Individual Information Systems – Design, Use, and a Negative Outcome in the Business and Private Domain

DISSERTATION

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Abstract

Digitalization increasingly changes individuals' business and private lives. Today, individuals build and use ever more complex individual information systems (IIS) composed of privately-owned and business-owned components. The COVID-19 pandemic has accelerated this development since individuals were forced to work from home due to the social distancing measures associated with the pandemic. The ongoing digitalization comes with great opportunities for individuals, such as higher mobility and flexibility, as well as for organizations, such as lower costs and increased productivity. However, the increased use of IIS at the workplace also bears risks for individuals. Such risks include technostress, which refers to stress that is caused by digital technologies. Technostress, in turn, can lead to health-related issues, reduced productivity, and higher turnover intentions. Thus, to leverage the positive opportunities of digitalization while reducing its associated risk of technostress, a better understanding of IIS, their use, and its effect on technostress, and of individual resources that may affect this relationship is needed.

In information systems (IS) literature, the person-environment fit approach is a well-known theoretical basis for examining the use of digital technologies and its associated outcomes. It states that next to digital technologies in a person's environment, personal resources are crucial for the analysis. Compatibility between an individual's resources and environment, including its IIS, is associated with positive outcomes, whereas a lack of fit causes adverse outcomes. Correspondingly, this dissertation investigates the use of IIS and its outcomes and regards the interplay of an individual's resources and the IIS.

The aim of this dissertation is threefold: First, to contribute to a better understanding of layers of IIS and their different components. Second, since a negative outcome of IIS use can be technostress, this dissertation seeks to advance knowledge on technostress creators and how they can be influenced by IIS use and by various IIS characteristics. Third, this dissertation aims to reveal which resources of individuals may help mitigate technostress. This dissertation uses quantitative methods, such as online surveys and structural equation modeling, and qualitative methods, such as literature analyses and semi-structured interviews. Thereby, the methodological focus lies on quantitative data collection and analysis, while some papers use a mixed-methods approach as a combination of quantitative and qualitative methods.

Chapter 2 of this dissertation aims at providing a better understanding of IIS by investigating its various components. Therefore, Chapter 2.1 conceptualizes four layers of IIS: devices, digital identities, relationships, and information. It also considers that IIS have two more or less integrated subsystems: the business information systems with business-owned components and the private information systems with privately-owned components. An empirical validation supports this four-layer conceptualization as well as the definition of integration between the two sub-systems on each of the four layers. Chapter 2.2 studies IT consumerization, which refers to the use of private IIS components in the business domain and applies a risk-benefit consideration. The results imply that benefits of consumerization of IT services, such as better functionalities of a private IT service outweigh risks, such as the threat of sanctions for the use of private IT services in the business domain.

Chapter 3 focuses on the phenomenon of technostress as a negative outcome of the increased IIS use. Chapter 3.1 analyzes how IT consumerization is related to perceived unreliability of digital technologies, which is a well-known technostress creator. The results reveal a positive relationship between IT consumerization and unreliability and show that unreliability is perceived higher when the IT portfolio integration and the individual's computer self-efficacy are low. Chapter 3.2 proceeds with studying general characteristics of digital technologies and how these are related to technostress. It presents ten characteristics that are associated with at least one technostress creator. Chapter 3.3 extends the concept of technostress and introduces a framework of twelve different technostress creators. In doing so, Chapter 3.3 also reveals four second-order factors underlying the twelve technostress creators and brings them into relation with work- and health-related effects.

Chapter 4 also deals with technostress and investigates resources that help mitigate technostress. Chapter 4.1 focuses on organizational measures that can be introduced in the business domain and finds different relationships of the investigated measures with different technostress creators. While some of the technostress creators can be inhibited by the implementation of organizational measures, others are found to be even intensified by the organizational measures. Chapter 4.2 focuses on social mechanisms that function as technostress inhibitors. Findings differ between technostress creators and the investigated social support dimensions. Furthermore, the results highlight the fact that some of the social support dimensions gain even greater importance in light of increasing telework.

In summary, this dissertation provides new insights into IIS and their use, the emergence of technostress in digitalized workplaces, and organizational as well as social mechanisms that help mitigate technostress. Hence, this dissertation supports current efforts in both research and practice to reduce technostress while leveraging the positive opportunities of workplace digitalization.

Zusammenfassung

Die Digitalisierung verändert unser berufliches und privates Leben zunehmend und hat dazu geführt, dass Individuen heute immer komplexere individuelle Informationssysteme (IIS) nutzen. Die COVID-19-Pandemie hat diese Entwicklung zusätzlich beschleunigt, da Beschäftigte durch die Social-Distancing-Maßnahmen gezwungen waren, von zu Hause aus zu arbeiten. Die fortschreitende Digitalisierung der Arbeitswelt bringt sowohl für Individuen als auch für Organisationen große Chancen mit sich. Dazu gehören eine höhere Mobilität und Flexibilität für Beschäftigte sowie geringere Kosten und eine gesteigerte Produktivität für Unternehmen. Allerdings birgt die verstärkte Nutzung von IIS am Arbeitsplatz auch Risiken. Zu diesen Risiken gehört Technostress, also Stress, der durch digitale Technologien verursacht wird. Technostress wiederum kann zu gesundheitlichen Problemen, verringerter Produktivität sowie einer höheren Fluktuationsrate führen. Um die Chancen der Digitalisierung nutzen und gleichzeitig die Risiken des Technostresses reduzieren zu können, ist ein besseres Verständnis über IIS, deren Nutzung und deren Auswirkung auf Technostress erforderlich sowie darüber, welche individuellen Ressourcen diesen Zusammenhang beeinflussen.

Der Person-Environment-Fit-Ansatz ist in der Wirtschaftsinformatik-Literatur eine bekannte theoretische Grundlage, auf der die Nutzung digitaler Technologien und die damit verbundenen Folgen untersucht werden können. Er besagt, dass neben digitalen Technologien, von denen eine Person umgeben ist, die individuellen Ressourcen wichtig sind. Kompatibilität zwischen individuellen Ressourcen mit der Umwelt, einschließlich des IIS, ist mit positiven Folgen assoziiert. Ein Mangel an Kompatibilität bringt dagegen negative Folgen mit sich. Dementsprechend werden in dieser Dissertation die Nutzung von IIS und deren Folgen untersucht und es wird dabei das Zusammenspiel der individuellen Ressourcen und des IIS betrachtet.

Die vorliegende Dissertation verfolgt drei Ziele: Erstens soll zu einem besseren Verständnis über die Ebenen eines IIS und deren Komponenten beigetragen werden. Zweitens soll das Wissen über Auslöser von Technostress erweitert werden sowie darüber, wie Technostress durch die Nutzung von IIS und durch verschiedene IIS-Charakteristika beeinflusst werden kann. Drittens strebt die Dissertation an, aufzuzeigen, welche individuellen Ressourcen helfen können, Technostress zu verringern. Zu diesem Zweck werden quantitative Methoden, wie z. B. Online-Befragungen und Strukturgleichungsmodellierung, und qualitative Methoden, wie z. B. Literaturanalysen und semi-strukturierte Interviews, eingesetzt. Der methodische Schwerpunkt liegt dabei auf der quantitativen Datenerhebung und -analyse, wobei teilweise ein Mixed-Methods-Ansatz als Kombination von quantitativen und qualitativen Methoden verwendet wird.

Kapitel 2 dieser Dissertation zielt darauf ab, ein besseres Verständnis über IIS und deren verschiedene Komponenten zu erlangen. Dafür werden in Kapitel 2.1 vier Ebenen eines IIS konzeptualisiert: Devices, Digital Identities, Beziehungen und Informationen. Zudem berücksichtigt die Konzeptualisierung, dass ein IIS aus zwei mehr oder weniger integrierten Teilsystemen besteht: dem beruflichen und dem privaten Informationssystem. Eine empirische Validierung unterstützt die Vier-Ebenen-Konzeptualisierung sowie die Definition der Integration zwischen den beiden Subsystemen auf jeder der vier Ebenen. Kapitel 2.2 analysiert IT-Consumerization – also die Nutzung privater IIS-Komponenten im beruflichen Kontext. Die Ergebnisse zeigen, dass der relative Nutzen, wie z. B. bessere Funktionalitäten des privaten IT-Services, die wahrgenommenen Risiken, wie z. B. die Androhung von Sanktionen für die Nutzung privater IT-Services im beruflichen Kontext, überwiegt.

Kapitel 3 beschäftigt sich mit Technostress als negativer Folge der verstärkten IIS-Nutzung. In Kapitel 3.1 wird analysiert, wie IT-Consumerization mit wahrgenommener Unzuverlässigkeit digitaler Technologien, einem bekannten digitalen Belastungsfaktor, zusammenhängt. Die Ergebnisse zeigen einen positiven Zusammenhang zwischen IT-Consumerization und Unzuverlässigkeit. Diese wird stärker wahrgenommen, wenn die IT-Portfolio-Integration und die Computer-Selbstwirksamkeit des Individuums niedrig sind. Kapitel 3.2 untersucht Charakteristika digitaler Technologien und deren Zusammenhang mit Technostress. Es werden zehn Charakteristika gesammelt, die mit mindestens einem digitalen Belastungsfaktor zusammenhängen. Kapitel 3.3 erweitert das Technostress-Konzept und präsentiert zwölf digitale Belastungsfaktoren. Zudem werden vier Faktoren aufgedeckt, die den zwölf Belastungsfaktoren zugrunde liegen, und mit arbeits- und gesundheitsbezogenen Folgen in Zusammenhang gebracht.

Kapitel 4 beschäftigt sich weiter mit Technostress und untersucht Ressourcen, die helfen, Technostress zu mindern. Kapitel 4.1 untersucht organisatorische Maßnahmen und findet unterschiedliche Zusammenhänge der untersuchten Maßnahmen mit verschiedenen digitalen Belastungsfaktoren. Während einige der Belastungsfaktoren durch die organisatorischen Maßnahmen gehemmt werden können, werden andere sogar verstärkt. Kapitel 4.2 untersucht soziale Mechanismen, die Technostress verringern können. Die Ergebnisse zeigen unterschiedliche Auswirkungen der untersuchten Dimensionen sozialer Unterstützung auf die digitalen Belastungsfaktoren. Darüber hinaus wird deutlich, dass einige der Dimensionen sozialer Unterstützung angesichts der zunehmenden Arbeit von zuhause eine noch größere Bedeutung erlangen.

Zusammenfassend liefert die vorliegende Dissertation neue Erkenntnisse über IIS und deren Nutzung, die Entstehung von Technostress und über organisatorische sowie soziale

Mechanismen, die helfen, Technostress zu mindern. Damit leistet die Dissertation einen Beitrag zu den aktuellen Initiativen in Forschung und Praxis, Technostress zu reduzieren und gleichzeitig die Chancen der Digitalisierung der Arbeit zu realisieren.

Content Overview

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Motivation[1]

Digitalization has long since entered individuals' lives. Today, more than 90 % of people in Germany use the Internet (Statistisches Bundesamt et al. 2021). This high degree of digitalization affects the business as well as the private domain of modern life. The business world is adjusting to the increasing availability and use of digital technologies. This opens up an immense potential that far surpasses established boundaries as novel digital technologies facilitate higher control of work activities along with new forms of communication and collaboration (Cascio and Montealegre 2016). Furthermore, ever more routine activities in the workplace are being automated and tasks that require cognitive capabilities are rising (Manyika et al. 2017). In the private domain, there have also been rapid changes. Since the release of the first Apple iPhone in 2007, the share of people using smartphones in 2020 has reached 78 % in Germany and even 82 % in the United States (Newzoo 2020). In 2020, the digitalization of business and private lives was further accelerated through the emergence of the COVID-19 pandemic. Due to social distancing measures, many individuals started working from home, which expedited digital adoption in developed countries such as Germany (Richter and Mohr 2020).

Richard Baskerville (2011a, 2011b) was one of the first to track this ongoing digitalization of individuals and pointed out that they build and manage their own increasingly powerful individual information systems (IIS). Such IIS can be even larger and more complex than the organizational information systems that, in the past, have been managed by entire IT departments (Baskerville and Lee 2013). The intensive use of IIS in both the private and the business context has positive as well as negative outcomes for individuals. On the one hand, it opens up new opportunities like better access to information and higher flexibility (Colbert et al. 2016). On the other hand, the increased use of digital technologies can also lead to negative outcomes, such as stress (Tarafdar et al. 2019). Stress at the workplace caused by digital technologies has been referred to as technostress. Studies in this area can be traced back to the clinical psychologist Craig Brod (1982) who coined the term and described the phenomenon as an individual's inability to deal with new technology in a healthy manner.

[1] Since it is in the nature of a cumulative dissertation that it consists of individual research papers, parts of this section and the final Section 5 comprise content taken from the research papers included in this thesis. To improve the readability of the text, I omit the standard labeling of these citations.

The mandate of our times is to leverage the positive opportunities of the ongoing digitalization of individuals while reducing the risk of technostress. To accomplish this, organizations, individuals, and designers of digital technologies must gain a better understanding of IIS in general but also of IIS use and its effect on technostress, and of individual resources that may affect this relationship. Only then can we develop effective measures to ensure the successful digitalization of individuals.

1.2 Ongoing Digitalization of Individuals and its Consequences

For a long time, literature on information systems (IS) has focused on the organizational perspective so as to assess how IS can contribute to organizational success. However, through intensified digitalization of individuals due to the low-cost availability and ever-greater reach of information and communication technology, individuals have built their own IIS. Baskerville (2011a, p. 1) defines an IIS as "an activity system in which individual persons, according to idiosyncratic needs and preferences, perform processes and activities using information, technology, and other resources to produce informational products and/or services for use by themselves or others." To date, much research has been conducted on the features of IIS, on their use by individuals for private and business purposes, and on the associated outcomes of this use.

While increased use of IIS can be associated with positive outcomes for the individual, there are also several negative outcomes. Pirkkalainen and Salo (2016) summarized four areas on the "dark side" of IIS: technostress, information overload, IT addiction, and IT anxiety. The first one – technostress – is of great interest in IS research. According to the topical literature, technostress is born from a lack of balance between the demands of digital technologies and the resources of individuals to meet those demands (Tarafdar et al. 2019). In psychology literature, Lazarus and Folkman (1984) define stress as a result of an interplay between environmental demands and personal resources, which is "appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" (Lazarus and Folkman 1984, p. 19). In the case of technostress, such demands result from IIS use (Tarafdar et al. 2019). At times, technostress can be framed as positive, for instance, when digital technologies are appraised as challenging or thrilling, but for the main part, the term is perceived as negative in the sense that digital technologies can be appraised as a threat (Tarafdar et al. 2019). In the pages of this dissertation, the term technostress refers to this negative meaning.

A well-known theoretical basis on which to examine IS use in different contexts and its associated outcomes is the person-environment fit approach (Kristof-Brown et al. 2005). It states that analysis must not stop at the IS itself but rather extend to the individual's resources. Person-environment fit refers to a "compatibility between an individual and a work environment that occurs when their characteristics are well matched" (Kristof-Brown et al. 2005, p. 281). Person-environment fit is generally associated with positive outcomes, whereas a lack of fit causes negative outcomes for the individual. The person-environment fit approach has lent itself to research on IS use as well as to stress studies, which is why it serves as the theoretical framework of this dissertation. Figure 1.2-1 illustrates the simplified process of IIS use as an interplay between the IIS and individual resources, which produces technostress as a negative outcome.

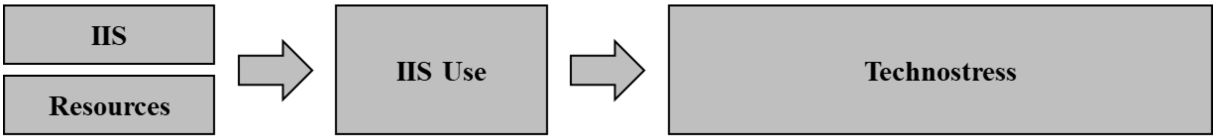

Figure 1.2-1: Theoretical Process on IIS Use and its Consequences

Different areas of IS research inspire this dissertation, such as studies of the general characteristics of IIS, research of IIS use at the intersection of business and private domains, and examinations of technostress that also account for the resources of individuals. Therefore, short introductions to all three of these key areas are provided in the following paragraphs.

Research on IIS in general and IIS use in particular began about ten years ago with the work of Richard Baskerville (2011a, 2011b). Speaking of the components of IIS, he states that two subsystems of IIS have to be considered (Baskerville 2011b): one, the "business information system" (BIS), which has components of the business domain of the individual, and two, the "private information systems" (PIS), which has components of the private domain. However, individuals do not exclusively use the BIS for business purposes and the PIS for private purposes. Rather, there can be an overlap in the use of BIS and PIS.

In the discussion of IIS use at the intersection of BIS and PIS, one concept that has received a lot of attention is IT consumerization (Niehaves et al. 2012). This concept is defined as the use of privately-owned IIS components for business purposes (Niehaves et al. 2012). This is one area in which BIS and PIS overlap – the use of the PIS in the business domain. Much research has been conducted to investigate the benefits due to which individuals engage in IT consumerization, and further studies have focused on the benefits and risks for organizations. For individuals, IT consumerization has been associated with increased creativity and innovative qualities as well as greater satisfaction, flexibility, mobility, and improved job performance (Behrens 2009; Harris et al. 2012; Weeger et al. 2015). However, it is also associated with a higher workload and blurred boundaries between the business and private domains (Weeger et al. 2015). As far as organizations are concerned, IT consumerization provides opportunities like reduced costs for digital technologies and higher employer attractiveness (Harris et al. 2012; Weeger et al. 2015), but these benefits also come with certain risks, such as IT security issues and a loss of control over digital technologies (Ortbach 2015; Weeger et al. 2015).

Research on technostress differentiates between different aspects of technostress: the creators, the outcomes, the antecedents, and the mitigation with the help of different resources. With regard to the former, five factors have been studied extensively: techno-invasion, techno-overload, techno-complexity, techno-insecurity, and techno-uncertainty. These technostress creators were first defined and analyzed by Tarafdar et al. (2007) and Ragu-Nathan et al. (2008).

Regarding the outcomes of technostress, organizational as well as individual well-being- and health-related consequences have been identified. Ragu-Nathan et al. (2008) found decreased job satisfaction, organizational commitment, and continuance commitment as outcomes of technostress. Meanwhile, lowered job performance and productivity have also been associated with technostress (Tarafdar et al. 2007; Tarafdar et al. 2015; Tu et al. 2005). As for the health of individuals, technostress is related to increased exhaustion and burnout (Day et al. 2012; Galluch et al. 2015; Srivastava et al. 2015) along with higher rates of headaches and sleeping difficulties (Gimpel et al. 2018).

Regarding the antecedents of technostress, several researchers have investigated how it is affected when different components of IIS are used. Ayyagari et al. (2011) found technology use in general and various characteristics of digital technologies to be associated with technostress creators. Other studies revealed the relationship between single digital technologies and technostress. Maier et al. (2015) found a link to certain characteristics of ERP systems, such as usefulness and reliability. Salo et al. (2019) examined aspects of social network services, Stich et al. (2019) analyzed the extent of email use and its effect on technostress, and Galluch et al. (2015) found that frequent interruptions while using digital technologies increase stress.

Regarding the potential mitigation of technostress, researchers have looked at multiple resources that individuals can use to mitigate technostress. These fall into two broad categories: technostress inhibitors and coping mechanisms. The former are “organizational mechanisms that have the potential to reduce the effects of technostress” (Ragu-Nathan et al. 2008, p. 422). The latter are mechanisms with which “users themselves aim to reduce technostress by deploying behavioral, cognitive, and perceptional efforts" (Weinert et al. 2020, p. 1203). Since this dissertation deals with organizational mechanisms, the research stream on technostress inhibitors will serve as the theoretical basis for the analysis of technostress mitigation. Three particular mechanisms have been identified by prior research: literacy facilitation, involvement facilitation, and technical support provision. Literacy facilitation refers to "mechanisms that encourage and foster the sharing of [digital technology]-related knowledge within the organization" (Ragu-Nathan et al. 2008, p. 427). Involvement facilitation denotes mechanisms that "[help] alleviate technostress by keeping users informed about the rationale for introducing new [digital technologies], by letting them know about the effects of such introduction, and by encouraging them to use and experiment with new [digital technologies]" (Ragu-Nathan et al. 2008, p. 427). Technical support provision refers to "activities related to end-user support that reduce the effects of technostress by solving users' [problems with digital technologies]" (Ragu-Nathan et al. 2008, p. 427). Several studies found technostress inhibitors to have positive effects on technostress outcomes such as job satisfaction, organizational commitment, continuance commitment, end-user satisfaction or productivity (e.g., Fuglseth and Sørebø 2014; Ragu-Nathan et al. 2008; Tarafdar et al. 2010; Tarafdar et al. 2011; Tu et al. 2008). Furthermore, Tarafdar et al. (2015), Tarafdar et al. (2010), and Tarafdar et al. (2011) found technostress inhibitors to have a direct negative impact on technostress creators.

