all, I am satisfied with my work.	Alles in allem bin ich mit meiner Arbeit zufrieden.	Cammann, Fichman, Jenkins, & Klesh (1979) as cited in Bowling & Hammond (2008)

Stress and strain

(used in Studies 5, 6, 7, 8, and 9)

Table D9
Items measuring stress and strain

Stress means a situation in which a person feels tense, restless, nervous or anxious or is unable to sleep at night because his/her mind is troubled all the time. Do you feel this kind of stress these days? (not in Study 5)	Stress bedeutet eine Situation, in der sich eine Person angespannt, unruhig, nervös oder ängstlich fühlt oder nachts nicht schlafen kann, weil ihr ständig Probleme im Kopf herumschwirren. Erleben Sie diese Art von Stress zur Zeit?	Elo et al. (2003)
I feel exhausted.	Ich fühle mich erschöpft.	Haslam & Reicher (2006)
I feel frustrated.	Ich bin frustriert.	Haslam & Reicher (2006)
I don't really care what happens to my colleagues or customers any more. (not in Study 9)	Meine Kollegen oder Kunden kümmern mich nicht mehr wirklich.	Haslam & Reicher (2006)
My body hurts after work.	Mein Körper tut mir nach der Arbeit weh.	Frese (1985)
I lose much sleep over worry.	Ich bekomme vor lauter Sorgen nicht genug Schlaf.	Goldberg (1972) as cited in Banks et al. (1980)
I feel I cannot overcome my difficulties.	Ich habe das Gefühl, dass ich meine Probleme nicht überwinden kann.	Goldberg (1972) as cited in Banks et al. (1980)
When I think about my job I get a tight feeling in my chest. (not in Studies 6, 7, and 8)	Wenn ich an meine Arbeit denke, spüre ich ein beengtes Gefühl in meiner Brust.	Parker & DeCotiis (1983)
I have felt nervous as a result of my job. (not in Studies 6, 7, and 8)	Ich leide durch meine Arbeit an Nervosität	Parker & DeCotiis (1983)
Often my job drives me right up the wall. (not in Studies 6, 7, and 8)	Meine Arbeit bringt mich oft „auf 180".	Parker & DeCotiis (1983)
I often think about quitting.	Ich denke oft darüber nach zu kündigen.	Schaubroeck, Cotton, & Jennings (1989)
I will probably look for a new job in the next year.	Ich werde mich wahrscheinlich im nächsten Jahr nach einem neuen Job umsehen.	Schaubroeck, Cotton, & Jennings (1989)

Sleep quality

(Jenkins et al., 1988; used in Studies 5 and 8)

Table D10
Items measuring sleep quality

How often in the past month did you: Have trouble falling asleep?	Wie oft im letzten Monat hatten Sie Probleme einzuschlafen?
How often in the past month did you: Wake up several times per night?	Wie oft im letzten Monat sind Sie mehrmals pro Nacht aufgewacht?
How often in the past month did you: Have trouble staying asleep (including waking far too early)?	Wie oft im letzten Monat hatten Sie Probleme durchzuschlafen (einschließlich viel zu frühes Aufwachen)?
How often in the past month did you: Wake up after your usual amount of	Wie oft im letzten Monat sind Sie nach Ihrer normalen Menge an Schlaf aufgewacht und haben sich müde und schlapp gefühlt?

Sleep quantity

(Gronover, 2018 based on Barber & Jenkins, 2014; used in Study 8)

Table D11
Item measuring sleep quantity

How many hours of sleep did you get on average per week in the last month?	Wie viele Stunden Schlaf haben Sie durchschnittlich pro Woche im letzten Monat bekommen?