1.3 Aim and Outline of this Thesis

In line with the person-environment fit approach (Kristof-Brown et al. 2005), this dissertation investigates the use of IIS and its consequences and, thereby, regards the interplay of an individual's (person) resources and the IIS (environment). The aim of this dissertation is threefold: First, to contribute to a better understanding of IIS design and its different components. As Baskerville and Lee (2013) have pointed out, IIS consist of two sub-systems: the private IIS and the business IIS. The first aim of this dissertation, then, extends to an improved understanding of the way in which individuals design their IIS with both private and business components. Second, since an especially problematic outcome of IIS use can be technostress, this dissertation seeks to advance knowledge not only on technostress creators but also on how they can be influenced by IIS use in general and various IIS characteristics in particular. Third, this dissertation aims to reveal which resources of individuals may have a positive impact on the relationship of IIS use and its consequences.

Figure 1.3-1 shows the outline of this thesis, starting with the introduction in Chapter 1. Chapter 2.1 presents a four-layer conceptualization of IIS. Chapter 2.2 investigates why employees choose to engage in IT consumerization, which is to say why they use private IIS components in the business context. Chapter 3.1 examines techno-unreliability as a negative outcome of IT consumerization. Chapter 3.2 proceeds by analyzing characteristics of digital technologies and their influence on technostress. Chapter 3.3 provides a comprehensive framework of twelve demands caused by digital work. It also provides a valid and reliable survey-based measurement model to assess these demands. Chapter 4 deals with both organizational (Chapter 4.1) and social support (Chapter 4.2) mechanisms that can mitigate technostress. Chapter 5 discusses the results, provides an outlook for future research, and offers concluding thoughts on this dissertation.

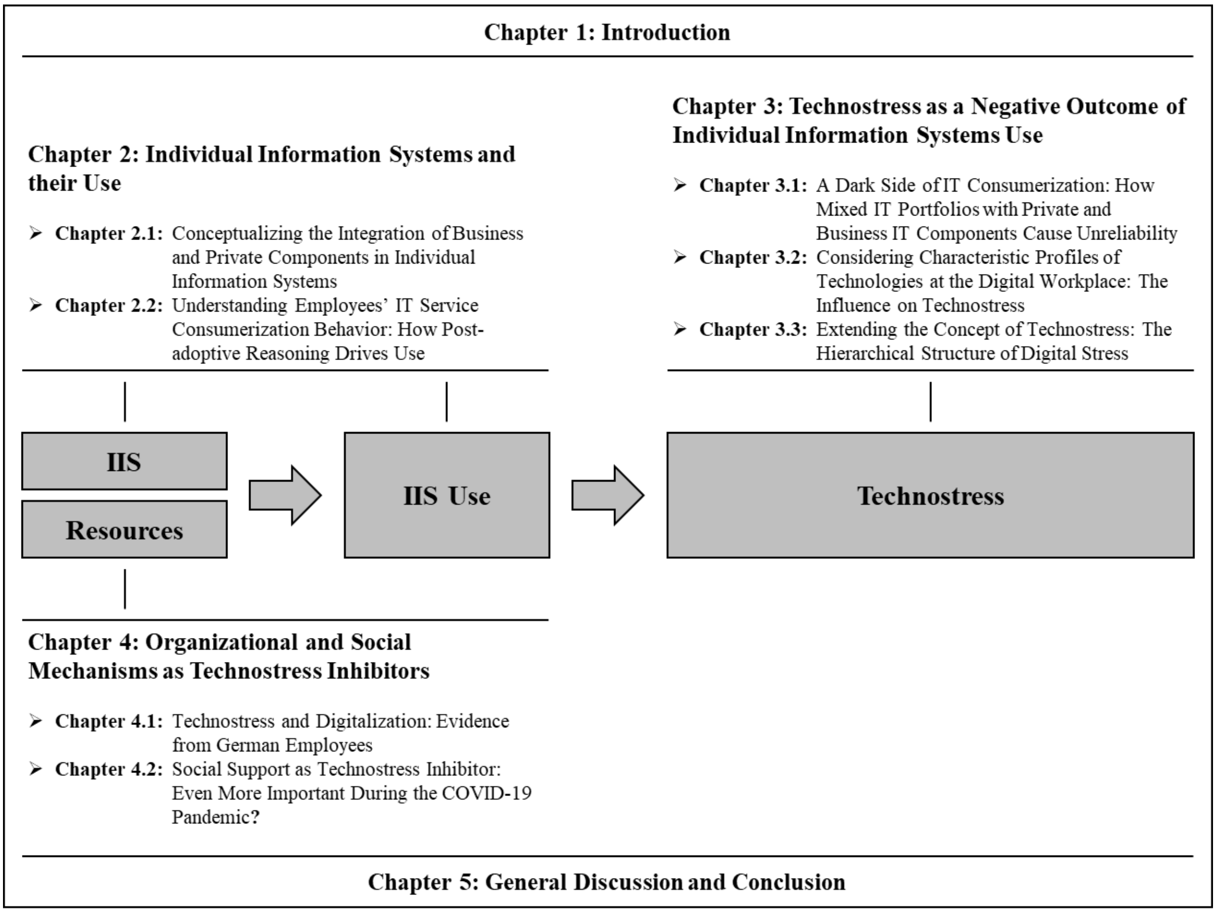

Figure 1.3-1: Structure of this Doctoral Dissertation

Table 1.3-1 gives an overview of the structure of this dissertation along with the research articles included therein. Chapter 2 illustrates IIS and their use (Paper 1 and Paper 2), Chapter 3 addresses technostress as a negative outcome of IIS use (Paper 3, Paper 4, and Paper 5), and Chapter 4 deals with certain organizational and social mechanisms as potential technostress inhibitors. Furthermore, the table presents the titles, co-authors, objectives, data collection, and research methods of the research articles. In the following, each part of this dissertation will be introduced whereupon the aims and research questions (RQ) of each of the papers will be outlined in more detail.

No.	Research Paper Title	Objective	Data Collection and Method	Co-Authors
Chapter 2: Individual Information Systems and their Use				
Paper 1 (Ch. 2.1)	Conceptualizing the Integration of Business and Private Components in Individual Information Systems	Conceptualization of IIS as well as IIS integration distinguishing four layers of IIS	Quantitative online survey, structural equation modeling	Afflerbach, Patrick; Gimpel, Henner; Utz, Lena
Paper 2 (Ch. 2.2)	Understanding Employees' IT Service Consumerization Behavior: How Post-adoptive Reasoning Drives Use	Investigation of the mechanisms by which employees choose to engage in IT consumerization	Mixed-methods study, quantitative and qualitative online survey, structural equation modeling	Schoch, Manfred; Gimpel, Henner
Chapter 3: Technostress as a Negative Outcome of Individual Information Systems Use				
Paper 3[1] (Ch. 3.1)	A Dark Side of IT Consumerization: How Mixed IT Portfolios with Private and Business IT Components Cause Unreliability	Investigation of how individuals are affected by negative outcomes of IT consumerization	Mixed-methods study, quantitative and qualitative online survey, structural equation modeling	Schoch, Manfred; Gimpel, Henner
Paper 4 (Ch. 3.2)	Considering Characteristic Profiles of Technologies at the Digital Workplace: The Influence on Technostress	Conceptualization and analysis of characteristics of digital technologies, their interplay at the workplace, and how they influence technostress	Mixed-methods study, structured literature analysis, qualitative interviews and focus group discussions, quantitative online survey, factor analysis, structural equation modeling	Becker, Julia; Berger, Michelle; Gimpel, Henner; Regal, Christian
Paper 5 (Ch. 3.3)	Extending the Concept of Technostress: The Hierarchical Structure of Digital Stress	Introduction of a comprehensive framework of twelve demands caused by digital work and introduction of a valid and reliable survey-based measurement model to assess the demands	Mixed-methods study, structured literature analysis, qualitative interviews and focus group discussions, quantitative online survey, factor analysis, hierarchical structural equation modeling	Gimpel, Henner; Regal, Christian; Urbach, Nils; Becker, Julia; Kühlmann, Torsten; Certa, Mathias; Tegtmeier, Patricia
Chapter 4: Organizational and Social Mechanisms as Technostress Inhibitors				
Paper 6[1] (Ch. 4.1)	Technostress and Digitalization: Evidence from German Employees	Analysis of the relationship between the degree of workplace digitalization and technostress, including the moderating effect of three technostress inhibitors	Quantitative online survey, structural equation modeling	Gimpel, Henner; Nüske, Niclas; Tarafdar, Monideepa
Paper 7 (Ch. 4.2)	Social Support as Technostress Inhibitor: Even More Important During the COVID-19 Pandemic?	Analysis of how social support mitigates technostress and how important this is at times of high telework (i.e., the COVID-19 pandemic)	Quantitative online survey, structural equation modeling, longitudinal regression analysis	-

[1] Please note that in these research papers, I was the lead author.

Table 1.3-1: Overview of Research Papers Included in this Dissertation

1.3.1 Individual Information Systems and their Use (Chapter 2)

Chapter 2 of this dissertation aims at providing a better understanding of IIS by investigating its various components. It includes two research articles that analyze IIS with regard to different layers of IIS and the two different domains of life in which IIS can be of use: the business and the private domain. To be more specific, Paper 1 conceptualizes and validates four layers of IIS while taking into account that IIS have two subsystems: the BIS and the PIS. Both may be integrated to some extent. Correspondingly, Paper 2 deals with IT consumerization, which refers to the use of private IIS components in the business domain.

Paper 1 addresses the ongoing digitalization, the associated ever-greater mobile accessibility, and how this, in turn, leads to increasingly blurred boundaries between the business and the private domains of modern life. In the social sciences, proponents of boundary theory state that individuals create boundaries around different domains of life in order to simplify their environment (Ashforth et al. 2000). IIS have been regarded as a new boundary management tactic (e.g., Golden and Geisler 2007) as individuals build their own IIS with the subsystems BIS and PIS (Baskerville 2011b). These subsystems can be completely integrated, which means that components from the BIS are used for both business and private purposes while components from the PIS are used for both private and business purposes. Also, the subsystems can be completely segmented. Alternatively, they can be in a state between complete segmentation and complete integration (Köffer et al. 2015). Prior research on IIS as a boundary management tactic has largely focused on the smartphone as a component of IIS, rather than on the IIS as a whole (Duxbury et al. 2014; Yun et al. 2012). Therefore, Paper 1 aims to make two key contributions to literature: First, Paper 1 conceptualizes IIS as a composite of four layers: devices, digital identities, relationships, and information. Second, Paper 1 looks at IIS integration on each of the layers, which broadens the perspective of prior research by taking a holistic view of IIS, rather than investigating single components. To validate this conceptualization, Paper 1 presents an empirical study testing a theoretical model that includes IIS integration on multiple layers. In short, Paper 1 addresses the following research question:

> *RQ1: How can IIS integration be conceptualized and which components of an IIS have to be considered?*

Paper 2 further analyzes the use of IIS at the intersection of the business and private domains. It further investigates reasons why individuals use private components of IIS for business purposes. This phenomenon is called IT consumerization (Niehaves et al. 2012) and is associated with benefits for both organizations and individuals, such as increased creativity, innovativeness, mobility, flexibility, and productivity (e.g., Behrens 2009; Ortbach 2015; Weeger et al. 2015). However, it is also associated with significant risks like IT security breaches and data privacy implications as well as a loss of organizational control (Behrens 2009; Crossler et al. 2014; Gewald et al. 2017). While it has become rather easy for individuals to use private IT services like messenger apps that run on their private smartphones, it has also become rather difficult for IT departments to manage IT service consumerization and the associated risks. By drawing on post-adoption literature and conducting a quantitative survey, Paper 2 seeks to provide a detailed understanding of why individuals engage in IT service consumerization. Such an understanding is required to tailor bespoke initiatives with which organizations can balance IT consumerization benefits and risks. This aim is reflected in the following research question:

RQ2: What rationales drive IT service consumerization post-adoptive user behavior?

1.3.2 Technostress as a Negative Outcome of Individual Information Systems Use (Chapter 3)

Chapter 3 focuses on the phenomenon of technostress as a negative outcome of the increased digitalization of individuals. Paper 3 picks up where Paper 2 left off, analyzing how IT consumerization is related to different technostress creators. Paper 4 proceeds with a study of general characteristics of digital technologies and how these are related to technostress. Paper 5 further extends the concept of technostress and introduces a framework of twelve different technostress creators.

A lot of the literature on IT consumerization focuses on why individuals use private IIS components for business purposes. This trend has also seen researchers look at the positive outcomes of IT consumerization for individuals, far more so than they look at negative consequences. Indeed, those have largely been ignored. Two exceptions are Niehaves et al. (2012), who found some indication that stress might be an outcome of IT consumerization, and Köffer et al. (2014), who observed that organizational encouragement of IT consumerization leads to a work overload and work-to-life conflict. However, studies at the intersection of those two research streams – IT consumerization and technostress – are rare. Thus, Paper 3 provides a mixed-methods study that examines how IT consumerization and technostress are related. By way of a qualitative pre-study, the paper first identifies technostress creators that may have their roots in IT consumerization. Building on the results with a quantitative main study, Paper 3 analyzes the relationship between IT consumerization and the technostress creator unreliability.

Paper 3 thus has a joint focus. It examines IT consumerization behavior, particularly how IT consumerization, the extent of integration of an individual's IT portfolio and the individual's computer self-efficacy affect unreliability. It also examines negative outcomes of this unreliability. The aim of Paper 3, then, is to answer the following research question:

RQ3: How does IT consumerization behavior affect the negative side of technostress and what factors drive the relationship?

Further on the topic of IT portfolios, Paper 4 collects and analyzes characteristics of digital technologies in the workplace. Given the rise of digital technologies, organizations and individuals hope to realize positive outcomes, such as increased productivity, by designing a digital workplace that facilitates efficient and effective ways of working (Gartner 2020; Köffer 2015). This increased digitalization, however, has also been associated with technostress. Much of the research in this area has been concerned with the various technostress creators and potential outcomes of technostress as well as technostress inhibitors and coping mechanisms (e.g., Galluch et al. 2015; Ragu-Nathan et al. 2008; Tarafdar et al. 2007; Tarafdar et al. 2010; Weinert et al. 2020). To date, however, hardly any studies have examined how different digital technologies and their characteristics impact technostress (e.g., Ayyagari et al. 2011; Maier et al. 2015; Salo et al. 2019), and at the time of writing, there is no research on the characteristics of an entire IT portfolio in a digital workplace and how these relate to technostress. To close this research gap with a mixed-methods approach, Paper 4 deals with the following three research questions:

RQ4.1: Which characteristics of digital technologies with relation to technostress exist?

RQ4.2: How does the characteristic profile of specific digital technologies look like?

RQ4.3: What is the influence of characteristic profiles of digital technologies used at the workplace on technostress?

Starting with the seminal papers of Tarafdar et al. (2007) and Ragu-Nathan et al. (2008), technostress research began to investigate five creators of technostress: techno-invasion, techno-overload, techno-complexity, techno-insecurity, and techno-uncertainty. More than a decade after these studies, however, the development of digital technologies has continued and other demands of digital work have been identified in research (e.g., Adam et al. 2017; Ayyagari et al. 2011; Galluch et al. 2015). Against this background, Fischer et al. (2019) have posed the question of whether these five much-discussed technostress creators are still current or whether others have to be considered. Paper 5 revisits the existing concept of technostress and extends it by shedding light on the further demands that result from digital work and providing and understanding of the underlying structure. The methodology used for this purpose brings together a structured literature review, qualitative expert and focus group interviews, and a large-scale quantitative study. The aim of Paper 5 is summarized in the following two research questions:

RQ5.1: What demands from contemporary work practices relating to digital technologies cause stress for employees?

RQ5.2: How do these different demands relate to each other?

1.3.3 Organizational and Social Mechanisms as Technostress Inhibitors (Chapter 4)

Chapter 4 deals with technostress as a negative outcome of IIS use and considers resources that help mitigate this kind of stress. It includes two papers that investigate different technostress inhibitors that may help to reduce technostress creators. Paper 6 focuses on organizational measures that can be introduced in the business world, whereas Paper 7 focuses on social mechanisms that function as technostress inhibitors and may gain a greater significance in light of today’s increasing amount of telework.

Paper 6 focuses on the organizational perspective in the mitigation of technostress. While organizations aim to benefit from the introduction of new digital technologies in the business lives of their employees, they also have to consider technostress associated with the digitalization of workplaces. However, the relationship between workplace digitalization and technostress has hardly been investigated, a prominent exception being Ayyagari et al. (2011). With this in mind, Paper 6 is conceived as a contribution to literature since it investigates how the degree of workplace digitalization is linked with technostress in general and with various technostress creators in particular. As for the mitigation of these negative outcomes of workplace digitalization, Paper 6 builds on three well-known technostress inhibitors: literacy facilitation, involvement facilitation, and technical support provision (Ragu-Nathan et al. 2008). All three of these mechanisms can be implemented by organizations. Plenty of studies have analyzed the effect of these three technostress inhibitors on outcomes of technostress, such as Ahmad et al. (2014), Fuglseth and Sørebø (2014), Ragu-Nathan et al. (2008), and Tarafdar et al. (2011). Other studies have investigated whether technostress inhibitors have a direct inhibiting effect on technostress creators or rather a moderating effect on the relationship between workplace digitalization and technostress creators. Examples of these studies include Tarafdar et al. (2010), Tarafdar et al. (2011), and Tarafdar et al. (2015). The second aim of Paper 6, then, is to analyze these relationships in a quantitative survey with structural equation modeling. Both aims of Paper 6 are summarized in two research questions:

RQ6.1: How is the degree of workplace digitalization linked to technostress?

RQ6.2: How do the technostress inhibitors literacy facilitation, involvement facilitation, and technical support provision moderate the relationship of the degree of workplace digitalization and technostress?

The COVID-19 pandemic has further fostered digitalization of workplaces since employees were asked to engage in telework so as to comply with social distancing measures. As a result, not only has digital work increased, but working conditions like the availability of organizational support have changed due to the physical distance between employees and offices. Individuals have had to find other sources of support to mitigate the technostress associated with increased digital work. In the field of psychology, social support is a well-known concept for the mitigation of work stress (Barrera 1986) and has been found to decrease work stress or negative outcomes of work stress (e.g., Barnett et al. 2012; Barrera 1986; McCarty et al. 2007; Sass et al. 2011; Wolgast and Fischer 2017). Potential sources of social support include people in the environment of individuals like supervisors, co-workers, or family members. Paper 7 transfers the social support dimensions – supervisor support, co-worker support, sense of community at work, and family support – to technostress research. By means of a longitudinal quantitative study, Paper 7 analyzes whether these four dimensions of social support can inhibit technostress creators and whether social support is even more important at times when telework is high. With this, Paper 7 aims to shed light on the following research questions:

RQ7.1: Are different dimensions of social support effective technostress inhibitors?

RQ7.2: Is social support as technostress inhibitor more important during the COVID-19 pandemic?

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2 Individual Information Systems and their Use

2.1 Conceptualizing the Integration of Business and Private Components in Individual Information Systems

Abstract

Individuals build their individual information system (IIS) with which they manage the boundary between different domains of their lives. Developments like permanent mobile accessibility lead to a blurring boundary between the private and business domains of life. Some highly integrate the two IIS sub-systems (the private and the business information system), while others keep them more separate. Understanding IIS integration is essential as it affects well-being and performance in both domains. We introduce a conceptualization of IIS and IIS integration that distinguishes four layers of IIS: devices, digital identities, relationships, and information. To measure IIS integration, we develop a method based on the IIS components' usage frequencies in either domain. We aim to verify our conceptualization and the measurement method by empirically testing a theoretical model that includes IIS integration on multiple layers. We find empirical support for the theoretically hypothesized relationships within the model. This empirical evidence supports our conceptualization. Individuals, organizations, and IT designers striving to manage IIS integration for individual and organizational benefits may use these results.

Keywords: Individual Information Systems, Boundary Theory, IIS Integration, Structural Equation Modeling

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2.1.1 Introduction

Since Apple released the iPhone in 2007, smartphone use has increased rapidly. Until 2016, the share of adults who owned a smartphone reached 60 % in Germany and even 72 % in the U.S. (Poushter 2016). Besides smartphones, individuals today use a range of digital technologies, such as computers, tablets, and smartwatches. Owing to the variety of mobile devices, social networking sites, media streaming, online shopping, and other online services have also increased (vor dem Esche and Hennig-Thurau 2014). This development leads to greater mobility and increasing work outside offices (Global Workplace Analytics 2016) for which people use both business and private devices (Harris et al. 2012). The efforts to contain the spread of the SARS-CoV-2 virus and COVID-19 led to a rapid increase of employees working from home using devices, digital identities, and the like stemming from both the private and the business domain of their lives. The consequences of this ongoing digitalization stand to reason: private and business life increasingly tend to overlap (Köffer et al. 2015; Middleton et al. 2014; Scheepers and Middleton 2013).

The social sciences have been dealing with the integration of different domains of life for decades. According to boundary theory, individuals create boundaries around domains of life (e.g., the private and business domains) to simplify their environment (Ashforth et al. 2000). People use different tactics (e.g., time, space, physical artifacts) to manage their boundaries (Nippert-Eng 1996). Boundary management leads to domain integration, segmentation, or a stage between these two extremes. Boundary theory researchers investigated the creation of boundaries and the consequences of integration or segmentation. The main consequences of higher integration are domain blurring and more cross-domain interruptions (Ashforth et al. 2000). Further, work-life conflict can arise if one domain's responsibilities interfere with another's (Desrochers et al. 2005; Greenhaus and Beutell 1985).

Via ongoing digitalization, individual information systems (IIS) developed as a new possible boundary management tactic. This new tactic attracts much attention in boundary theory research (e.g., Golden and Geisler 2007). Further, IIS researchers have transferred constructs from boundary theory to explain the consequences of IIS integration or segmentation (e.g., Köffer et al. 2014a). People build their own IIS, which leads to more or less overlap between private and business life. An IIS has two sub-systems, which either serve us as a business person or as a private person (Baskerville 2011b). We call these sub-systems the "business information system" (BIS) and the "private information systems" (PIS). Notably, BIS and enterprise information systems (EIS) differ: BIS is a system of an individual in the business domain, while EIS refers to an entire organization. To date, most studies on IIS as a boundary management tactic concentrate on the technical artifact smartphone as a representative of a socio-technical IIS, which fosters integration, but have not investigated IISs as a whole (Duxbury et al. 2014; Yun et al. 2012). Moreover, IIS researchers have not yet explored that integration lies on a continuum between complete integration and complete segmentation (Köffer et al. 2015). We extend the literature by taking a holistic view on IIS and address the following research question:

> *How can IIS integration be conceptualized and which components of an IIS have to be considered?*

Researchers proposed different IIS conceptualizations varying in the sub-layers of an IIS, respectively, its sub-systems (e.g., Gaß et al. 2015; Lee et al. 2015). As the first contribution of this paper, we aim to combine the different views and propose a four-layer conceptualization of IIS. The four layers in this conceptualization are devices (i.e., the hardware tool like smartphones or laptops), digital identities (i.e., the representation of the individual in different IT services like the email address or phone number), relationships (i.e., the social ties which are connected via the technology layers of the IIS like colleagues or friends), and information (i.e., the information that is being processed by use of the technology layers of the IIS).

The second contribution of this paper is the conceptualization of IIS integration on each of the layers. By different use behaviors of their IIS on the different layers of the IIS, individuals can influence the amount of integration and segmentation of their private and business lives. When keeping their PIS and BIS apart, the overlap of both domains of life tends to be smaller. On the other hand, individuals can integrate the systems into the opposite domains – which, for example, means using the private devices and digital identities for both private and business matters – to integrate their private and business lives intentionally. We extend the literature by taking a holistic view of IIS and present a conceptualization of IIS integration regarding all four layers of IIS.

Sub-optimal integration of BIS and PIS as IIS sub-systems can lead to excessive degrees of work-life conflict, reduce individual well-being, and reduce work performance. Our conceptualization of IIS and IIS integration is a step towards supporting individuals, organizations, and IT designers in striving for (individually) optimal IIS integration levels to lessen the adverse effects arising from sub-optimal integration.

To empirically test our concept of IIS integration on the four layers and the measurement method, we build a research model based on Ashforth et al. (2000). We test the model empirically based on survey data and thereby follow the guidelines of MacKenzie et al. (2011) for construct measurement and validation. We find support for IIS integration on the four layers and the measurement method and find that IIS integration is highest at the device level and lowest at the relationship level. Our results support the relevance of considering IIS integration and provide a frame of reference for the analysis and management of IIS integration.

This paper's remainder is structured as follows: Section 2.1.2 sets up the theoretical foundation on boundary theory and IIS. Section 2.1.3 introduces the four layers of IIS and our conceptualization of IIS integration. Section 2.1.4 develops a research model and describes the design and operationalization of the survey and its results. Section 2.1.5 discusses the findings, theoretical contributions, and practical implications for individuals, organizations, and IT designers. The section also provides an outlook for future research.

2.1.2 Theoretical Background

2.1.2.1 Boundary Theory

Boundary theory emerged from social psychology and the organizational sciences. Individuals face and enact different roles, defined as "the building block of social systems and the summation of the requirements with which such systems confront their members as individuals" (Katz and Kahn 1978, pp. 219-220). To simplify the environment, individuals create and negotiate boundaries between their roles. These boundaries lead to creating fragments of life, or domains, each containing one or more roles. The two major domains are the private and the business domain (Ashforth et al. 2000; Nippert-Eng 1996; Rothbard et al. 2005).

Boundaries are everything that delimits a domain's scope (Ashforth et al. 2000). Individuals use different tools and tactics to manage their boundaries; this can be time, space, behaviors, or physical artifacts such as calendars, keys, or clothes. Teleworkers, for instance, often use time to divide their day into private time and business time or use space and set up one room solely for business matters (Fonner and Stache 2012; Jahn et al. 2016; Kreiner 2006; Nippert-Eng 1996; Park and Jex 2011).

Creating boundaries leads to higher domain segmentation. Domain segmentation describes the state in which individuals create boundaries that are inflexible and impermeable. Domains are separated without any overlaps in time, space, artifacts, and activities. At the other extreme, domain integration describes the state in which individuals deliberately design boundaries as flexible and permeable. This state implies that individuals make "no distinction […] between what belongs to 'home' or 'work' and when and where [one domain's roles] are engaged" (Nippert-Eng 1996, p. 567). Time, space, artifacts, and activities of the domains overlap entirely.

However, in these pure forms, integration and segmentation are very rare. The de facto shaping of boundaries lies on a continuum between integration and segmentation, leaning towards either pole (Ashforth et al. 2000; Kreiner 2006; Nippert-Eng 1996).

Integration and segmentation have three main consequences: domain blurring, the level of cross-domain interruptions, and the magnitude of transition between domains. Work-family blurring, for instance, is "the experience of difficulty in distinguishing one's work from one's family [domain]" (Desrochers et al. 2005, p. 460). Cross-domain interruptions are interruptions from one domain to another, for instance, a private call from the wife or husband during business hours (Ashforth et al. 2000; Chen and Karahanna 2014). The magnitude of transition between two domains is the effort needed to psychologically and physically leave one domain and enter another (Ashforth et al. 2000). Higher domain integration leads to higher domain blurring and more cross-domain interruptions, while higher segmentation leads to higher psychological and physical magnitude of transition between the domains (Ashforth et al. 2000).

The most investigated consequence of domain integration is work-life conflict (also called work-family or work-home conflict). This conflict arises when "pressures from the work and family domains are mutually incompatible in some respect" (Greenhaus and Beutell 1985, p. 77). Desrochers et al. (2005), for instance, found a positive effect of domain blurring on work-life conflict. In turn, work-life conflict can cause higher stress or strain and lower organizational commitment (Ahuja et al. 2007; Ayyagari et al. 2011; Yun et al. 2012).

An individual's preference for domain integration or segmentation matters. Domain integration does not automatically cause adverse effects. The moderating effect of the individual's preference is often referred to as person-environment fit – congruence between an individual's preference for integration and the de facto level experienced. A higher fit leads to positive outcomes, such as greater job satisfaction, higher organizational commitment, lower stress, and lower work-life conflict (Fonner and Stache 2012; Köffer et al. 2014a; Kreiner 2006; Rothbard et al. 2005).

2.1.2.2 Individual Information Systems

An IIS is a specific IS type. Baskerville (2011a, p. 1) defines IIS as "an activity system in which individual persons, according to idiosyncratic needs and preferences, perform processes and activities using information, technology, and other resources to produce informational products and/or services for use by themselves or others." Today, individuals are their own administrator and autonomously designing more and more powerful and complex IS, which are even larger and more complex than the organizational IS administrated by IT departments in the past (Baskerville and Lee 2013).

To identify the consequences of individualized IS, scholars have addressed the positive effects. On the personal side, these are advantages such as increased autonomy, motivation, or ease of adoption, and for organizations, the positive effects include higher adoption speed and increased employee availability (Del Prete et al. 2011; Dell and Intel 2011; Murdoch et al. 2010; Niehaves et al. 2012). Other studies have focused on the "dark side" of individual IS. In their meta-analysis, Pirkkalainen and Salo (2016) summarized these studies clustering IS's (not only IIS's) adverse effects on individuals into four areas: technostress, information overload, IT addiction, and IT anxiety. In addition to this classification, Pirkkalainen and Salo (2016) identified the contexts in which the four phenomena can be observed: business or private domain.

IT consumerization research investigates the reasons and consequences of privately owned IT used by employees for business purposes (Niehaves et al. 2012; Ortbach et al. 2013; Ortbach 2015). IT consumerization is one of two possible directions of IIS integration. IT consumerization research finds important consequences for individuals (increased flexibility and performance but also data privacy implications) as well as organizations (increased innovation in business processes but also increased IT security issues and loss of organizational control) (Behrens 2009; Ortbach 2015; Weeger et al. 2015). IT consumerization literature suggests the need for investigating the impacts of an IIS in which private and business domains are integrated to some extent.

As the business and private domain of life increasingly overlap and blur, an integrated consideration of both is necessary to identify IIS's impacts on individuals' whole lives. This IIS integration and the consequences of different extents of integration have not yet been studied.

2.1.2.3 Boundary Theory in IIS Research

Boundary theory and its related constructs explain the effects of more or less integrated domains of life, considering that boundaries are built using different tactics. IIS developed as a new possibility for managing boundaries. Individuals can connect to the private and the business domain, regardless of time or space, overcoming the traditional boundaries (Golden and Geisler 2007; Park and Jex 2011). Thus, the extent of an individual's overall domain integration is now more influenced by boundary management tactics. For instance, teleworkers may use two different rooms to segment their domains but may also use their computer in one room to write both business and private emails.

Responding to this development, IIS-related boundary management has become a key topic in boundary theory and in IS research (Duxbury et al. 2014; Fenner and Renn 2010; Jahn et al. 2016; Köffer et al. 2015; Kreiner 2006). While social science researchers analyze IIS as a new boundary management tactic that can generate new possible boundary-setting strategies (Golden and Geisler 2007; MacCormick et al. 2012), IIS researchers investigate the more intense integration of domains and the associated effects of higher domain blurring and more cross-domain interruptions (Chamakiotis et al. 2014; Koch et al. 2012; Köffer et al. 2014a). Further, integrated approaches combine knowledge from both disciplines to understand the consequences of IIS integration and boundary management (e.g., Duxbury et al. 2014; Jahn et al. 2016).

Concerning boundary management, Jahn et al. (2016) classified integration strategies using information technologies in relation to primary objectives: segmentation, integration, or mediation between the two. Further, Duxbury et al. (2014) interviewed 25 professional knowledge workers about how their individual smartphone use affects their lives, identifying different groups: integrators, who tend to integrate domains by use of their smartphone, segmentors, who tend to segment domains, and struggling segmentors, who only use their business devices during non-business hours owing to pressure from their organizations. Concerning the effects of IIS integration on individuals, Yun et al. (2012) found that the use of smartphones for both private and business tasks results in higher work-life conflict, which causes job stress. Generally concerned with mobile technology, Köffer et al. (2014a) investigated the impacts of organizational encouragement for such a dual-use of mobile technology. They show that the increased domain blurring from a higher IIS integration increases work-life conflict if the extent of integration does not fit an individual's segmentation preference. Köffer et al. (2014b) found that IIS integration positively affects job performance. Wang and Zhang (2015) examined services (e.g., social networking sites, instant messaging) as another component of an IIS, detecting the same effect: increased work-life conflict owing to higher domain blurring.

In summary, research at the intersection of boundary theory and IIS suggests that IIS has to be considered an important new boundary management tool influencing an individual's well-being. This relationship has to be further investigated. However, the literature on IIS and boundary theory has not yet addressed the fact that integrating two domains sits on a continuum between complete integration and complete segmentation.

2.1.3 Conceptualizing IIS Integration

To conceptualize IIS integration, we follow different steps: First, we conduct a qualitative user interview with one employee of a knowledge intense organization to get a feeling of his/her components of IIS and its integration and combine these notions with experiences of the researchers. Based on this information, we build a fictive persona called "Bob" to enhance IIS components' imageability and integration. Second, we search the literature to understand different categorizations of components of IIS and build a multi-layer definition of IIS based on the findings from literature and the qualitative insights. Third, we conceptualize the integration of the layers of IIS and suggest a measurement method for this integration.

2.1.3.1 An Example of an Integrated IIS

Bob is 31 years old and lives together with his partner. He is a project manager and has an office in his company, but often works from home. He has his room at home, which he uses as a workroom. Bob has a private and a business notebook but uses only (also in the office in the company) his private device for private and business purposes. He uses his private smartphone for his work and his private life, whereas he does not use the business smartphone at all. However, he plans to have a second SIM card, two different numbers, and different ringtones for his business and personal calls. Furthermore, he has a landline phone in the office. For private instant messages, he uses WhatsApp and Teams for business ones. In some urgent exceptions, he contacts colleagues via WhatsApp. For business video calls, he uses Teams and Zoom. Further, Bob uses email and has a private and a business email address. For social networking, he uses Facebook and Twitter. Bob's business project has its own Twitter account, and he is responsive for communication about news in this project. In his spare time, Bob likes to watch videos on YouTube. Sometimes, he uses this channel also for research regarding his work. Bob has been working in his company for several years and has some colleagues who have become close friends. He talks with them about his family and private topics such as holidays. Also, he tells his partner about his current business projects.

In Bob's situation, two critical questions come to mind: What is a structure to understand Bob's IIS? How does this IIS contribute to the integration or segmentation of his private and business life? In what follows, we first consider the former conceptualization of IIS and IIS integration and demonstrate how a researcher who embraces it will encounter difficulties in explaining Bob's IIS and its integration as a whole. We will then show how an enhanced conceptualization of IIS and IIS integration informed by existing literature provides a more complete account of

Bob's IIS and its integration. Further, we will show how this conceptualization can be operationalized.

2.1.3.2 Four-Layer Definition of IIS

Prior research suggests different categorizations of components of IS. Essential works in the realm of IIS are the papers by Lee et al. (2015), Gaß et al. (2015), and Baskerville (2011a) on which we will build our conceptualization of IIS. At the end of this section, we review our conceptualization by examining whether it meets different notions on IS categorization from other literature streams.

According to Lee et al. (2015), an IS is the combinational interplay of technology artifacts, information artifacts, and social artifacts. A technology artifact is regarded as a human-created tool (e.g., hardware or software) that is "used to solve a problem, achieve a goal or serve a purpose that is human defined, human perceived or human felt" (Lee et al. 2015, p. 8). An information artifact is "the instantiation of information, where the instantiation occurs through a human act either directly […] or indirectly" (Lee et al. 2015, p. 8). A social artifact consists of "relationships or interactions between or among individuals" (Lee et al. 2015, p. 9). Gaß et al. (2015) suggest that an IIS has different information and communication technology components such as devices, services, applications, websites, and apps and like Baskerville (2011a) and Lee et al. (2015), Gaß et al. (2015) argue that the social context is important. Further, they point out that an individual has different IT identities in different contexts shaped by their values, attitudes, morals, knowledge, and skills (Gaß et al. 2015).

In the case of the conceptualization of IIS from Lee et al. (2015) and Gaß et al. (2015), we encounter the following problem: Bob, who uses his personal smartphone for private and business life, would be considered to have a highly integrated IIS. However, he plans to use two different SIM cards with two different numbers, different ringtones for his business and personal calls, and could set his phone so that no notifications or personal calls occur during his working hours. Thus, technology allows Bob to use techniques to separate his PIS and BIS. Otherwise, some of his colleagues are also Bob's friends, with whom he also talks about private topics. Hence, we need a more complex conceptualization of the integration of IIS to take all that into account. In that regard, Baskerville (2011a) notes that IIS, like IS in general, consist of technology artifacts, information artifacts, and social artifacts, but he further distinguishes between privately owned components and employer-provided components. Thus, he distinguishes to sub-systems of IIS: the PIS and the BIS.

To unite the perspectives of Baskerville (2011a), Lee et al. (2015), and Gaß et al. (2015), we propose a multi-layer conceptualization. We consider devices and digital identities as the first two sub-layers of the technology artifact, which together cover the technology components of Gaß et al. (2015). Devices are the hardware tool for processing information (e.g., computer, smartphone, telephone). Multiple services may run on one device, such as email, social networking, or telephoning which can have different digital identities (e.g., private and business email addresses). Using a digital identity from the private context can reflect other attitudes or intentions than using the business digital identity. Thus, we determine digital identities as the second layer of technology that bridges to social relationships. Following these notions, our four IIS layers are devices, digital identities, relationships, and information (Figure 2.1-1). As noted, on one device (e.g., smartphone), multiple services (e.g., instant messenger, email) can be used with multiple possible digital identities (e.g., private and business email address). Together, the two layers of the technology artifact are used to interact in different relationships, which represent the third layer. The fourth layer is the information transferred by the use of the technology artifact to the different relationships.

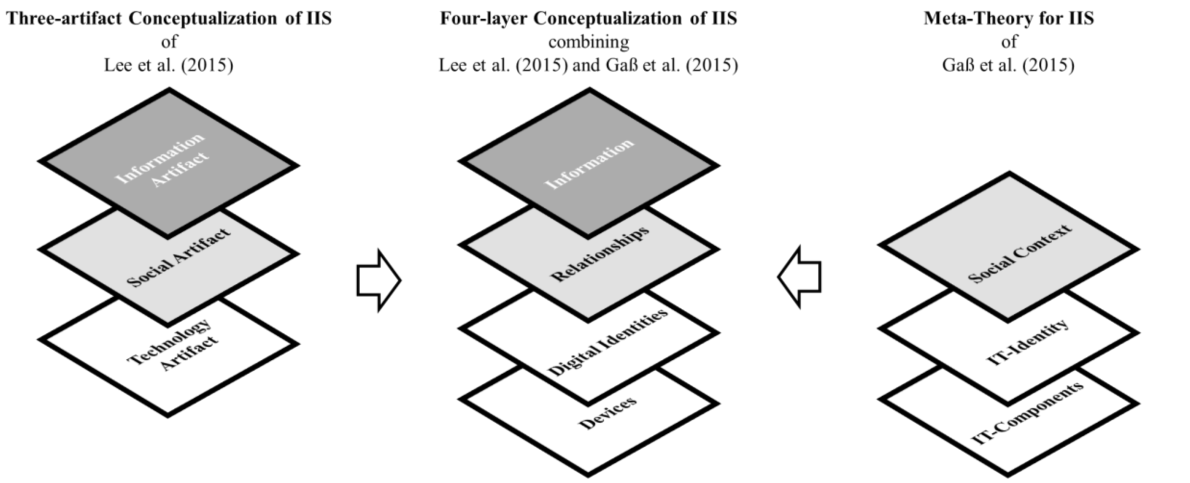

Figure 2.1-1: The Four Layers of IIS

Each of the sub-systems of IIS (PIS and BIS) consists of these four layers and different components on each layer (Baskerville 2011a). Figure 2.1-2 shows the example of Bob's IIS.