Commitment

(Felfe et al., 2002; used in Study 6)

Table D12
Items measuring commitment

I would be very happy to be able to continue my working life in this organisation	Ich wäre sehr froh, mein weiteres Arbeitsleben in dieser Organisation verbringen zu können
I am proud to belong to this organisation	Ich bin stolz darauf, dieser Organisation anzugehören
I feel a strong sense of belonging to my organisation	Ich empfinde ein starkes Gefühl der Zugehörigkeit zu meiner Organisation
I think my values match those of the organisation	Ich denke, dass meine Wertvorstellungen zu denen der Organisation passen

Productivity

(Tarafdar et al., 2007; used in Study 8)

Table D13
Items measuring productivity

Information and communications technologies help to improve the quality of my work.	Informations- und Kommunikationstechnologien helfen, die Qualität meiner Arbeit zu verbessern.
Information and communications technologies help to improve my productivity.	Informations- und Kommunikationstechnologien helfen, meine Produktivität zu verbessern.
Information and communications technologies help me to cope with more work than would otherwise be possible.	Informations- und Kommunikationstechnologien helfen mir dabei, mehr Arbeit bewältigen zu können als sonst möglich wäre.
Information and communications technologies help me to do my job better.	Informations- und Kommunikationstechnologien helfen mir, meine Arbeit besser ausführen zu können.

Innovation

(Welbourne et al., 1998; used in Study 8)

Table D14
Items measuring innovation

I'm coming up with new ideas at work.	Im Rahmen meiner Arbeit fallen mir neue Ideen ein.
I'm working to implement new ideas at work.	In der Arbeit bemühe mich darum, neue Ideen zu implementieren.
I'm finding improved ways to do things at work.	Im Rahmen meiner Arbeit suche ich nach besseren Wegen, um Dinge umzusetzen.
I'm creating better processes and routines at work.	In der Arbeit entwickle ich bessere Prozesse und Routinen.

Work-life-balance

(Valcour, 2007; used in Study 7)

Table D15
Items measuring work-life-balance

Please indicate for the following statements on a scale from very dissatisfied (1) to very satisfied (5) how satisfied you are with them in your life.	Bitte kreuzen Sie bei den folgenden Aussagen von „sehr unzufrieden" (1) bis „in sehr hohem Maße zufrieden" (5) an, inwiefern Sie diesen in Ihrem Leben zufrieden sind.
The way you divide your time between work and personal or family life	Mit der Art und Weise, wie ich meine Zeit zwischen Arbeit und Privat- oder Familienleben aufteile, bin ich...
the way you divide your attention between work and home	Mit der Art und Weise, wie ich meine Aufmerksamkeit zwischen Arbeit und Zuhause aufteile, bin ich …
how well your work life and your personal or family life fit together	Wie gut mein Arbeitsleben und Privat- oder Familienleben zusammenpassen, macht mich...
your ability to balance the needs of your job with those of your personal or family life	Die Fähigkeit, die Bedürfnisse meiner Arbeit mit denen meines Privat- oder Familienlebens in Einklang zu bringen, macht mich…
the opportunity you have to perform your job well and yet be able to perform home-related duties adequately.	Die Möglichkeit, dass ich meinen Job gut erledigen kann und dennoch in der Lage bin, privat- oder familienbezogene Aufgaben angemessen zu erledigen, macht mich…

Work-life-conflict

(Geurts et al., 2005; used in Study 7)

Table D16
Items measuring work-life-conflict

How often does it happen that …	Wie oft passiert es, dass ...
You are irritable at home because your work is demanding?	Sie zu Hause gereizt sind, weil Ihre Arbeit anspruchsvoll ist?
You do not fully enjoy the company of your spouse/family/friends because you worry about your work?	Sie die Gesellschaft Ihres Partners/Ihrer Familie/Ihrer Freunde nicht in vollem Umfang genießen, weil Sie sich um Ihre Arbeit sorgen?
You find it difficult to fulfil your domestic obligations because you are constantly thinking about your work?	Sie Schwierigkeiten haben, Ihre häuslichen Verpflichtungen zu erfüllen, weil Sie ständig über Ihre Arbeit nachdenken?
You have to cancel appointments with your spouse/family/friends due to work-related commitments?	Sie aus beruflichen Gründen Termine mit Ihrem Partner / Ihrer Familie / Ihren Freunden absagen musst?
Your work schedule makes it difficult for you to fulfil your domestic obligations?	Ihr Arbeitszeitplan es Ihnen schwer macht, Ihr häuslichen Verpflichtungen zu erfüllen?
You do not have the energy to engage in leisure activities with your spouse/family/friends because of your job?	Sie aufgrund Ihrer Arbeit nicht die Energie haben, mit Ihrem Partner / Ihrer Familie / Ihren Freunden Freizeitaktivitäten zu betreiben?
You have to work so hard that you do not have time for any of your hobbies?	Sie so hart arbeiten müssen, dass Sie für keines Ihrer Hobbys Zeit haben?
Your work obligations make it difficult for you to feel relaxed at home?	Ihre beruflichen Verpflichtungen es Ihnen schwer machen, sich Zuhause zu entspannen?
Your work takes up time that you would have liked to spend with your spouse/family/friends.	Ihre Arbeit Zeit in Anspruch nimmt, die Sie gerne mit Ihrem Partner / Ihrer Familie / Ihren Freunden verbracht hätten.