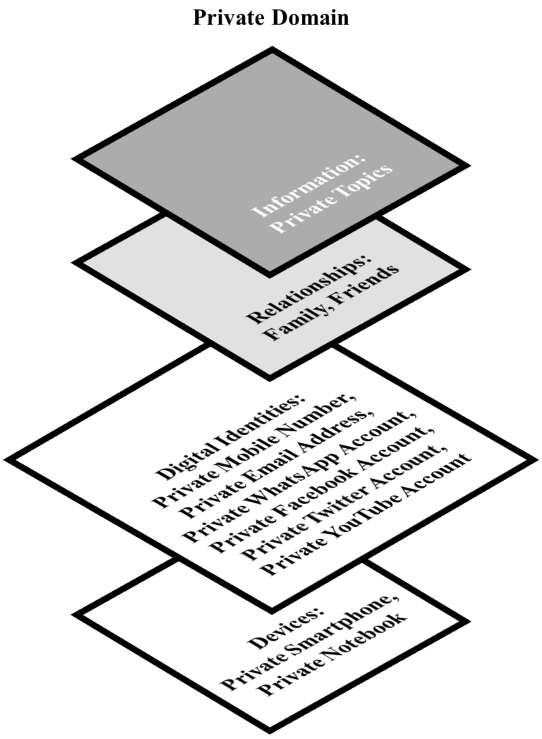

Figure 2.1-2: Four Layers of IIS from the Example of Bob

To further inspire and verify our four-layer conceptualization, we had a look at different categorizations of IS in prior research. Berger et al. (2018) for example, name services, content, network, and devices as layers for IS. This perspective matches our conceptualization as what Berger et al. (2018) call network can be assigned to our layer of different relationships, and content meets our layer of information. Also, Alter (2008, p. 451) defines IS as a "work system is a system in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce specific products and/or services for specific internal or external customers." The elements of this definition fit our layers of technologies (i.e., devices and digital identities), information, and relationships.

2.1.3.3 Definition and Operationalization of IIS Integration

We define the integration of an IIS as the degree of overlap in its sub-systems (PIS and BIS). Complete IIS integration is the state in which the boundaries around PIS and BIS are entirely flexible and permeable. All components, whatever domain they originate from, are used in the context of all social domains. On the other hand, complete IIS separation is the state in which PIS is only used in the private context, and BIS is only used in the business context.

Existent studies on IIS and boundary theory have focused on distinct components of an IIS (especially smartphones). There has been no analysis of the complete range of IIS components.

We propose considering IIS integration on four layers to be essential since the different layers can have different integration extents. Building on the example of Bob's IIS, integration of his IIS may be designed in the way that Bob does not have a business smartphone but uses the private smartphone for private and business purposes. Besides, he may use an emailing service in both contexts. However, he distinguishes between different digital identities as he only uses the private email address for private mails and the business email address for business messages.

Furthermore, integration on the relationship layer may be there as Bob has some friends that are colleagues at work at the same time. He may also talk with the colleagues about the upcoming private vacation plans and his girlfriend about his current business projects showing the integration of information. Only in exceptional cases, Bob's IIS integration is at one of both extreme points (complete integration or complete segmentation). For Bob, the information layer is highly integrated. The other layers lie in the range between the two extrema. Figure 2.1-3 shows the example.

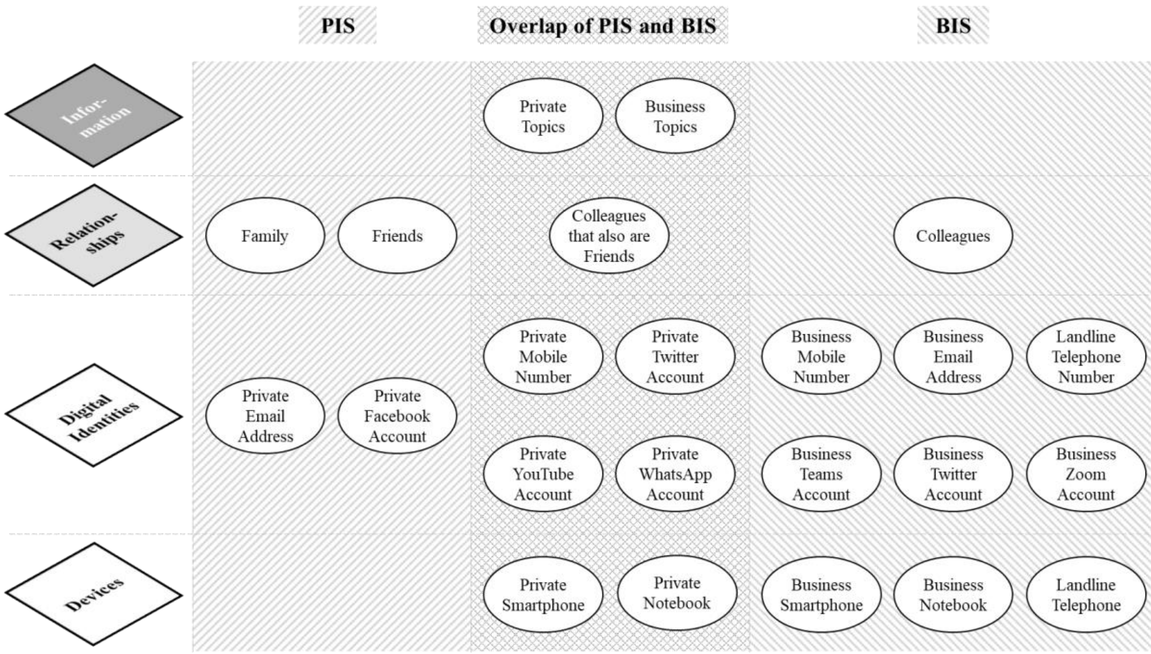

Figure 2.1-3: Integration of IIS from the Example of Bob

Integration and segmentation sit on a continuum. Only by determining the extrema of IIS integration we can interpret the extent of integration. With complete IIS integration, private and business layers are used equally often for private and business-related matters and cannot be assigned to either domain. In contrast, IIS segmentation is the absence of IIS integration. Here, the layers are only used for matters of their domain. Thus, IIS integration is the extent to which the PIS components and the BIS components are used equally often for both private and work matters.

Let us turn to measuring IIS integration. An IIS has multiple layers and potentially multiple components per layer. Integration may first be measured for each of these components separately; they can then be aggregated to one measure of integration for each layer and an overall IIS integration measure.

Let L be the set of layers: devices (*dev*), digital identities (*digid*), relationships (*rel*), and information (*info*). For each $l \in L$, let C_l be the set of components on layer l. Let u_c^p be the usage frequency of component $c \in C_l$ for private matters and u_c^b its usage frequency for business matters, both measured on a non-negative scale. Given that c is a component of the IIS, we assume that it is indeed used and, thus, the maximum of the usage frequency measure is strictly positive for at least one of the two sub-systems. With this, we calculate the integration of a component c as

$$doi_c = \frac{\min(u_c^p, u_c^b)}{\max(u_c^p, u_c^b)},$$

$$doi_c \in [0,1].$$

We denote it as doi for *degree of integration* to point to the continuous nature.

After calculating the degree of integration for each component (doi_c), we aggregate by layer. If one component was not used at all, the integration is the aggregation via the other components. Specifically, we build a weighted mean of each component's integration, considering each component's usage frequencies. Thus, for instance, if one device is used more often than another, its extent of integration counts more in the extent of device integration. This results in the following measure:

$$DOI_l = \frac{\sum_{c \in C_l} [doi_c \cdot (\boldsymbol{u_c^p} + \boldsymbol{u_c^b})]}{\sum_{c \in C_l} (\boldsymbol{u_c^p} + \boldsymbol{u_c^b})},$$

$$DOI_l \in [0,1].$$

2.1.4 Empirical Assessment

To test our four-layer conceptualization of IIS, our concept of IIS integration, and measurement method empirically, we build a research model based on the theoretical assumptions of Ashforth et al. (2000). We then design an online survey to test the model empirically and present our findings.

2.1.4.1 Model Development

Our conceptual model applies concepts of boundary theory in the context of IIS. The model's central paradigm is that PIS and BIS's integration is a technological boundary management tactic. Integrating both of an IIS's sub-systems means designing the boundaries between the social domains as flexible and permeable. Flexible boundaries enable more efficient domain changes but may also overwhelm individuals when private and business domains fuse unintentionally. Adhering to boundary theory's central idea (Ashforth et al. 2000), IIS integration affects domain blurring, cross-domain interruptions, and psychological and physical magnitude of transition between the domains.

Having a highly integrated IIS may blur the domains since it is harder to distinguish which role of which domain to enact when using it. It may also cause more cross-domain interruptions as there are no distinct sub-systems but one overall integrated IIS. Therefore the individual cannot leave behind or switch off one sub-system. For instance, as Bob uses one smartphone for both private and business matters, it can easily happen that a call from work incurs when having dinner with his girlfriend (cross-domain interruptions). He can also get confused about which role to enact when responding to the caller (domain blurring). Reflecting these ideas of Ashforth et al. (2000), we hypothesize:

H1: Higher IIS integration is positively related to higher domain blurring.

H2: Higher IIS integration is positively related to more cross-domain interruptions.

Regarding the magnitude of transition between the domains, there is a difference between the physical and the psychological magnitude of transition (Ashforth et al. 2000). For the physical magnitude of transition, we expect higher IIS integration to be negatively related to it since the individual does not have to physically change to the other sub-system with a highly integrated IIS. Thus, the integrated IIS enables Bob to deal with some business matters at home (physical magnitude of transition). Contrary to this, we expect a higher IIS integration to be positively related to the psychological magnitude of transition. Individuals facilitate the psychological transition between domains by generating certain habits, which Ashforth et al. (2000) call transition scripts. Consciously changing from BIS to PIS could be such a transition script that facilitates psychological transition. Thus, if IIS integration is high, the conscious transition between the domains does not take place in the same amount as with a highly segmented IIS. Thus, the psychological transition is less facilitated. Thus, we hypothesize:

H3: Higher IIS integration is negatively related to the physical magnitude of transition.

H4: Higher IIS integration is positively related to the psychological magnitude of transition.

The definitions of the model's constructs can bee seen in Table 2.1-1.

Construct	**Definition**	**Source**
IIS Integration	The degree of overlap in use of the sub-systems of the IIS (PIS and BIS).	Self-developed
Domain Blurring	"The experience of difficulty in distinguishing" one domain from another domain.	Desrochers et al. (2005, p. 460)
Cross-Domain Interruptions	Interruptions that occur from one domain into another.	Ashforth et al. (2000); Chen and Karahanna (2014)
Physical Magnitude of Transition	The effort that is needed to leave one domain and enter another physically.	Ashforth et al. (2000)
Psychological Magnitude of Transition	The effort that is needed to leave one domain and enter another psychologically.	Ashforth et al. (2000)

Table 2.1-1: Definitions of Constructs

We further include several control variables in our empirical analysis. The first two variables are the segmentation preferences to keep the business domain separate from the private domain and vice versa, which are highly discussed variables in the realm of IIS integration and boundary theory (Köffer et al. 2014a; Kreiner 2006; Rothbard et al. 2005; Yun et al. 2012). Also, we include three variables that indicate responsibilities in either the private or the business domain and, thus, which are important influencing factors at the interplay of the two domains: the weekly working hours, the number of children, and the number of cohabitants in the individual's household. Last, we include gender and age as control variables.

2.1.4.2 Measurement Development and Data Collection

We followed the guidelines by MacKenzie et al. (2011) to develop and validate measures for IIS integration and the dependent variables of our research model.

The first step is to develop a conceptual definition of the construct (Section 2.1.3). In the second step, we generated items to represent IIS integration on each of the layers. For device integration and digital identity integration, we formulated items by ourselves. Therefore, we followed standard guidelines proposed by Hinkin (1998), MacKenzie et al. (2011), and Tourangeau et al. (2000). For the integration of relationships, we adopted Nippert-Eng's (1996, p. 577) definition of integration of relationships ("co-workers come to home to socialize with family;

family comes to workplace to socialize/work with co-workers”). Since private relationships should not be restricted to family, we changed it to “family and friends.” For information integration, we adopted the item scale from Clark (2002).

Analogously, we adopted items for the model’s dependent variables from the literature. We adopted the domain blurring items from (Desrochers et al. 2005) and the items for cross-domain interruptions based on Chen and Karahanna (2014). For the psychological and physical magnitude of transition, since there was no validated scale in the literature, we created four items each, based on Ashforth et al.’s (2000) definition. For segmentation preference, we used Kreiner’s (2006) item scale.

All constructs except for the IIS integration are reflective constructs. IIS integration is a formative construct that builds on the four manifest variables of device integration, digital identity integration, relationship integration, and information integration. Those four manifest variables were computed, as explained in Section 2.1.3.3. Appendix 2.1.A provides an overview of all items. All items were measured on a seven-point Likert scale.

To assess content and face validity of the item scales, we conducted a card sorting among fellow researchers (Moore and Benbasat 1991; Thatcher et al. 2018). We asked participants to match the items to the definition of each layer integration in an online mask. Sixteen participants completed the task. Participants matched 38 of the 44 items correctly by a percentage of at least 80 %. We critically reviewed the other six items and reformulated to cover the content of the respective construct better.

Next, to collect data to test the measures empirically, we designed an online survey, measuring the constructs from the research model and demographics. We restricted participation to currently or recently employed or self-employed people since the survey sought to collect data concerning both domains. We recruited participants from the United States via the online crowdsourcing market Amazon Mechanical Turk. Respondents were paid a small incentive for participation in the study. To ensure data quality, we applied several measures like an instructional manipulation check (Oppenheimer et al. 2009), an attention check, and free text questions to identify unusual comments (Chmielewski and Kucker 2020). Following the recommendations of Hair et al. (2014, p. 21), we aim to achieve a sample size of at least 191 respondents. 205 respondents took part in the study providing data that met our quality guidelines. 36 % of the respondents were female. The average respondents’ age was 37 years.

2.1.4.3 Results

Measurement Model

For scale purification and refinement, we assessed our measurement model by structural equation modeling (PLS-SEM) using SmartPLS 3.0 and followed the suggestions of Hair et al. (2014). To assess the formative measure for IIS integration as the extent of integration on the four layers, we examined content validity by performing a "subjective but systematic evaluation of how well the domain content of a construct is captured by its indicators" (Hair et al. 2014, p. 115). Based on the theoretical derivation and the conducted card sorting, we assume content validity. We assessed the indicators for collinearity by controlling whether each indicator's variance inflation factor (VIF) value was lower than 5.0 (Hair et al. 2014). Our data fulfilled this criterion. We also examined the indicators' outer weights and outer loadings. For weights, only the outer weight of relationship integration was significant. However, as recommended by Hair et al. (2014), we retained all four indicators, as the outer loadings of all four indicators were significant and higher than 0.5. Appendix 2.1.B provides an overview of the constructs' outer weights and loadings.

To assess the reflective measures of domain blurring, cross-domain interruptions, psychological magnitude of transition, and physical magnitude of transition, we started by examining internal consistency reliability. According to Hair et al. (2014), internal consistency reliability is assessed via composite reliability (CR), which should be higher than 0.708. All constructs exceeded this threshold. For convergent validity, we examined indicator reliability and average variance extracted (AVE). To assess indicator reliability, we controlled each indicator's outer loadings. All of them are over the expected 0.708. Also, AVE is satisfactory since the minimum AVE for all constructs is 0.747 (Hair et al. 2014).

For discriminant validity, we first examined each indicator's cross-loadings with all other constructs to check whether they were lower than the indicator's outer loading on the construct. Our data met this criterion. Second, each construct's square root of the AVE was higher than the highest correlation with other constructs (Fornell-Larcker criterion). Thus, discriminant validity is supported. Table 2.1-2 shows means, standard deviations (SD), and CR values as well as the AVE values for all constructs. Information for control variables as well as on (cross-)loadings and the Fornell-Larcker criterion can be found in Appendix 2.1.C.

	# Items	Mean	SD	Loadings	CR	AVE
IIS Integration	4	0.626	0.279	0.564-0.994	-	-
Domain Blurring	2	4.568	1.885	0.857-0.897	0.870	0.770
Cross-Domain Interruptions	2	4.198	1.998	0.863-0.866	0.855	0.747
Psychological Magnitude of Transition	4	3.990	2.015	0.878-0.903	0.940	0.797
Physical Magnitude of Transition	4	3.990	2.011	0.868-0.910	0.939	0.795

Table 2.1-2: Descriptive Statistics, Main Factor Loadings, Internal Consistency, and Average Variance Extracted

Since the item scales already met the quality criteria, we did not collect a new sample as suggested by MacKenzie et al. (2011). However, we finalized the process by assessing nomological validity, which will be presented in the Sub-section “Structural Model and Testing of the Hypotheses.”

Initial Statistics on IIS Integration

We calculated the degree of integration for each layer following the previously described method. Therefore, we assigned the seven-point Likert scales that we used for asking for usage frequency of devices and digital identities and integration of relationships and information with values of 1 to 7. The corresponding histograms appear in Figure 2.1-4. Table 2.1-3 provides an overview of the mean and standard deviations for the four layers divided by gender, age, marital status, and weekly working hours. We also conducted tests on significant differences between the groups, displaying the p-values of the unpaired t-tests and the analysis of variance (ANOVA).

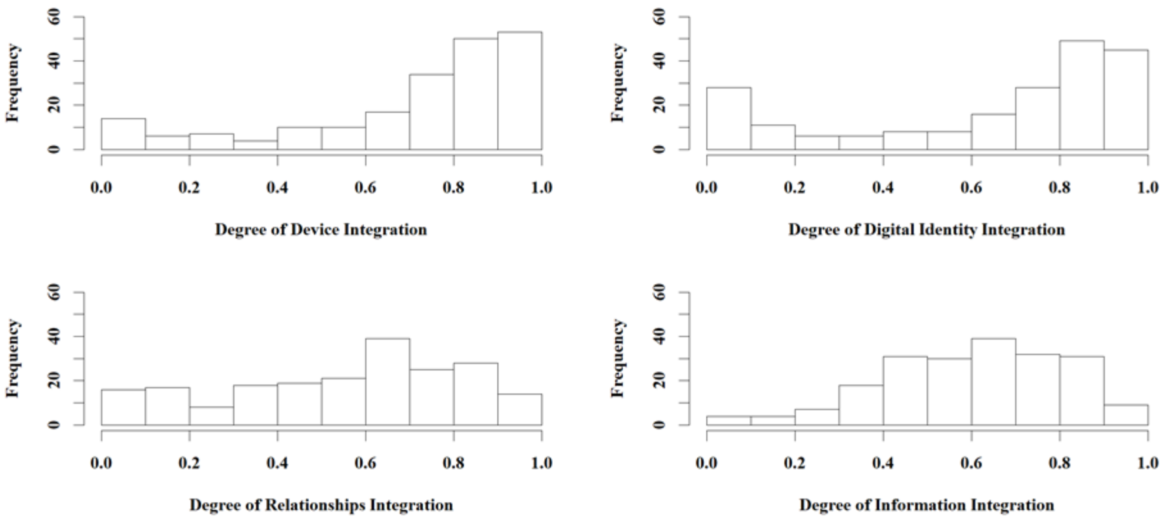

Figure 2.1-4: Histograms for Degree of Integration for the Four Layers (n = 205)

		Device Integration			Digital Identity Integration			Relationship Integration			Information Integration		
	N	**Mean**	**SD**	**p-value**	**Mean**	**SD**	**p-value**	**Mean**	**SD**	**p-value**	**Mean**	**SD**	**p-value**
Total													
	205	0.708	0.282		0.641	0.331		0.554	0.266		0.603	0.203	
Gender[1]													
Female	73	0.715	0.294	0.793	0.657	0.329	0.613	0.525	0.286	0.273	0.592	0.229	0.579
Male	132	0.704	0.276		0.632	0.333		0.569	0.253		0.609	0.187	
Age[2]													
Under 25	4	0.595	0.366		0.284	0.396		0.514	0.305		0.583	0.134	
25 to 34	109	0.732	0.252		0.682	0.303		0.591	0.238		0.61	0.183	
35 to 44	44	0.709	0.294	0.361	0.568	0.365	0.043*	0.48	0.278	0.088	0.563	0.217	0.511
45 to 54	22	0.714	0.323		0.704	0.307		0.601	0.315		0.655	0.251	
> 54	26	0.614	0.328		0.594	0.358		0.485	0.283		0.601	0.221	
Marital Status[2]													
Single	38	0.701	0.265		0.618	0.343		0.529	0.297		0.578	0.205	
In a Relationship	14	0.580	0.262		0.470	0.307		0.417	0.275		0.530	0.171	
Married	143	0.742	0.271	0.003**	0.690	0.314	<0.001***	0.594	0.244	<0.001***	0.629	0.186	0.007**
Divorced	8	0.426	0.360		0.235	0.239		0.274	0.168		0.451	0.355	
Widowed	2	0.401	0.313		0.439	0.480		0.236	0.334		0.302	0.280	
Weekly Working Hours[1][3]													
< 30	23	0.755	0.256	0.346	0.783	0.179	0.001**	0.653	0.229	0.037*	0.629	0.215	0.565
30 or more	180	0.700	0.286		0.625	0.34		0.540	0.269		0.602	0.202	

Notes: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

1) p-value of unpaired t-test.

2) p-value of ANOVA.

3) N = 203 owing to missing information.

Table 2.1-3: Mean, Standard Deviation, and Results of Tests for Significant Differences of Degree of Integration

The results differ by IIS layer. The device layer shows the highest mean, followed by digital identities. Respondents use many devices for both business and private matters and sometimes use different digital identities on these devices for different matters. The relationship and the information layer show relatively high mean integration values of 0.554 and 0.603. Respondents often talk or write with their family/friends and colleagues about business and private matters.

Structural Model and Testing of the Hypotheses

The structural models did not suffer from collinearity issues, as indicated by all VIF values being lower than 5.0. Figure 2.1-5 presents the estimates of the model.

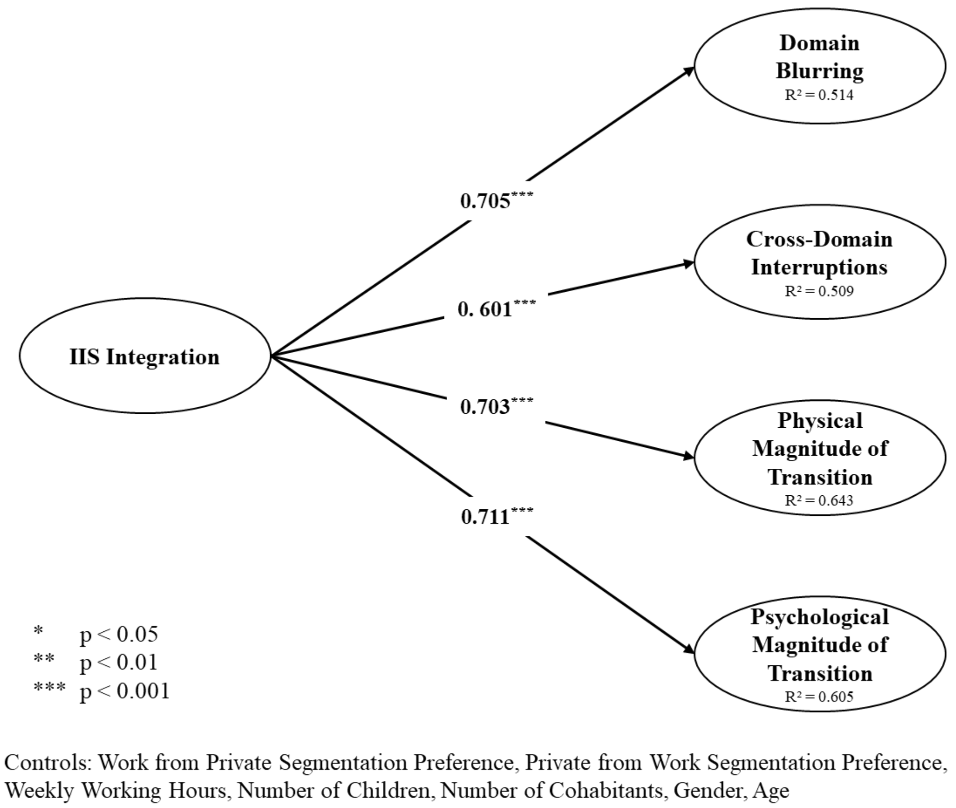

Figure 2.1-5: Model Results

IIS integration is positively related to domain blurring, cross-domain interruptions, and psychological magnitude of transition, supporting H1 to H3. However, it is also positively related to the physical magnitude of transition, not negatively, as suggested in H3. Results for control variables can be found in Appendix 2.1.D.

To further verify our findings, we controlled our data for non-response bias by analyzing the model for the first half of the respondents and the second half separately (Armstrong and Overton 1977). We found no support for non-response bias.

Second, we checked for common method variance (CMV) by employing the correlational marker technique as a post hoc test (Lindell and Whitney 2001; Richardson et al. 2009). We partialled out the smallest and the second-smallest shared variance in bivariate correlations among substantive exogenous latent variables. Since we found only minor changes in significance of the bivariate correlation among these variables, we assume that CMV is not a concern in this study. Also, we implemented the correlational marker technique with a theoretically unrelated marker variable (Lindell and Whitney 2001; Richardson et al. 2009). Again, partialling out the smallest and second-smallest shared variance between the marker and the substantive exogenous variables resulted in no substantial changes in significance of bivariate correlations. Thus, we do not find evidence that would point at CMV in our study.

Third, we did a robustness check on our measurement method by changing one of its specifications. As proposed, we calculated the *DOI* by weighting the partial integrations (*doi*) with the usage frequency. For the robustness check, we built an unweighted mean. We ran the PLS algorithm with the unweighted *DOIs* and found the same significant relationships. This finding further verifies the core of our measurement method, which is to calculate the extent of IIS integration by putting each component's usage frequency for one domain into a relationship with the other domain's usage frequency, since changing one subordinate specification did not change the results.

2.1.5 Discussion and Conclusion

We proposed a conceptualization for IIS and IIS integration. Thus, we defined four layers of IIS, IIS integration as the overlap of IIS sub-systems from the private and business domains, and developed a measurement method to quantify the integration. We also developed a theoretical model on the effects of IIS integration, which we tested in an empirical study to assess our conceptualization. We found results that support the conceptualization of four IIS layers, IIS integration, and the measurement method.

2.1.5.1 Discussion of Results

Our results support the definition of four layers of IIS: devices, digital identities, relationships, and information. Since we derived the four layers from qualitative insights and prior literature and assessed the construct for collinearity and content validity in our empirical analysis, we found a substantial impact of each layer. Further, nomological validity was confirmed. Nomological validity implies that a construct's validity "is demonstrated when the empirical relationships observed with a measure match the theoretically postulated nomological net of the construct" (Judd et al. 1991, pp. 56-57). It was confirmed since we can put the construct into a relationship with the theoretical constructs based on boundary theory and found statistically significant relationships, most as expected. Further, except for the digital identities layer, all layers' outer loadings were significant, strengthening verification. Hence, we found a valid specification of IIS integration and supports our conceptualization based on Baskerville (2011a), Lee et al. (2015), and Gaß et al. (2015).

Support for the conceptualization of IIS integration also supports the method of measuring IIS integration by aggregating usage overlap over components and putting the sub-systems' usage frequencies into a relationship with one another. Since we found the relationships of IIS integration derived from boundary theory already confirmed in research, we have support for the method.

2.1.5.2 Theoretical Contributions

Our first theoretical contribution is the definition of four IIS layers. Thereby, we build upon Baskerville's (2011a) work and definition of IIS. Furthermore, our definition applies and extends Lee et al.'s (2015) three-layer definition of IS to IIS and includes the notions of Gaß et al. (2015). This definition will help researchers understand IIS better since the four layers can be analyzed and designed separately. Overall, these contributions add to the young yet sparse literature stream on IIS and will strengthen its importance within IS research.

Second, we make an important contribution to the literature by conceptualizing IIS integration. With our definition, we extend prior notions of IIS integration that investigate the integration of only parts of an IIS and neglect the fact that integration may differ between the layers. Different layers of an IIS may have different consequences on the individual. We extend these notions taking a holistic view of IIS and present a conceptualization of IIS integration regarding all four layers of IIS. This will help future research better understand the effects of different kinds of IIS integration and give more exact suggestions for building IISs with an individually optimal extent of integration on the different layers. Our investigation focuses on the two major domains of life: private and business. However, our conceptualization can be adopted to other domains as well. Accordingly, it can be used to investigate different sub-domains of the private domain (e.g., family domain and the domain of the engagement in charity) or different sub-domains of the business domain (e.g., the domains of different organizational teams of which the individual is a member).

Third, the measurement method contributes to future studies. Thus, researchers can investigate the consequences of different degrees of IIS integration. This ability better meets the notion of a continuum between complete integration and segmentation than, for instance, sorting individuals into three groups with different integration states, as per Jahn et al. (2016) and Duxbury et al. (2014).

Fourth, by being able to confirm IIS integration's effect on the boundary theory constructs (e.g., blurring and interruptions), we found support for the transfer of boundary theory to IIS research. Since we investigated IIS as a whole, we extend the work of Köffer et al. (2014a), Wang et al. (2016), and Yun et al. (2012), who focused only on smartphones and instant messaging. Future research should take up this finding and further investigate the reasons and consequences of IIS integration. Further, we contribute to boundary theory since we point out and demonstrate IIS's relevance as a boundary management tactic along with the more traditional tactics.

We also provide exploratory findings on the relationship between the extent of IIS integration by layer with gender, age, marital status, and working hours. These findings may inspire and inform future theorizing.

2.1.5.3 Practical Implications

Our results suggest different practical implications for individuals, organizations, and IT designers. Individuals must understand the different implications of IIS's design affecting its integration, like blurring and cross-domain interruptions. However, individuals differ in their extent of integration that is ideal and most efficient for them. Thus, individuals should explore the different consequences to be able to construct an IIS as suitable for themselves and as their organization or social environment allow.

Organizations should be aware that their employees differ in the optimal extent of integration and should enable them to create their IIS as integrated or segmented as they prefer. Bring your own device policies, allowing private use of business email, and clearly defining which work-related information may be shared with family and friends are possible ways to facilitate IIS integration. However, organizations should also allow for keeping the IIS segmented. If employees can optimize their individual extent of IIS integration they may bring the highest benefit for the organization.

IT designers can support constructing an individual's optimal IIS by technology that allows users to switch between integration and segmentation. For instance, smartphones should be able to distinguish if a caller is business-related or private, so that the user can decide whether cross-domain interruptions should be permitted or not at a given time or place.

2.1.5.4 Limitations and Outlook

Our findings have limitations. We measured the integration of IIS by respondents' self-reporting on the usage frequency of the IIS components. Future research could advance data collection and measure IIS integration objectively, such as via automated device and digital identity usage measurement. Further, we did not differentiate between the direction of IIS integration (i.e., the differentiation between private IIS components reaching into the business domain and vice versa). Future research could pick up on that and deepen the understanding of IIS integration in that regard. Also, we restricted our data collection to communication as the main use case of IIS. Although communication is an important use case in both the business and the private domain, further studies should measure the integration of IIS as a whole.

Besides these limitations, we introduced four layers of IIS, conceptualized IIS integration, and presented a measurement model for IIS integration. Since both the private and business domains will remain important to individuals, researchers should investigate the reasons and consequences of IIS integration. Further, future research should provide individuals with solutions to handle and to be able to consciously define IIS integration on each layer in order to reduce adverse effects.

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2.1.7 Appendix

Appendix 2.1.A. Survey Questionnaire

Device Integration (source: self-developed)	
INT01_01	Please indicate how often you use your private device x[1)] for your private communication.
INT01_02	Please indicate how often you use your private device x[1)] for your business communication.
INT01_03	Please indicate how often you use your business device x[1)] for your private communication.
INT01_04	Please indicate how often you use your business device x[1)] for your business communication.
[1)] Respondents answered each item for five different devices: computer, laptop, tablet, smartphone, and landline telephone.	
Digital Identity Integration (source: self-developed)	
INT02_01	Please indicate how often you use your private account x[2)] or numbers for your private communication.
INT02_02	Please indicate how often you use your private account x[2)] or numbers for your business communication.
INT02_03	Please indicate how often you use your business account x[2)] or numbers for your private communication.
INT02_04	Please indicate how often you use your business account x[2)] or numbers for your business communication.
[2)] Respondents answered each item for nine different digital identities: landline telephone number, mobile telephone number, video telephony account, email address, instant messaging account, social network account, and file sharing account.	
Relationship Integration (source: self-developed based on Nippert-Eng 1996)	
Integrating business relationships into the private domain	
INT03_01	I often meet co-workers privately.
INT03_02	My circle of friends also consists of co-workers.
INT03_03	My circle of family also consists of co-workers.
Integrating private relationships into the business domain	
INT03_04	I often meet family members at my office or for job-related matters.
INT03_05	I often meet friends at my office or for job-related matters.
INT03_06	Some of my friends or family members are also my co-workers.
Information Integration (source: Clark 2002)	
Integrating business information into the private domain	
INT04_01	I talk about my work schedule with my family.
INT04_02	I talk with my family about work projects that require me to spend extra time at work.
INT04_03	I discuss my work obligations with my family.
INT04_04	I discuss work demands with my family.
INT04_05	I tell my family about my current work projects.
INT04_06	I share pleasant things that happened at work with my family.
INT04_07	I share unpleasant things that happened at work with my family.
INT04_08	I talk with my family about what kind of day I had at work.
Integrating private information into the business domain	
INT04_09	I talk about my family schedule with my supervisor.
INT04_10	I talk with my supervisor about family activities that may require me to spend extra time at home.
INT04_11	I discuss my family obligations with my supervisor.
INT04_12	I discuss home demands with my supervisor.
INT04_13	I talk about my current family activities at work.
INT04_14	I share pleasant things that happened at home with others at work.

INT04_15	I share unpleasant things that happened at home with others at work.
INT04_16	I talk with others at work about what kind of day I had at home.
Domain Blurring (source: Desrochers et al. 2005)	
BLU01	It is often hard to tell where my work life ends and my private life begins.
BLU02	I tend to integrate my work and private duties when I work at home.
	I have a clear boundary between my career and my roles as a private person.*
Cross-Domain Interruptions (source: Chen & Karahanna 2014)	
INT01	During non-work hours, I am often interrupted by colleagues/other work contacts about work-related matters.
INT02	During work hours, I am often interrupted by family/friends/other non-work contacts about non-work-related matters.
Psychological Magnitude of Transition (self-developed based on Ashforth et al. 2000)	
PSY01	It is hard for me to psychologically switch from my private roles to my business roles.
PSY02	It is hard for me to psychologically switch from my business roles to my private roles.
PSY03	Switching from my private roles to my business roles takes a lot of psychological effort.
PSY04	Switching from my business roles to my private roles takes a lot of psychological effort.
Physical Magnitude of Transition (self-developed based on Ashforth et al. 2000)	
PHY01	When I am at home, it is hard for me to physically reach or gain access to business communication tools.
PHY02	When I am at work, it is hard for me to physically reach or gain access to private communication tools.
PHY03	Switching from my private roles to my business roles takes a lot of physical effort.
PHY04	Switching from my business roles to my private roles takes a lot of physical effort.
Work from Private Segmentation Preference (source: Kreiner 2006)	
WFP01	I don't like to have to think about work while I'm at home.
WFP02	I prefer to keep work life at work.
WFP03	I don't like work issues creeping into my home life.
WFP04	I like to be able to leave work behind when I go home.
Private from Work Segmentation Preference (source: Kreiner 2006)	
PFW01	I don't like to have to think about my family/personal life while I'm at work.
PFW02	I prefer to keep my family/personal life at home.
PFW03	I don't like family/personal life issues creeping into my work life.
PFW04	I like to be able to leave my family/personal life behind when I go to work.
Theoretically Unrelated Marker Questions for Control of CMV (source: self-developed)	
CMV01	I do not trust any classical and conventional medical therapies.
CMV02	I want to be independent from classical and conventional medical therapies.
Demographics	
	Gender
	Age in years
	Weekly working hours
	Number of children
	Number of cohabitants

** Reverse-coded. This item was dropped during validity testing.*

Appendix 2.1.B. Weights and Loadings of the Formative Construct IIS Integration

	Outer Weight	p-value	Outer Loading	p-value
INT01 → IIS Integration	0.007	0.946	0.564	0.000
INT02 → IIS Integration	0.074	0.463	0.651	0.000
INT03 → IIS Integration	0.117	0.133	0.738	0.000
INT04 → IIS Integration	0.867	0.000	0.994	0.000

Appendix 2.1.C. Further Results for the Evaluation of the Measurement Model

Descriptive Statistics, Main Factor Loadings, Internal Consistency, and Average Variance Extracted for Latent Control Variables

	# Items	Mean	SD	Loadings	CR	AVE
Work from Private Segmentation Preference	4	5.259	1.595	0.765-0.845	0.882	0.651
Private from Work Segmentation Preference	4	5.155	1.537	0.603-0.924	0.857	0.605

Loadings for Latent Variables (main loading in bold font)

		IIS	BLU	INT	PSY	PHY	WFP	PFW
IIS Integration	INT01	**0.564**	0.435	0.373	0.425	0.429	-0.159	0.067
	INT02	**0.651**	0.451	0.417	0.484	0.561	-0.264	-0.064
	INT03	**0.738**	0.540	0.507	0.580	0.550	0.165	0.154
	INT04	**0.994**	0.704	0.675	0.766	0.783	-0.095	0.043
Domain Blurring	BLU01	0.679	**0.897**	0.760	0.806	0.727	-0.082	-0.007
	BLU02	0.558	**0.857**	0.523	0.576	0.480	-0.074	0.084
Cross-Domain Interrup-tions	INT01	0.584	0.665	**0.866**	0.632	0.629	-0.124	0.082
	INT02	0.587	0.616	**0.863**	0.636	0.552	0.056	0.208
Psychological Magnitude of Transition	PSY01	0.699	0.729	0.671	**0.903**	0.762	-0.065	-0.012
	PSY02	0.670	0.717	0.662	**0.890**	0.735	-0.068	0.060
	PSY03	0.689	0.683	0.623	**0.878**	0.782	-0.090	0.012
	PSY04	0.693	0.717	0.663	**0.901**	0.746	-0.050	0.087
Physical Magnitude of Transition	PHY01	0.664	0.568	0.554	0.654	**0.868**	-0.072	-0.004
	PHY02	0.669	0.608	0.617	0.727	**0.882**	-0.046	0.017
	PHY03	0.742	0.651	0.627	0.814	**0.910**	-0.093	0.028
	PHY04	0.727	0.658	0.635	0.817	**0.906**	-0.191	0.009
Work from Private Seg-mentation Preference	WFP01	-0.041	-0.077	0.029	-0.030	-0.058	**0.765**	0.439
	WFP02	-0.083	-0.066	-0.080	-0.039	-0.077	**0.774**	0.386
	WFP03	-0.073	-0.091	0.036	-0.080	-0.114	**0.841**	0.577
	WFP04	-0.067	-0.059	-0.094	-0.080	-0.105	**0.845**	0.371
Private from Work Seg-mentation Preference	PFW01	0.057	0.047	0.189	0.069	0.049	0.400	**0.924**
	PFW02	-0.001	0.011	0.023	-0.030	-0.029	0.467	**0.603**
	PFW03	-0.009	-0.027	0.108	-0.017	-0.065	0.553	**0.833**
	PFW04	0.068	0.063	0.082	0.015	0.008	0.512	**0.714**

Note: IIS = IIS Integration, BLU = Domain Blurring, INT = Cross-Domain Interruptions, PSY = Psychological Magnitude of Transition, PHY = Physical Magnitude of Transition, WFP = Work from Private Segmentation Preference, PFW = Private from Work Segmentation Preference

Inter-Factor-Correlations (square root of AVE in the diagonal)

	IIS	BLU	INT	PSY	PHY	WFP	PFW
IIS Integration	-						
Domain Blurring	0.709	0.877					
Cross-Domain Interruptions	0.677	0.741	0.864				
Psychological Magnitude of Transition	0.770	0.797	0.734	0.893			
Physical Magnitude of Transition	0.787	0.698	0.683	0.847	0.892		
Work from Private Segmentation Preference	-0.084	-0.089	-0.040	-0.077	-0.115	0.807	
Private from Work Segmentation Preference	0.051	0.040	0.167	0.041	0.014	0.548	0.778