IT resilience

(Klesel et al., 2018; used in Study 9)

Table D17
Items measuring IT resilience

In situations where stress is caused by technology in general or technology use, …	In Situationen, in denen Stress durch Technologie im Allgemeinen oder die Nutzung von Technologie verursacht wird, …
... I tend to bounce back quickly.	… gewinne ich schnell wieder an Fassung.
... I have a hard time making it through those situations. (R)	… fällt es mir schwer, diese Situationen durchzustehen. (R)
... It does not take me long to recover.	… brauche ich nicht lange, um mich zu erholen.
... It is hard for me to snap back. (R)	… ist es schwer für mich, mich wieder einzukriegen. (R)
... I usually come through those times with little trouble.	… stehe ich diese Zeiten meistens ohne große Probleme durch.
… I tend to take a long time to get over it. (R)	… fällt es mir schwer, diese Situationen durchzustehen. (R)
When using my technologies, …	Wenn ich meine Technologien (Methoden, Systeme und Geräte) nutze, …
… I make sure I take breaks to maintain my strength and energy.	… achte ich darauf, Pausen zu machen, um meine Kraft und Energie aufrechtzuerhalten.
… I am careful that they do does not dominate my personal life.	… achte ich darauf, dass sie nicht mein persönliches Leben dominieren.
… I am able to adapt to changes.	… kann ich mich an Veränderungen anpassen.
… I am confident in working with them.	… bin ich selbstsicher im Umgang mit ihnen.
… I feel comfortable with them.	… fühle ich mich wohl mit ihnen.
… I am sure I can work with them.	… bin ich mir sicher, dass ich mit ihnen umgehen kann.
… I can work with them even if no one tells me how to do it.	… kann ich mit ihnen umgehen, auch wenn mir niemand erklärt, wie.
… I can handle them better than most.	… kann ich besser mit ihnen umgehen als die Meisten.
When things go wrong or I have problems in using technologies, …	Wenn Dinge schieflaufen oder ich Probleme bei der Nutzung von Technologien (Methoden, Systeme und Geräte) habe, …
… they usually overshadows [sic] the other parts of my life. (R)	… überschattet das für gewöhnlich andere Bereiche meines Lebens. (R)
… they don't ever "faze me" for long.	… beeinflussen sie mich nicht lange.

(continued)

… they drag me down. (R)	… ziehen sie mich runter. (R)
… I have developed some reliable ways to relax.	… habe ich verlässliche Wege gefunden, um zu entspannen.
… I can deal with whatever comes.	… kann ich mit was auch immer passiert, umgehen.
… past success gives me confidence for them.	… geben mir vergangene Erfolge hierfür Selbstvertrauen.
… I have close and secure relationships.	… habe ich enge und sichere Beziehungen.
… I can make unpopular or difficult decisions.	… kann ich unbeliebte oder schwierige Entscheidungen treffen.
… I prefer to take the lead in problem solving.	… bevorzuge ich es, bei der Problemlösung die Leitung zu übernehmen.
… I see the humorous side of things.	… sehe ich die humorvolle Seite der Dinge.
… coping with this stress strengthens me.	… stärkt mich die Bewältigung dieses Stresses.
… under this pressure, I focus and think clearly.	… kann ich mich unter diesem Druck fokussieren und klar denken.
… I prefer to have structured plans.	...bevorzuge ich es, strukturierte Pläne zu haben.
… I maintain daily rules even in difficult situations.	… behalte ich sogar in schwierigen Situationen tägliche Routinen bei.
… and I have a goal, I do my best to attain it.	… und ich ein Ziel habe, gebe ich mein Bestes, es zu erreichen.
… regular rules make my daily life easier.	… machen regelmäßige/ routinierte Regeln mein Alltagsleben einfacher.