Appendix 2.1.D. Structural Model Results for Control Variables

	Path Coefficient	
Work from Private Segmentation Preference → Domain Blurring	-0.075	
Work from Private Segmentation Preference → Cross-Domain Interruptions	-0.078	
Work from Private Segmentation Preference → Physical Magnitude of Transition	-0.030	
Work from Private Segmentation Preference → Psychological Magnitude of Transition	-0.005	
Private from Work Segmentation Preference → Domain Blurring	0.050	
Private from Work Segmentation Preference → Cross-Domain Interruptions	0.185	*
Private from Work Segmentation Preference → Physical Magnitude of Transition	-0.005	
Private from Work Segmentation Preference → Psychological Magnitude of Transition	0.007	
Weekly Working Hours → Domain Blurring	0.067	
Weekly Working Hours → Cross-Domain Interruptions	-0.025	
Weekly Working Hours → Physical Magnitude of Transition	0.024	
Weekly Working Hours → Psychological Magnitude of Transition	0.025	
Number of Children → Domain Blurring	0.017	
Number of Children → Cross-Domain Interruptions	0.011	
Number of Children → Physical Magnitude of Transition	-0.014	
Number of Children → Psychological Magnitude of Transition	0.002	
Number of Cohabitants → Domain Blurring	0.013	
Number of Cohabitants → Cross-Domain Interruptions	0.140	
Number of Cohabitants → Physical Magnitude of Transition	0.160	**
Number of Cohabitants → Psychological Magnitude of Transition	0.109	
Gender → Domain Blurring	0.003	
Gender → Cross-Domain Interruptions	0.105	*
Gender → Physical Magnitude of Transition	0.019	
Gender → Psychological Magnitude of Transition	0.004	
Age → Domain Blurring	0.072	
Age → Cross-Domain Interruptions	0.028	
Age → Physical Magnitude of Transition	-0.065	
Age → Psychological Magnitude of Transition	-0.053	

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

2.2 Understanding Employees' IT Service Consumerization Behavior: How Post-adoptive Reasoning Drives Use

Abstract

Though IT consumerization brings chances for individuals and organizations, some important risks, such as information security and privacy issues, arise. With mobile devices and private mobile data plans widely available, employees can use private consumer IT services for business purposes with little to no dependencies to the existing organizational infrastructure. This complicates the possibilities for governance of IT use by organizations and makes it increasingly difficult to control the disadvantages of IT consumerization. Therefore, an understanding of the mechanisms by which employees choose to engage in IT consumerization is necessary. Existing studies on IT consumerization focus primarily on the adoption of private IT devices, rather than on IT services, like file sharing or instant messaging. However, a detailed view of the relative advantages presented by these services is essential to understand the usage decisions in a post-adoptive phase. As a complementary perspective, this paper thus investigates reasons for IT service consumerization behavior using a mixed-methods approach. We use a net-valence model to analyze benefits and risks of IT service consumerization. Building on knowledge from post-adoption literature, survey data shows evidence that on the benefit side, functionalities of IT services matter. On the risk side, IT policies may be an effective way to manage IT service consumerization – but only if policy breaches lead to perceived sanctions for the individual. These quantitative results are enhanced by qualitative findings that amongst others give further insights on the effect of functionalities of IT services on IT service consumerization behavior. This paper adds to the scientific body of knowledge by detailing the understanding of IT consumerization on a service layer and derives practical implications for IT departments on how to manage IT service consumerization more efficiently, that is, organizations have to provide high functionality in their own IT services to retain control over the used IT services.

Keywords: IT Consumerization, IT Services, Individual Information Systems, Technology Acceptance, Communication, Collaboration, Survey Research, Structural Equation Modeling

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2.2.1 Introduction

With the rise of portable and mobile IT devices such as laptops, tablets, and smartphones, consumers have increasingly started to bring their own consumer IT into their workplaces which introduces potential chances as well as risks to the organizations (Harris et al. 2012). The trend towards work from home and mobile work during the COVID-19 pandemic has further strengthened the use of employees' consumer IT for work purposes. As Baskerville (2011b) pointed out, the digitization of the individual has increased to the point where individuals operate, run, and administrate vast parts of their increasingly complex individual information systems (IIS) by themselves.

Many companies have adopted bring your own device (BYOD) policies in the hopes of reducing their information technology expenses and increasing productivity and convenience (Lee et al. 2017). With consumer software and mobile applications widely available at low cost, employees also start to bring their privately-owned applications and services. IT services provide aspects of different layers of an IS such as infrastructure, platforms, and software (Demirkan et al. 2008) and are often agile, scalable, and innovative and, thus, have been associated with advantages for their users, such as increased creativity, innovativeness, mobility, flexibility, and productivity (e.g., Behrens 2009; Ortbach 2015; Weeger et al. 2015). However, emerging risks, such as IT security and data privacy implications (e.g., Crossler et al. 2014; Gewald et al. 2017; Ortbach et al. 2013; Weeger et al. 2015), and a loss of organizational control (Behrens 2009) arise. In that regard, researchers and practitioners see the usage of consumer IT as a contributor to shadow IT systems (e.g., Chua et al. 2014; Haag and Eckhardt 2017). However, as such services mainly run on private devices and access the internet through private data plans, it is increasingly difficult for organizations to govern them. Thus, understanding the technology usage and its reasons as well as spill-over effects into the organizational context have become paramount to managing the benefits and risks of IT consumerization.

In the past, IT departments of organizations were able to exclude personal devices from their network through technical measures to control unauthorized IT consumerization and therefore control for unforeseeable threats. For IT services geared towards communication and collaboration, such as instant messaging and file sharing, controlling such activities is less feasible. This is because private IT services are not operated on the business computing and network infrastructure. To regain control, companies embrace policies and demand their employees to install mobile device management (MDM) software to ensure data privacy and security (Lee et al. 2017). However, an effective enforcement is only possible for organizational resources accessed through such consumer IT (Putri and Hovav 2014). Yet, many employees today use private instant messaging services (such as WhatsApp, Facebook Messenger, and WeChat) or private file sharing services (such as Dropbox and Google Drive), which are beyond the reach and control of the organizations' IT departments, to communicate and collaborate with their colleagues, business partners, and customers.

Previous studies have analyzed the antecedents of IT consumerization using a technology adoption lens (cf. Ortbach 2015). However, many contributions focus on bring-you-own-device programs, with some exceptions that deal with IT consumerization as a whole. IT services, on the other hand, represent a different phenomenon. Because such IT services have been previously used by the users in the private context, the users are in a post-adoptive phase where they have learned about the concrete features of the IT services. The decision is thus between two alternatives that the users carefully assess. Understanding these rationales for user behavior is paramount regarding IT service consumerization, where users are highly autonomous and technical efforts to govern its usage are not applicable. Yet, to the best of our knowledge, no research endeavor has aimed to answer this important question regarding IT service consumerization:

What rationales drive IT service consumerization post-adoptive user behavior?

To address the issue, we use a feature-centric post-adoption perspective, which builds on and extends previous research on IT consumerization. Accordingly, our study investigates rationales of IT service consumerization behavior based on a benefit-risk assessment. In particular, we investigate the effect of functionalities of IT services as well as the effects of perceived sanctions of IT policy breaches and information privacy concerns. We focus on communication and collaboration services, specifically on instant messaging and file sharing services as exemplars. We use a mixed-methods approach to collect quantitative as well as qualitative data in order to provide a credible and complete picture of the phenomenon and to derive stronger inferences.

With this paper, we advance the theoretical understanding of IT service consumerization, in particular the factors that influence why users opt to use or decide not to use individual consumer IT services for the purpose of communication and collaboration on a feature-level. For practitioners, we improve the understanding of IT service consumerization which helps them tailor initiatives (such as the introduction of new functionalities or additional IT security measures) to more efficiently reach their own targets of balancing and managing IT consumerization benefits and risks.

2.2.2 Theoretical Background

2.2.2.1 The Interplay between BYOD, IT Consumerization, and Shadow IT

An IS is the combination of technology, information, and social artefacts (Lee et al. 2015). Baskerville (2011b) recognized that the use of IS is not limited to the organizational context, and that its definition may need expansion into the context of private individuals. He argued that individuals build and use IIS to "perform processes and activities using information, technology, and other resources to produce informational products and/or services for use by themselves or others" (Baskerville 2011a, p. 3). The complexity of such IIS is rising constantly, with private infrastructure, devices, applications, and entire services being widely available for affordable prices. Likewise, mobile devices and mobile data plans with vast amounts of data allowance have grown exponentially over the last years (Poushter 2016). This development leads to an unmatched technological autonomy with which individuals command their IIS (Baskerville and Lee 2013). Consequently, individuals can now also bring their own autonomous IIS wherever they go – for instance into the workplace. This transfer of use is known as IT consumerization, which is defined as the usage of privately-owned IIS components for business purposes (Niehaves et al. 2012). Building on Harris et al. (2012), Ortbach et al. (2013) introduced three possible types of IT consumerization: (1) the organizationally approved adoption of consumer IT, which includes BYOD strategies, (2) the usage of consumer IT which is not formally permitted by the organization, and (3) the strategic inclusion of consumer IT into the organizational IS landscape. The latter cannot be directly influenced by the individual and, thus, is not within the scope of this paper on the digitization of the individual.

The incorporation of private devices into an organization's IT governance through BYOD policies is growing and has drawn much attention from researchers (e.g., Crossler et al. 2014; Köffer et al. 2015; Lee et al. 2017; Putri and Hovav 2014). BYOD is considered a subcategory of IT consumerization (Ortbach 2015) and has many positive aspects, such as reduced costs and investments, the availability of modern devices, and increased employee satisfaction, creativity, innovativeness, mobility, flexibility, and productivity (e.g., Behrens 2009; Harris et al. 2012; Ortbach 2015; Stieglitz and Brockmann 2012). On the flipside, risks emerge, such as the undermining of official systems, lack of integration into existing IT landscapes, endangerment of organizational data flows, data quality risks, and IT security risks (e.g., Györy et al. 2012; Ortbach et al. 2014; Silic and Back 2014). The introduction of BYOD policies gives organizations the ability to manage aspects of private devices and, thus, mitigate some of the associated risks. For example, they can demand certain security certificates as a prerequisite to accessing their organizational networks and resources (Ortbach et al. 2014). This way of managing private devices is called MDM and helps organizations ensure control over data privacy and data security (Lee et al. 2017). An effective enforcement, however, is only possible for organizational resources that are accessed through managed private devices (Putri and Hovav 2014). In contrast, Ortbach (2015) points out that practitioners frequently report major issues with privately-owned IS that are brought into organizations without permission. This phenomenon contributes to shadow IT, which is defined as devices and systems used by employees inside of an organization without formal IT department approval (Behrens 2009; Györy et al. 2012; Silic and Back 2014). This shows that IIS are not limited to devices, but also include other components that overlap with the organizational IS landscape in many ways. In the literature, the phenomenon has been called bring your own system (Baskerville and Lee 2013). Ortbach et al. (2013) mentioned applications and internet services as elements of such systems.

With the development of cloud computing, many layers of an IS are now increasingly provided as services (e.g., infrastructure as a service, platform as a service, and software as a service). This development extends into the realm of consumer IT, where web applications, data storage, and communication tools are increasingly provided as service offerings without the need for consumers to understand the different layers of the service. Weeger et al. (2015) named emailing and Haag and Eckhardt (2014) named bring your own cloud (file sharing) as examples for such consumer services. Other examples are instant messaging services, such as WhatsApp, Facebook Messenger, or WeChat. In the case of file sharing, providers like Dropbox offer the infrastructure for their services (e.g., the cloud storage), as well as desktop and mobile applications, and web interfaces through which the customer can access and share their data conveniently. Thus, complementary to the existing IT consumerization literature, which predominantly focuses on devices, we focus on IT service consumerization. It can be seen as an extension of privately-owned shadow IT services and bring your own service opportunities (if formally approved by the IT departments). Congruent with Haag and Eckhardt (2017), we depict the interplay of these research streams in Figure 2.2-1.

We expect IT consumerization regarding services to be different from devices because they are managed by the individual autonomously (Baskerville 2011b) and can hence be operated fully detached from the existing organizational infrastructure. We argue that for IT service consumerization it is crucial to understand the reasons for its usage and the efficacy of indirect governance measures that may control its utilization.

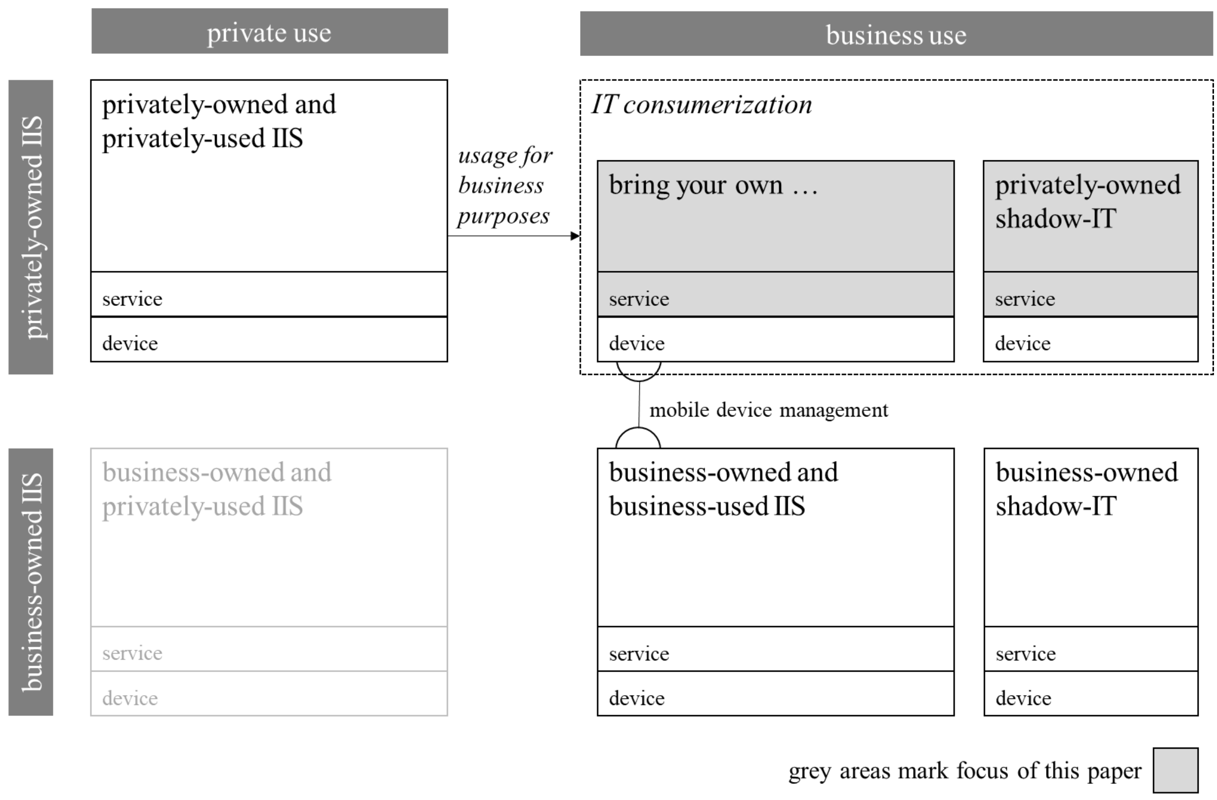

Figure 2.2-1: Interplay of Related Research Streams and Positioning of this Paper

2.2.2.2 IS Use

Technology use can be divided into multiple phases: adoption, initial use, and post-adoptive use (Jasperson et al. 2005; Venkatesh et al. 2016b). Adoption, thereby, "refers to the stage before and right after a target technology implementation/introduction," whereas "initial use refers to the stage when users begin to apply the technology to accomplish their work/life tasks" (Venkatesh et al. 2016b). Regarding the adoption of technologies, researchers have frequently applied technology acceptance models. Numerous authors have based their works on the theory of planned behavior (TPB), the technology acceptance model (TAM), the unified theory of acceptance and use of technology (UTAUT), as well as related models (cf. Venkatesh et al. 2003; Venkatesh et al. 2016b). The focus of such models is to understand antecedents of the use of new technologies. A key objective for organizations using new technologies is to reach acceptance and usage of new technologies to improve productivity (Venkatesh et al. 2003). Therefore, research aims to derive implications for the configuration or design of new technologies and to give suggestions for building an environment in the organization that helps employees be both motivated and able to adopt new technologies. This understanding can be and has been extended to the context of IT consumerization, where the goal is to understand why employees transfer the use of familiar technologies from the private context to the business context (Ortbach 2015) and what factors stop them from doing so.

Post-adoptive behavior according to Jasperson et al. (2005, p. 531) is "feature use behaviors, and feature extension behaviors made by an individual user after an IT application has been […] made accessible to the user, and adoption applied by the user in accomplishing his/her work activities." Thus, post-adoption behavior is the individual's use of a subset of features of a technology after it has been installed (Jasperson et al. 2005). Viewing post-adoption in the larger context of IT adoption is generally accepted (Jasperson et al. 2005). Yet, pre-adoption decisions are based on limited information about a technology (Griffith 1999 as cited in Jasperson et al. 2005), while in the post-adoption phase users have already learned about the technology and its features (Jasperson et al. 2005). Thus, in this phase users evaluate the features and make usage decisions based on their utility. Such a feature-centric view of technology is valuable as specific features "influence and determine work outcomes" (Jasperson et al. 2005, p. 529). This view on post-adoption differentiates between different use behaviors, such as deep feature usage, more distinctly to gain a more detailed understanding of the way IS is used as well as its consequences (Burton-Jones and Straub 2006). The focus of this paper, however, lies on understanding the drivers of usage based on a more detailed understanding of the respective features in the post-adoption phase, rather than the efficiency of that use. This taps into the realm of task-technology fit, which has been analyzed with a feature-centric post-adoption lens before (Lin and Huang 2008). We proceed to analyze the theoretical lenses that have been applied in relation to IT consumerization.

2.2.2.3 Prior Use-related Research on IT Consumerization

Ortbach (2015) provided a comprehensive literature overview on existing empirical research on IT consumerization and the analyzed antecedents. We extend upon it by identifying research contributions published from 2014 to 2019. Our own analysis results in eleven contributions (see Appendix 2.2.A). The results show that many studies regarding IT consumerization are related to technology acceptance research and are based on TPB (Lee et al. 2017; Ortbach et al. 2013), TAM (e.g., Ortbach 2015) or UTAUT (e.g., Weeger et al. 2015). The main antecedents of IS use, as unified by UTAUT, have been included in these studies.

Perceived usefulness (also referred to as performance expectancy) and other related constructs have been shown to have the strongest impact on IT consumerization intention (e.g., Gewald et al. 2017; Junglas et al. 2019; Lee et al. 2017; Ortbach et al. 2013). In other words, the positive impact on work results is a main driver of IT consumerization. Ease of use (also referred to as effort expectancy) has further been consistently included and shown to have a substantial and significant impact (e.g., Ortbach 2015; Weeger et al. 2015). The strong role of those two constructs is congruent with the vast majority of technology acceptance literature and therefore integrates well with previous research on IS use (Venkatesh et al. 2003; Venkatesh et al. 2012). Other UTAUT constructs, such as social influence (e.g., Bautista et al. 2018; Weeger et al. 2015) and facilitating conditions (e.g., Bautista et al. 2018; Hopkins et al. 2013) have been shown to have substantial and significant impact.

Several IT consumerization papers have further introduced risk and threat constructs (e.g., Gewald et al. 2017; Weeger et al. 2020). This is congruent with Venkatesh et al. (2016b) who showed risk (and its counterpart trust) to be one of the most frequent endogenous mechanisms extending UTAUT models in the literature. Further, several IT consumerization studies compare these risks with the benefits of IT consumerization (such as increased performance) and find that the benefits generally outweigh the risks. An exception is Ortbach et al. (2013) who found that IT security risks do in fact contribute to behavioral beliefs amongst highly educated respondents.

This taps into insights on individual differences between users. Other individual characteristics that have been studied regarding their ability to promote IT consumerization behavior include self-efficacy (e.g., Crossler et al. 2014; Lee et al. 2017) and personal innovativeness (e.g., Junglas et al. 2019; Ortbach 2015). Such characteristics have been shown to promote general IT use as well (e.g., Venkatesh et al. 2016b).

Regarding employee expectations, Weeger et al. (2015) found evidence that employees expect employers to allow private devices on the job. According to the study, the main reasons for this are, again, performance related. Employers face substantial challenges with this demand, as they must consider the increasing potential for privacy and security threats. As an effective way of mitigating such risks, practitioners and researchers alike suggest clear BYOD policies.

Restrictive BYOD policies may demand employees to install monitoring mechanisms (such as MDM) onto their devices in order to access organizational resources. Yet, Lee et al. (2017) found that employees have concerns regarding such monitoring mechanisms, and thus their personal privacy. Lebek et al. (2013) echoed this by finding that security concerns limit BYOD adoption.

In contrast to hardware devices, the usage of consumer IT services stays largely unnoticed by organizations and, thus, the management of IT service consumerization is much more difficult than the management of devices that access company resources. While this aspect of the IT consumerization phenomenon is growing rapidly, it has yet to be studied. A detailed understanding of user behavior and the underlying rational, however, is paramount to managing and harnessing IT service consumerization.

Previous research indicates that IT consumerization behavior heavily depends on performance expectations. Yet, our literature analysis concludes that to this date research lacks key contributions regarding the post-adoption stage and a feature-centric view of the phenomenon. However, since many private services, particularly for communication and collaboration, are already used in the private context, we consider it necessary to view private and business services as components of an IT portfolio where the users base their usage decisions on relative utility and comparative advantages.

2.2.3 Method and Model Development

2.2.3.1 Mixed-Methods

This study follows a mixed-methods approach (Venkatesh et al. 2013; Venkatesh et al. 2016a). We follow two purposes with this approach. First, corroboration: qualitative insights will help us assess the credibility of the findings of our quantitative model. We do so concurrently and in an embedded way through mixing in the data collection phase. This approach allows us to provide stronger inferences and to explain our empirical findings from the quantitative strand through qualitative insights. In doing so, we pursue the secondary purpose of completeness. In other words, we aim to provide a more meaningful picture and richer explanations of the phenomenon (Venkatesh et al. 2013). The quantitative part uses a structural equation model and the qualitative part uses coding principles (open and axial coding) that are known from grounded theory (Strauss and Corbin 1990). Details on the individual methods are provided after the model development.

2.2.3.2 Pre-Test

Before our main study, we conducted a qualitative pre-study, in which 15 doctoral students from the field of IS were asked to provide reasons for their usage of consumer IT for business purposes. After clustering the answers, we matched most of them to existing UTAUT constructs. In addition, more or better features, as well as habit and experience were frequently named. This indicates that a post-adoption view is necessary to fully understand the phenomenon. Furthermore, and congruent with previous research on IT consumerization, privacy and security risks were mentioned. We used these insights to develop our model which we solely base on literature in the following.

2.2.3.3 Model Development

Our research model builds on an individual's assessment of benefits and risks of engaging in a certain behavior. This principle is used in net-valence models, which say that for engaging in the behavior the perceived benefits (positive valence) of the behavior have to outweigh the risks (negative valence) (Fishbein 1967; Lewin et al. 1944). In the context of IT consumerization, Weeger et al. (2020) and others have shown that individuals balance the perceived benefits and risks of engaging in BYOD programs and build their behavioral intention on that assessment. Thus, consistent with net-valence models, we suggest that individuals assess whether the benefits of IT consumerization outweigh its risks (Weeger et al. 2020).

In terms of benefits and consistent with previous research regarding technology acceptance, we propose that usefulness and ease of use are the main benefits that have to be considered. We suggest that both constructs can be traced back to different functionalities of the technology that make them either useful (e.g., due to functionalities that allow for more flexibility in communicating with colleagues) or easy to use (e.g., due to an easily understandable user interface). Therefore, and consistent with prior work on post-adoption as well as task-technology fit, we consider individual functionalities in our research model (Jasperson et al. 2005; Sykes and Venkatesh 2017). In the context of IT consumerization, the assessment of benefits is always based on the comparison of both privately-owned IT and business provided solutions as part of a deliberate portfolio decision (Briggs et al. 1998; Harris et al. 2012; Junglas et al. 2019). This decision is between the standard work solution provided by the organization and the individual private solution where use could be transferred to the work context. Thus, we include relative usefulness and relative ease of use of the consumer IT service in contrast to the business offered IT service to our model.

In terms of risks, employees are faced with the risk of losing their job by violating the organization's policies of IT usage with respective sanctions or by causing the organization some kind of harm by engaging in IT consumerization. Such harm may be caused due to a loss of the organization's data. Furthermore, by blurring the contexts of business and private lives by using the private IT service in the business context, individuals also risk their own private data to be unintendedly disclosed to others.

Figure 2.2-2 provides a graphical overview of the research model. In the following sub-sections, we derive the corresponding hypotheses in detail.

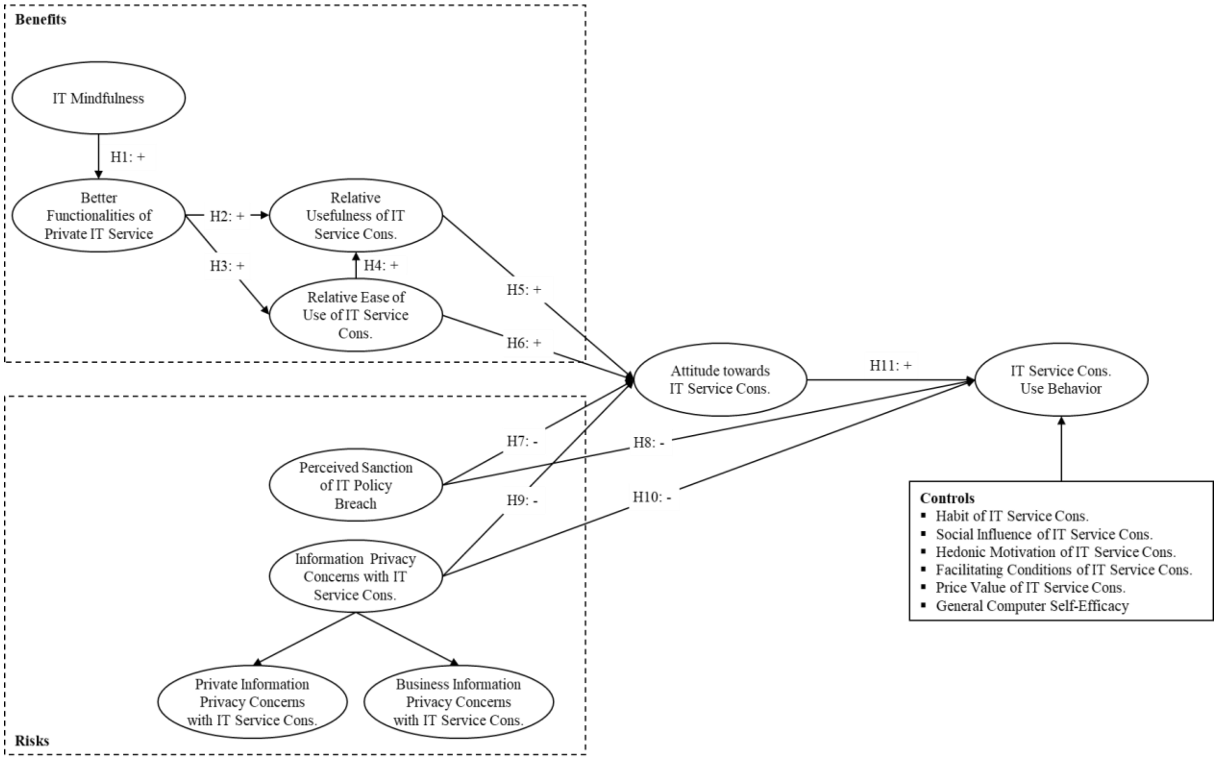

Figure 2.2-2: Research Model

The Influence of Benefits

Powerful, innovative, and rapidly improving private IT has been mentioned as a reason for IT consumerization since its alleged first appearance in the literature (Moschella et al. 2004). Congruently, Ruch and Gregory (2014) mention capabilities and functionalities of technologies as an important aspect for assessing why employees prefer consumer over business IT. Hence, better functionalities of the private IT service as compared to the business IT service is an important factor for individual's benefit-risk assessment.

According to post-adoption literature, a simple quantitative increase in features does not automatically yield performance outcomes. Rather, "performance benefits are most likely to occur when individuals recognize a match between the requirement of a work task and the features" of a technology (Jasperson et al. 2005, p. 531). This is congruent with the view of Goodhue and Thompson (1995) who proposed that benefits arise from a fit between a job's tasks and the technology in use. Yet, which features a user considers to be helpful depends on multiple factors, amongst which are also the experience with the application in use (Jasperson et al. 2005). Individuals expect to be able to better fulfill their job tasks as the functionalities either allow for high efficiency or effectiveness in doing the job (e.g., by being able to share large files with people outside the organization) or make the technology easy to use and integrate it in the workplace (e.g., a business-owned and managed emailing service might be more difficult to use than a consumer service, which may be easily integrated into private mobile devices) (Goodhue and Thompson 1995; Jasperson et al. 2005). The first expectation, perceived usefulness, reflects the degree to which individuals expect an IT service to help them improve their job performance (Venkatesh et al. 2003). The second expectation, perceived ease of use, represents "the degree of ease an individual associates with using a privately-owned [service] compared to one provided by an IT department" (Gewald et al. 2017, p. 64).

Jasperson et al. (2005) further suggested that the individual evaluates the features in the post-adoption phase in a process that they refer to as "technology sensemaking." These cognitive processes of the individual may go beyond the mere exploitation of feature sets of a given technology and rather lead to the extension of features "that go beyond the uses intended by the application's designers" (Jasperson et al. 2005, p. 532). Such deliberations are said to be dependent on the individual's awareness of and openness to value added use of IT (Thatcher et al. 2018). This shows that employees are able to assess the tools and services they utilize for business purposes and that this assessment does influence use decisions. A constant assessment is a key element of IT mindfulness that "refers to an individual's continuous scrutiny and refinement of expectations based on new experiences, appreciation of subtleties, and identification of novel aspects of context that can improve foresight and functioning" (Thatcher et al. 2018, p. 832). Thus, if individuals are IT mindful, they better recognize and identify IT functionalities that are important for their job. Thus, we pose our first hypotheses:

> *H1: IT mindfulness has a positive effect on perceiving better functionalities of private IT services as compared to business IT services.*

> *H2: Perceiving better functionalities of private IT services as compared to business IT services has a positive effect on the perceived relative usefulness of using a private IT service in the business context.*

> *H3: Perceiving better functionalities of private IT services as compared to business IT services has a positive effect on the perceived relative ease of use of using a private IT service in the business context.*

Congruent with the TAM (Davis et al. 1989), we consider a positive effect of relative ease of use on relative usefulness of IT service consumerization and hypothesize:

> *H4: Higher perceived relative ease of use of using a private IT service in the business context has a positive effect on its perceived relative usefulness.*

The effect of higher usefulness and higher ease of use reflects the previously described fundament of net-valence models: Perceived benefits positively influence the attitude towards IT service consumerization. This is consistent with other studies which show that increased usefulness and ease of use are important reasons for IT adoption decisions in general (e.g., Davis et al. 1989; Venkatesh et al. 2012) as well as in the IT consumerization context (Gewald et al. 2017; Ortbach 2015; Weeger et al. 2015). Thus, we formulate the following two hypotheses:

> *H5: Higher perceived relative usefulness of using a private IT service in the business context has a positive effect on the attitude toward IT service consumerization.*

> *H6: Higher perceived relative ease of use of using a private IT service in the business context has a positive effect on the attitude toward IT service consumerization.*

The Influence of Risks

To control and manage consumer IT in the workplace, some authors mentioned the prohibition of its usage as an important factor. For example, Ortbach et al. (2013) found that organizational policies may be able to influence consumerization behavior and that IT policies are effective in that regard. However, such IT policies often only influence employees' attitude towards IT consumerization as well as the actual use behavior if a breach is perceived to have severe consequences (Herath and Rao 2009; Klesel et al. 2019). In the context of net-valence assumptions, such sanctions of IT policy breaches are assessed as risks lowering the attitude toward the behavior. Thus, we hypothesize:

> *H7: Higher perceived sanction of IT policy breach has a negative effect on the attitude toward IT service consumerization.*

> *H8: Higher perceived sanction of IT policy breach has a negative effect on the use of IT service consumerization.*

It has been argued that data security plays an important role in IT consumerization decisions (Crossler et al. 2014; Niehaves et al. 2012). With the usage of private services for business purposes the employee gives up control over information to the service provider, which should raise concerns over the privacy of information. The unsanctioned usage of IT (shadow IT) has been associated with an increased risk for business data loss or leaks (Silic and Back 2014). Thus, we expect IT consumerization to be assessed as a potential information privacy risk. This is congruent with Gewald et al. (2017) and Weeger et al. (2015) who investigated information privacy risks – and thereby covered both private and business information – as antecedents for IT consumerization intention and attitude. Moreover, Ortbach et al. (2013) found risking important data to be a strong inhibitor of actual IT consumerization use behavior. Hence, we propose:

H9: Higher information privacy concerns with IT consumerization have a negative effect on the attitude toward IT service consumerization.

H10: Higher information privacy concerns with IT consumerization have a negative effect on the use of IT service consumerization.

The Influence of Attitude

Congruent with TBP, TAM, and UTAUT, we expect a significantly positive effect of attitude towards use on the actual use behavior (Venkatesh et al. 2003).

H11: Higher attitude towards IT Service Consumerization has a positive effect on use of IT service consumerization.

Control Variables

As proposed in the well-studied UTAUT2 model, there are several other variables that are important antecedents of the use of technologies (Venkatesh et al. 2012). Therefore, we include these further variables (habit, social influence, hedonic motivation, facilitating conditions, and price value) as controls in our model. Further, we include general computer-self-efficacy (Marakas et al. 2007).

2.2.4 Empirical Analysis

2.2.4.1 Survey Design and Procedures

To test the model empirically, we design an online survey. Since this survey seeks to collect data concerning IT usage in the business context, we restrict participation to current full-time employees. We choose instant messaging and file sharing as the analyzed consumer IT services. Communication and collaboration do not follow the set perimeters of organization-specific business processes and thus leave room for spontaneous personal interactions (Frank et al. 2017). Therefore, these services appear more susceptible to IT consumerization as they can largely be operated separately from existing organizational resources. The chosen services are important for digital communication and collaboration and provided in most commercial office suites (Gotta et al. 2015). This approach enables us to validate the impact of the antecedents and moderators across services, and thereby increases our study's rigor. Thus, all participants of the survey are asked to answer all items twice for the two services.

The questionnaire starts with a detailed explanation of the scope of communication and collaboration services and what consumerization of such services means (see Appendix 2.2.B). Next, participants are asked to indicate their IT consumerization behavior. For that, we use the item from Carter and Petter (2015) who measure use behavior on a six-point Likert scale ranging from “not at all” to “very many times”. Likewise, we use existing item scales for all our constructs. We use Thatcher et al.’s (2018) scale on IT mindfulness and Lin and Huang’s (2008) scale on perceived task-technology fit to measure better functionalities of the private service in contrast to the business service. For relative usefulness and relative ease of use, we use items from Venkatesh et al. (2012) and for perceived sanction of IT policy breach items from Herath and Rao (2009). We operationalize information privacy concerns as a second-order construct of private information privacy concerns and business information privacy concerns. For those two first-order constructs, we build on the perceived privacy risk scale from Cocosila et al. (2009) and adapt it to the context of business and private information. For attitude, we use Degirmenci et al.’s (2019) scale that is based on Nysveen et al. (2005) and Taylor and Todd (1995). For the controls from UTAUT2 (i.e., habit, social influence, hedonic motivation, facilitating conditions, and price value), we again use items from Venkatesh et al. (2012). Lastly, we use Marakas et al.’s (2007) scale for general computer self-efficacy. Finally, we add theoretically unrelated marker questions to control for common method variance (CMV) (Lindell and Whitney 2001; Richardson et al. 2009). Where necessary, we adopt the items to the IT consumerization context. All measurements are reflective. We measure all items on a seven-point Likert scale. Appendix 2.2.B provides an overview of all items.

We distributed the questionnaire via the online crowdsourcing market Amazon Mechanical Turk (MTurk). Such online crowdsourcing markets are internet-based platforms that allow recruiting participants for surveys and other tasks (Steelman et al. 2014). Research on MTurk’s participant pool indicates that it is closer to the U.S. population than participants from traditional university subject pools (Paolacci et al. 2010). Further, MTurk participants are seen to be undistinguishable from an internet sample on several psychometric scales such as the big five personality traits (Buhrmester et al. 2011). MTurk has also been used in IS research before (e.g., James et al. 2019; Kehr et al. 2015; Lowry et al. 2016; Soror et al. 2015). We restricted participation to MTurk workers from the U.S. having worked on at least 50 tasks via the platform and with a work approval rate of at least 90 %. Participants received a monetary reward of USD 2 for completing the survey (average time 12 minutes). Prior research suggests that this level of compensation is adequate on MTurk and encourages valid responses (Buhrmester et al. 2011; Jia et al. 2017; Mason and Suri 2012; Steelman et al. 2014). To ensure data quality, we implemented several measures. Next to a traditional attention check ("If you are answering this survey cautiously, tick the second box from the left.") and an instructional manipulation check (Oppenheimer et al. 2009), we used free text questions to identify "unusual comments" (Chmielewski and Kucker 2020, p. 466).

2.2.4.2 Quantitative Results

Descriptive Statistics

After rigorously cleaning the data as described, 221 completed data sets remained. 46 % of participants are female and 54 % male with an average age of 37 years. 83 % of the respondents do not live alone, more than 50 % with at least two other people indicating private responsibilities. More than 77 % of the participants have a managerial position in their job (lower, middle, or upper management) indicating high business responsibilities.

Of the two communication and collaboration services, instant messaging is the service with the higher average level of use of the private service for business purposes. On average, respondents used the private instant messaging services more than several times in the last three weeks. For consumerization of file sharing, the average user reported a use between a couple of times and several times. The corresponding histograms appear in Figure 2.2-3.

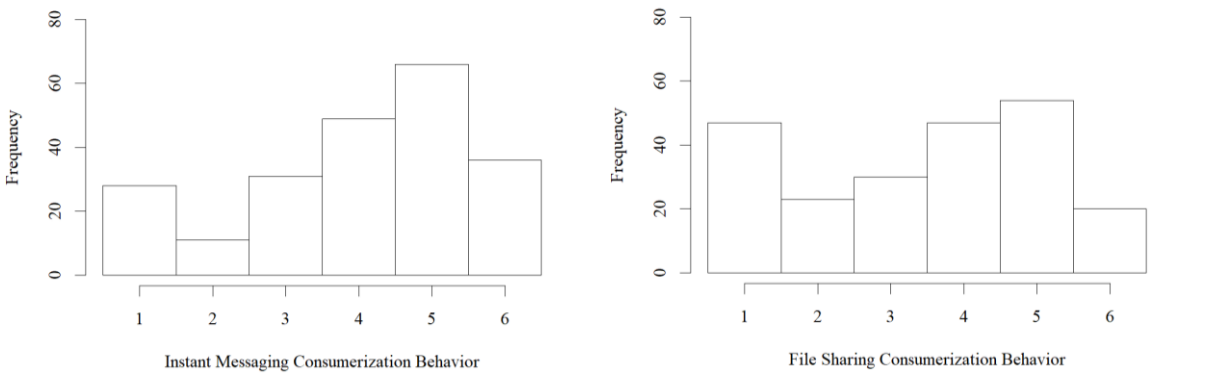

Figure 2.2-3: Histograms for Use of IT Consumerization of the Two Services (n = 221) in the Previous Three Weeks on a Six-Point Scale Ranging from "not at all" to "very many times"

Evaluation of the Measurement Model

Each of the two models – one per service – is assessed through PLS-based structural equation modelling (PLS-SEM) because of the relatively small sample size (Urbach and Ahlemann 2010) using SmartPLS 3.2 (Ringle et al. 2015). We follow Hair et al.'s (2014) guidelines for the evaluation of reflective measures and for assessing the second-order construct information privacy concerns. Thus, we start by examining internal consistency reliability (ICR) which is assessed via Cronbach's Alpha (Alpha) and composite reliability (CR) (Hair et al. 2014; Nunnally and Bernstein 1994). All scales exceed the threshold of 0.708 with a minimum of 0.825 for Alpha and 0.883 for CR. Convergent validity is satisfactory as the minimum of all indicators' outer loadings on their respective factor is 0.689 and the minimum AVE for all constructs is 0.653 (Hair et al. 2014). For discriminant validity, we first examine each indicator's cross-loadings with all other constructs, to check whether they are lower than the indicator's outer loading on the construct. Our data meets this criterion. Second, each construct's square root of the AVE is higher than the highest correlation with other constructs (Fornell-Larcker criterion) (Fornell and Larcker 1981). Third, the heterotrait-heteromethod (HTMT) ratios of all first-order constructs are below 0.85 or at least below 0.9 (Henseler et al. 2015). Thus, discriminant validity is supported. Table 2.2-1 and Table 2.2-2 show means, standard deviations (SD), Alpha and CR values as well as the AVE values for all constructs with multi-item scales. Information for control variables as well as on (cross-)loadings, the Fornell-Larcker criterion and the HTMT ratios can be found in Appendix 2.2.C. Appendix 2.2.D shows the results of testing for CMV.