Annex

Single items used in the app for Study 9

Table D18
Items used in the app for Study 9 to examine work, detachment, satisfaction, and stress

Work: Did you work today?	Hast Du heute gearbeitet?	
Detachment: To what extent have you been able to mentally detach from your work today in your leisure time?	Inwieweit konntest Du Dich heute in Deiner Freizeit gedanklich von der Arbeit distanzieren?	Based on Sonnentag & Fritz, 2007
Stress: Stress means a situation in which a person feels tense, restless, nervous or anxious or is unable to sleep at night because his/her mind is troubled all the time. Do you feel this kind of stress these days?	Stress bedeutet eine Situation, in der sich eine Person angespannt, unruhig, nervös oder ängstlich fühlt oder nachts nicht schlafen kann, weil ihr ständig Probleme im Kopf herumschwirren. Erlebst Du diese Art von Stress zur Zeit?	Elo et al., 2003
Satisfaction: To what extent do you agree with the following statement: All in all, I am satisfied with my life.	Inwieweit stimmst Du der folgenden Aussage zu? Alles in allem bin ich mit meinem Leben zufrieden	Based on Diener et al., 1985

Annex E – Specified Hypotheses for Study 8

Hypothesis 1: **ICT-specific demands are negatively related to well-being.**

Hypothesis 1a: Technostress creators, as ICT-specific demands, are negatively related to well-being (higher stress and strain, lower engagement and satisfaction, lower sleep quality and quantity).

Hypothesis 1b: Telepressure, as ICT-specific demand, is negatively related to well-being (higher stress and strain, lower engagement and satisfaction, lower sleep quality and quantity).

Hypothesis 1c: Digitalisation anxiety, as ICT-specific demand, is negatively related to well-being (higher stress and strain, lower engagement and satisfaction, lower sleep quality and quantity).

Hypothesis 2: **ICT-specific demands are negatively related to performance.**

Hypothesis 2a: Technostress creators, as ICT-specific demands, are negatively related to performance (lower productivity, lower innovation).

Hypothesis 2b: Telepressure, as ICT-specific demand, is negatively related to performance (lower productivity, lower innovation).

Hypothesis 2c: Digitalisation anxiety, as ICT-specific demand, is negatively related to performance (lower productivity, lower innovation).

Hypothesis 3: **Detachment mediates the relationship between ICT-specific demands and well-being.**

Hypothesis 3a: Detachment mediates the relationship between technostress creators, as ICT-specific demands, and well-being (stress and strain as reverse indicator, engagement and satisfaction, sleep quality, sleep quantity).

Hypothesis 3b: Detachment mediates the relationship between telepressure, as ICT-specific demand, and well-being (stress and strain as reverse indicator, engagement and satisfaction, sleep quality, sleep quantity).

Hypothesis 3c: Detachment mediates the relationship between digitalisation anxiety, as ICT-specific demand, and well-being (stress and strain as reverse indicator, engagement and satisfaction, sleep quality, sleep quantity).

Hypothesis 4: **Technostress inhibitors moderate the relationship between ICT-specific demands and well-being: A high degree of inhibitors can reduce the negative effect of ICT-specific demands on well-being.**

Hypothesis 4a: Technostress inhibitors moderate the relationship between technostress creators, as ICT-specific demands, and well-being (stress and strain as reverse indicator, engagement and satisfaction, sleep quality, sleep quantity).

Hypothesis 4b: Technostress inhibitors moderate the relationship between telepressure, as ICT-specific demand, and well-being (stress and strain as reverse indicator, engagement and satisfaction, sleep quality, sleep quantity).

Hypothesis 4c: Technostress inhibitors moderate the relationship between digitalisation anxiety, as ICT-specific demand, and well-being (stress and strain as reverse indicator, engagement and satisfaction, sleep quality, sleep quantity).

Hypothesis 5: **Technostress inhibitors moderate the relationship between ICT-specific demands and performance: A high degree of inhibitors can reduce the negative effect of ICT-specific demands on performance.**

Hypothesis 5a: Technostress inhibitors moderate the relationship between technostress creators, as ICT-specific demands, and performance (productivity, innovation).

Hypothesis 5b: Technostress inhibitors moderate the relationship between telepressure, as ICT-specific demand, and performance (productivity, innovation).

Hypothesis 5c: Technostress inhibitors moderate the relationship between digitalisation anxiety, as ICT-specific demand, and performance (productivity, innovation).

Hypothesis 6: **Technostress inhibitors moderate the relationship between ICT-specific demands and detachment: A high degree of inhibitors can reduce the negative effect of ICT-specific demands on detachment.**

Hypothesis 6a: Technostress inhibitors moderate the relationship between technostress creators, as ICT-specific demands, and detachment.

Hypothesis 6b: Technostress inhibitors moderate the relationship between telepressure, as ICT-specific demand, and detachment.

Hypothesis 6c: Technostress inhibitors moderate the relationship between digitalisation anxiety, as ICT-specific demand, and detachment.

Annex F – Screenshots of App in Study 9

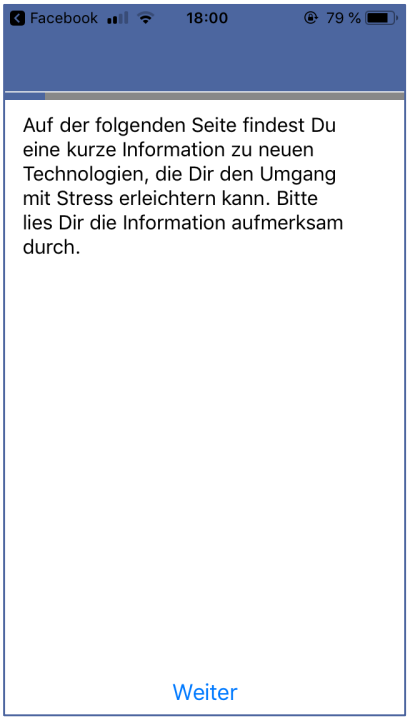

Figure F1. Introduction slide for informational group.

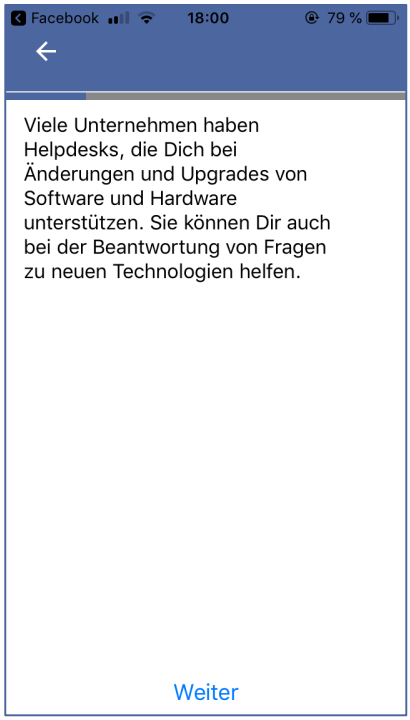

Figure F2. Exemplary statement 1 for informational group.

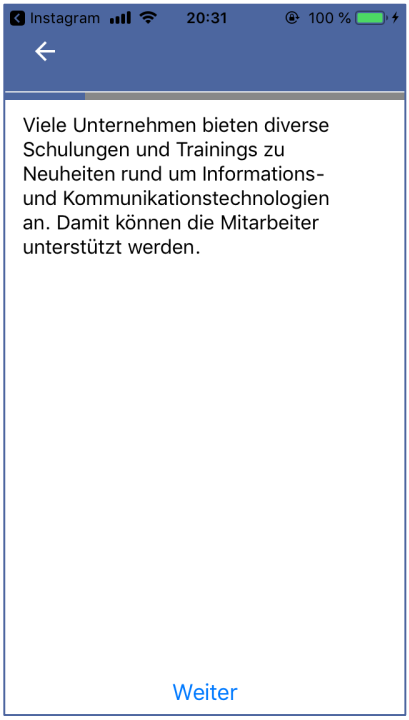

Figure F3. Exemplary statement 2 for informational group.

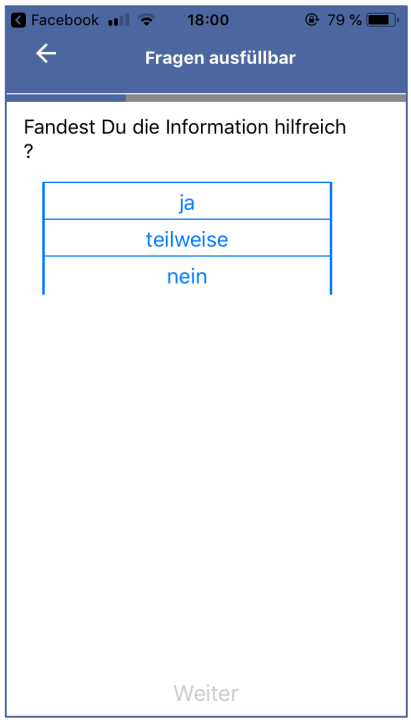

Figure F4. Item asking whether statement was helpful.

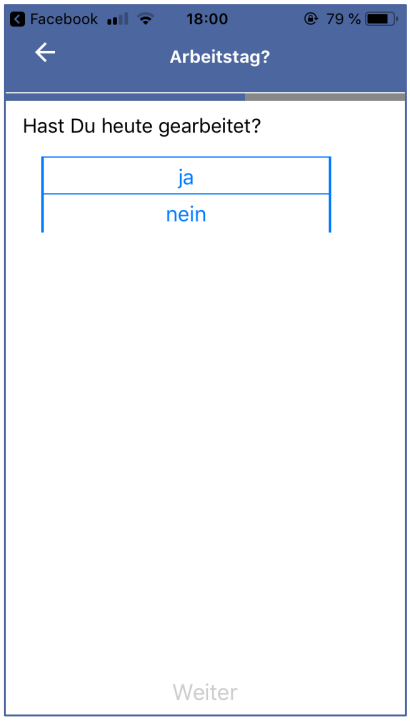

Figure F5. General question for all groups on work.

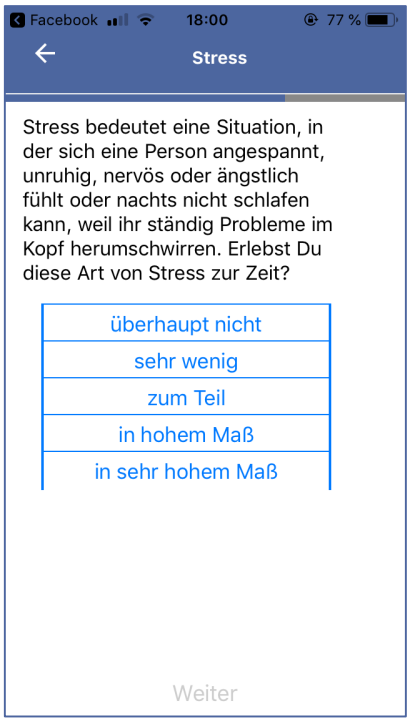

Figure F6. General question for all groups on stress.

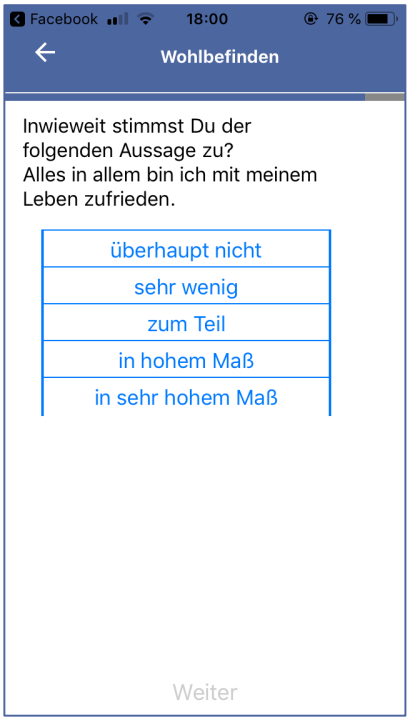

Figure F7. General question for all groups on satisfaction.

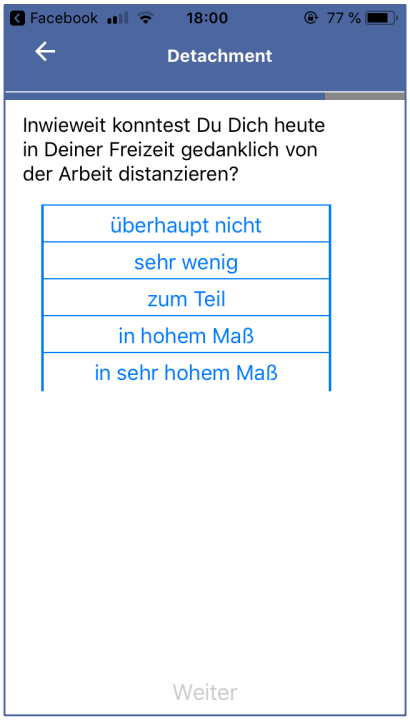

Figure F8. General question for all groups on detachment.

Annex G – Statements of Informational Intervention in Study 9

Statement 1:

Setting oneself personal goals concerning the use of technical tools (e.g. not checking work-related messages before 8 am in the morning) can help to reduce stress and increase well-being.

[Sich selbst persönliche Ziele zur Nutzung technischer Geräte zu setzen (z.B. keine arbeitsbezogenen Nachrichten vor 08:00 Uhr morgens zu checken) kann dabei helfen, Stress zu reduzieren und das Wohlbefinden zu steigern.]

Statement 2:

Did you know that most of the mobile phones have a „Do not disturb"-feature? During leisure time activating this feature (especially for messages which are related to work) can lead to an improved ability to detach from work. This can improve your mood and decrease tiredness.

[Wusstest Du, dass die meisten Mobilgeräte eine Nicht-Stören-Funktion besitzen? Während der Freizeit kann die Aktivierung dieser Funktion (v.a. für Nachrichten, die mit der Arbeit zusammenhängen) dazu führen, dass man besser von der Arbeit abschalten kann. Das kann zu besserer Laune und weniger Müdigkeit führen.]

Statement 3:

The awareness of being able to cope with the use of new technologies can help to increase well-being and performance at work. No matter how complex the technology is: You can handle it!

[Das Bewusstsein, den Umgang mit neuen Technologien meistern zu können, hilft dabei, Wohlbefinden und Leistung auf der Arbeit zu steigern. Egal wie komplex die Technologie auch ist: Du kannst sie meistern!]

Statement 4:

Many companies offer helpdesks which can support you with changes and upgrades of software and hardware. They can also help you with answering questions on new technologies.

[Viele Unternehmen haben Helpdesks, die Dich bei Änderungen und Upgrades von Software und Hardware unterstützen. Sie können Dir auch bei der Beantwortung von Fragen zu neuen Technologien helfen.]

Statement 5:

Many companies offer various workshops and trainings concerning news about information and communication technologies. With that employees can be supported.

[Viele Unternehmen bieten diverse Schulungen und Trainings zu Neuheiten rund um Informations- und Kommunikationstechnologien an. Damit können die Mitarbeiter unterstützt werden.]

Statement 6:

Writing a to-do-list before your official after-work hours with open tasks for the next day can help to mentally detach from work.

[Das Schreiben einer To-Do-Liste vor Feierabend mit offenen Aufgaben für den nächsten Tag kann dabei helfen, gedanklich von der Arbeit abschalten zu können.]