	# Items	**Mean**	**SD**	**Loadings**	**Alpha**	**CR**	**AVE**
IT Mindfulness	11	5.613	1.379	0.726-0.857	0.951	0.958	0.673
Better Functionalities	7	4.903	1.855	0.852-0.916	0.957	0.964	0.795
Usefulness	3	5.201	1.796	0.876-0.924	0.890	0.932	0.820
Ease of Use	4	5.061	1.827	0.898-0.929	0.930	0.950	0.827
Sanction	3	4.353	2.004	0.858-0.957	0.910	0.940	0.840
Information Privacy Concerns	6	3.775	2.047	0.854-0.872	0.943	0.955	0.780
Private Information Privacy Concerns	3	3.703	2.029	0.877-0.939	0.905	0.941	0.841
Business Information Privacy Concerns	3	3.846	2.064	0.931-0.954	0.942	0.963	0.895
Attitude	6	4.974	2.059	0.923-0.970	0.977	0.981	0.898

Table 2.2-1: Descriptive Statistics, Main Factor Loadings, Internal Consistency, and Average Variance Extracted for Consumerization of Instant Messaging

	# Items	**Mean**	**SD**	**Loadings**	**Alpha**	**CR**	**AVE**
IT Mindfulness	11	5.613	1.379	0.734-0.857	0.951	0.957	0.669
Better Functionalities	7	4.431	2.057	0.885-0.938	0.969	0.974	0.845
Usefulness	3	4.787	2.040	0.887-0.960	0.921	0.950	0.865
Ease of Use	4	4.712	1.987	0.933-0.944	0.954	0.966	0.878
Sanction	3	4.353	2.004	0.855-0.951	0.910	0.940	0.840
Information Privacy Concerns	6	4.035	2.119	0.881-0.888	0.952	0.962	0.807
Private Information Privacy Concerns	3	4.006	2.115	0.889-0.945	0.916	0.947	0.858
Business Information Privacy Concerns	3	4.065	2.125	0.945-0.956	0.947	0.966	0.904
Attitude	6	4.605	2.196	0.933-0.965	0.981	0.984	0.913

Table 2.2-2: Descriptive Statistics, Main Factor Loadings, Internal Consistency, and Average Variance Extracted for Consumerization of File Sharing

Evaluation of the Structural Model and Hypotheses Testing

Collinearity is not an issue, since all variance inflation factors are lower than 5.000 (maximum of 3.259). Figure 2.2-4 and Figure 2.2-5 present the estimates and R^2 values for the models of the two different communication and collaboration services. The results for the control variables (only habit has a significant effect on use) as well as adjusted R^2 values can be found in Appendix 2.2.E and Appendix 2.2.F.

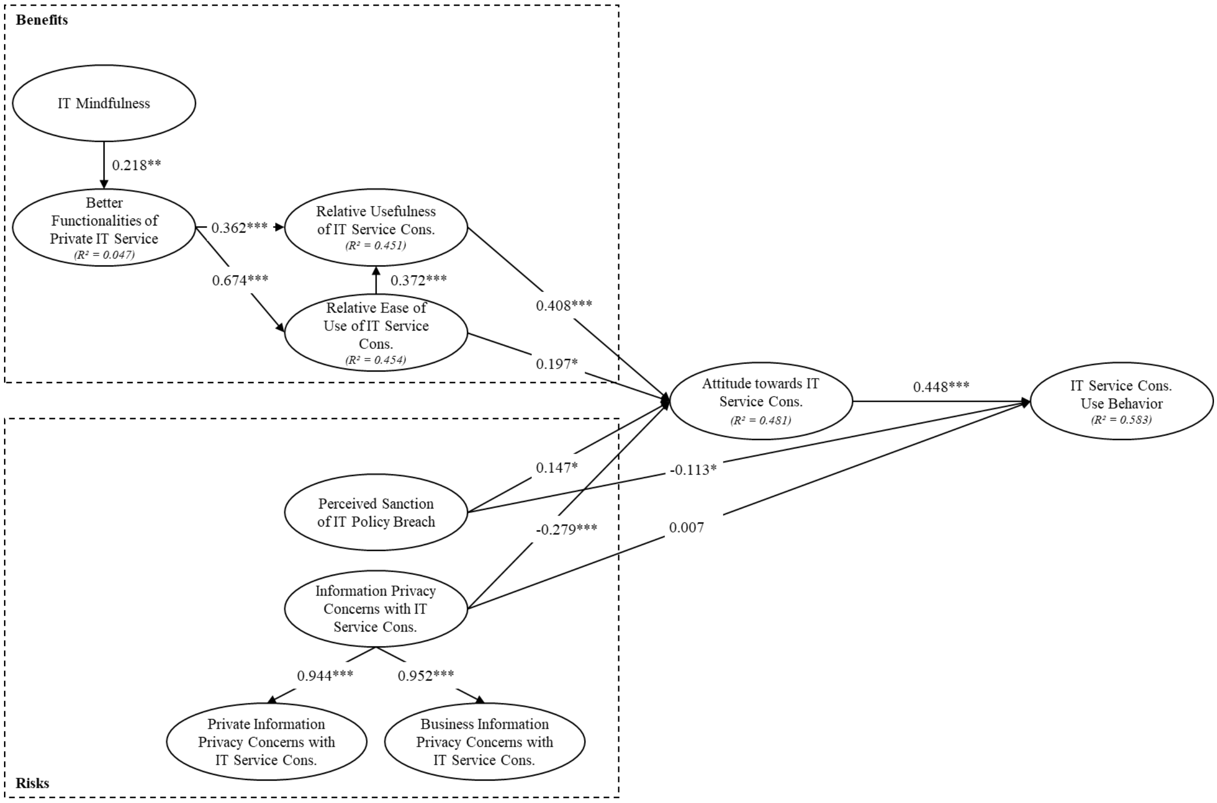

Figure 2.2-4: Model Results for Consumerization of Instant Messaging

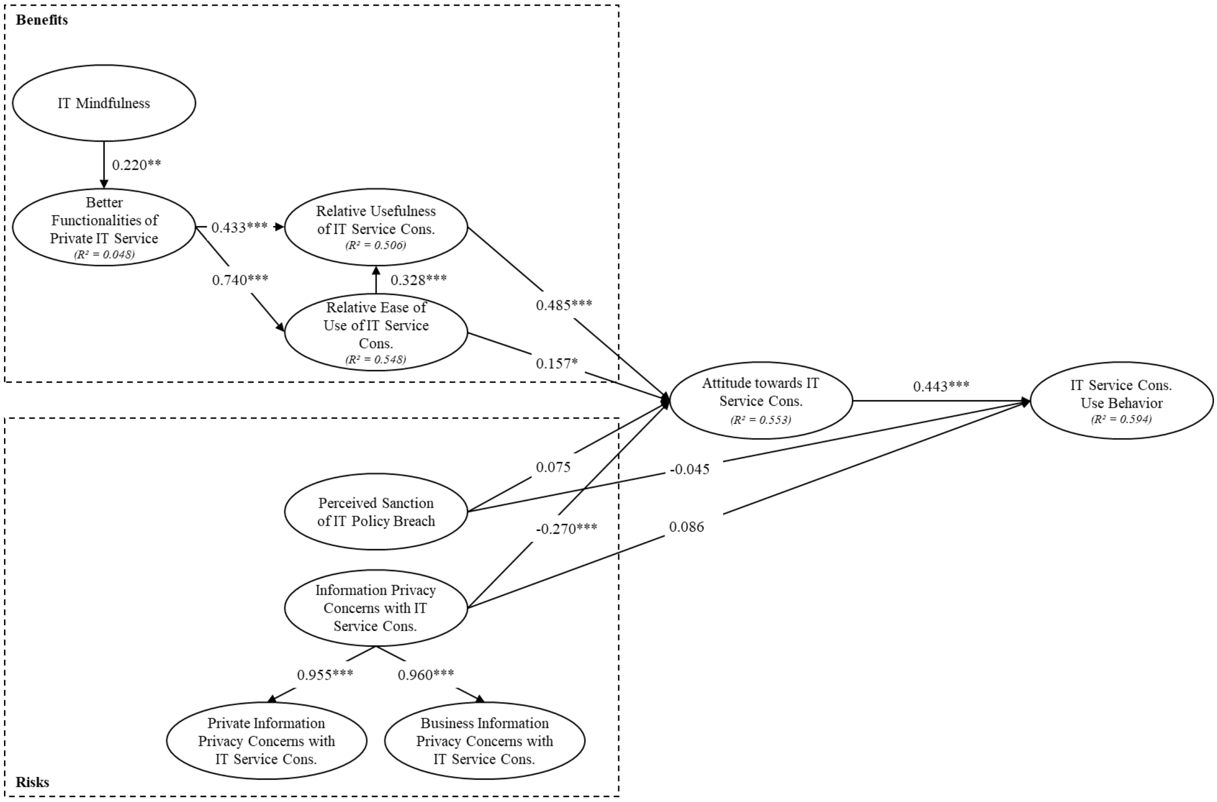

Figure 2.2-5: Model Results for Consumerization of File Sharing

Table 2.2-3 summarizes the hypotheses and the respective empirical results observed in this study. The resulting effects will be discussed in the next section.

Theoretical Hypotheses			**Empirical Results**	
			Instant Messaging	**File Sharing**
H1	pos.	IT Mindfulness → Better Functionalities	+	+
H2	pos.	Better Functionalities → Usefulness	+	++
H3	pos.	Better Functionalities → Ease of Use	+++	+++
H4	pos.	Ease of Use → Usefulness	+	+
H5	pos.	Usefulness → Attitude	++	++
H6	pos.	Ease of Use → Attitude	+	+
H7	neg.	Sanction → Attitude	+	n.s.
H8	neg.	Sanction → Use	-	n.s.
H9	neg.	Information Privacy Concerns → Attitude	-	-
H10	neg.	Information Privacy Concerns → Use	n.s.	n.s.
H11	pos.	Attitude → Use	++	++

Note: plus signs indicate a significant and positive effect, minus signs a significant and negative effect, n.s. a non-significant effect at the 5 % level.
For significant effects, +/- indicates a small ($f^2 \geq 0.02$), ++/-- a medium ($f^2 \geq 0.15$), and +++/--- a large ($f^2 > 0.35$) effect size.

Table 2.2-3: Overview of Hypotheses and Empirical Results

2.2.4.3 Qualitative Insights and Meta-Inferences

For the qualitative strand of our analysis, we asked the respondents to name reasons for why they are using private IT for work purposes. This part consisted of two question, one regarding file sharing and one regarding instant messaging. We collected 348 valid responses to this question (192 for instant messaging, 156 for file sharing). These answers were coded using open coding in a first step. We proceeded with axial coding to relate codes to core coding categories. These coding categories were matched with the model constructs in a last step to integrate findings from the qualitative and quantitative strand of our research in meta-findings (Venkatesh et al. 2013). Our findings are presented in Table 2.2-4.

Model Construct	Coding Category	Description of Category	Example for Instant Messaging	Example for File Sharing
Better functionalities of private IT service	Ubiquitous access of private IT	A lack of flexible and mobile access to business resources, mainly due to technical restrictions.	*"There is a lot of pressure from my job to be on call and be available outside of business hours, […] IM makes the task of responding easy and it shows leadership [that] I am tethered to my job."*	*"Our in-house server is not accessible via smartphone. I have to be at my desk and the system the IT has there [is bad] anyway."*
	Collaboration efficiency	Collaboration features provided by private IT that business solution does not offer, e.g., chat history, labeled chats, ability to share documents and picture (IM), real-time collaboration, change history, storage space (FS).	*"This way we can all have things organized and in one location, and I am able to label chats by who is in what group."*	*"The file sharing I use allows for comments, history, and a lot of meta data to be seen by the people who share it so it has a large impact on accountability and seeing who made what changes and if the ball got dropped somewhere in that chain."*
	Speed	Getting the job done faster, e.g., through reduced response time, even if business IT is not checked regularly.	*"I use it because I can reach work colleagues and those I need information from faster."*	*"Makes it very easy to send and receive documents that make the workday flow better."*
	Convenience and ease	Getting the job done more conveniently through familiar and easy-to-use IT. Often related to concrete features, e.g., organization of files, easy to change password, availability of notifications.	*"Because it is easier and quicker for me to use this, it is already downloaded and updates me when I get a message."*	*"I use this because it also is convenient […] It is easy for me to organize and find what I need without having to search or scroll through hundreds of other files."*
	Information security	Perceived security of the private service is superior to the business service, e.g., due to end-to-end encryption.	*"I felt that it was the smartest thing to do for security purposes. I'm able to have some sense of security and not feel like my data is being compromised, that's the most important reason."*	*"The cloud storage I use claims to encrypt data stored which is something that is necessary when I am working with sensitive projects."*
	No adequate business alternative	The business does not provide the service, yet the service benefits the job requirements or is perceived to be necessary to fulfill the job.	*"I have used the private instant message service for business purposes before because at the time, my company did not have a business instant messaging service."*	*"Sometimes it's necessary for me to share my files for business reasons. Since I don't have a business file sharing account, I don't have much of a choice."*

Model Construct	Coding Category	Description of Category	Example for Instant Messaging	Example for File Sharing
Policy and perceived sanction	Policy and sanction	Company policy does not allow the use of private IT for work purposes and employees follow those rules.	*"I do not use my private IM service for business. We are not allowed to download anything or use unauthorized programs on our machines at work."*	*"The company I work for does not want to risk company files being downloaded on an employee's private file sharing service. [...] An employee will be fired on the spot if he/she is caught using private instant messaging services or private file sharing services on the job."*
Information privacy concerns	Security concerns (prerequisite of privacy)	Concerns regarding the security of data or mishandling proprietary information when stored outside of the organization's IT systems.	*"I don't. It's insecure and compromising of internal data."*	*"I never share files through my private file sharing service. I don't feel its right to do that and I worry about security issues."*
	Privacy concerns	Using private services crosses boundaries for some users. They prefer to keep things separated.	*"I don't use my private instant messaging for business. I prefer to keep everything separate because I don't want colleagues intruding on my personal time by tracking me down on my private services."*	-
	Know boundaries	Employees perceive certain communication activities as "okay", based on their own judgement of topic criticality.	*"Scheduling meetings, informal chit chats and check ins are all perfectly fine. It's mostly about knowing the boundaries here. I'm not going to be exchanging info about customer accounts on a private IM."*	*"It's a judgement call."*
Habit	Habit	Prior use has created a habit of using private services for both sender and receiver.	*"Most of my clients that I communicate with have already become used to dealing with me through my private instant messaging service."*	*"I really just haven't thought about changing it [...] even though it makes me a little uncomfortable. I could change over to a business account, but [...] I just haven't gotten to it."*
Social Influence	Social norms	Coworkers and superiors use the service and thereby (directly or indirectly) influence others to do the same.	*"The only reason I ever use my private instant messaging for business purposes, is in response to a coworker using theirs to contact me using that avenue first."*	*"Just since it makes it easier to share information with my coworkers, and everyone else in the company also uses the service."*
	Networking	Networking with others is considered more personal by some when private IT is used.	*"Because I am a manager, it is important to maintain meaningful contact not only between other managers and myself but also between my workers and me."*	*"To present myself as a more personal businessman."*

Model Construct	**Coding Category**	**Description of Category**	**Example for Instant Messaging**	**Example for File Sharing**
Others	Informal relationships	Informal and private relationships with co-workers contribute to the usage of private channels for communication and collaboration.	*"I'm outside friends with some of my coworkers so it is easier to talk business with them with the contact that I already had."*	*"For the reason that my closest friends work with me, so we will often share our files this way."*
	Privacy concerns with business IT	The usage of private services allows for privacy regarding informal conversations with co-workers. It is sometimes deliberately used to avoid organizational communication tools.	*"Users deliberately try to hide what they're doing like little kids. Whether its photo sharing, snide comments about co-workers, or forgetting a password and asking someone over text message instead of asking IT."*	*"You can quickly send files between people and only those people can see it. You can set passwords and rename the files, so people don't know what you are sending, etc."*
	Integration Preference	Some employees simply prefer the use of only one platform for business and private purposes.	*"I like that I can do business things from a personal platform instead of separating everything such as contacts."*	*"I like having everything I use, personal and business, on one shared platform."*

Table 2.2-4: Qualitative Insights and Meta-Inferences

The findings indicate that the two constructs regarding performance and ease of use can be related back to concrete features of the private IT that are better than the business IT (or the limited availability of adequate business IT). A number of other constructs were identified that match with our model. This includes privacy and security considerations, as well as policy rules. Interestingly, several respondents are aware of policies and security issues but justify their use of private IT because they claim to know the boundaries where information becomes critical enough to not be communicated through private channels. However, these judgement calls appear to be a fine line. Lastly, there were three categories that have not been considered in prior literature using quantitative models. First, respondents indicate that private IT is used with an inner circle of colleagues where informal relationships exist. Second, and contrary to our hypotheses, some employees are hesitant to use business IT because of privacy concerns. They appear to distrust their employer or actively hide information from the employer. Lastly, personal preferences for using only one service exist (integration preference). The overwhelming majority of codes could be matched to those categories mentioned above. Noteworthy but rare exceptions are monetary considerations of what appear to be self-employed individuals.

2.2.5 Discussion

2.2.5.1 Theoretical Implications

To the best of our knowledge, this study is the first to investigate IT consumerization on a service level. On a device level, Harris et al. (2012) suggested that providing consumer devices to employees can help manage the adoption of consumerization. Such initiatives are known as choose your own device policies (Köffer et al. 2015; Weeger et al. 2015). This enables the effective use of MDM and thus governance of such devices. Our research suggests that such initiatives are not feasible for the service component of IT consumerization and, thus, cannot manage the phenomenon fully. To close this gap, we investigate IT consumerization antecedents for private services. In our study, we use a net-valence model to differentiate between benefits and risks as influencing factors for the use decision of such services.

Combining the qualitative and quantitative strand of our study, we contribute to the theoretical body of knowledge on IT consumerization in four ways, which are depicted and summarized in Table 2.2-5 and will be discussed in the following.

<table>
<tr><th>Net-Valence Model for IT Service Consumerization Driven by Benefits</th><th>IT Service Consumerization as Portfolio Decision</th></tr>
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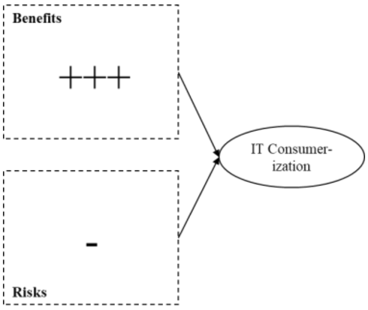

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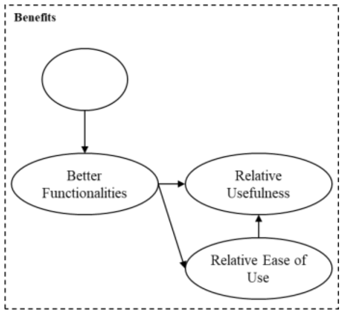

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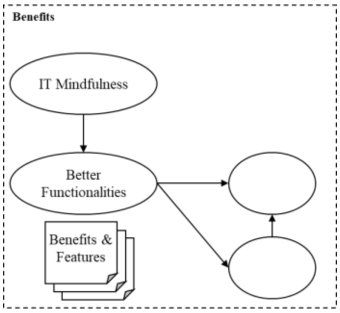
<tr><td>

- Showed that benefits substantially outweigh risks in the users' rational
- The lack of options to govern IT service consumerization puts particular emphasis on business alternatives

</td><td>

- Established IT service consumerization as deliberate portfolio decision
- Introduced relative constructs to do the comparative nature justice

</td></tr>
<tr><th>Post-Adoptive Exogenous Mechanisms for IT Service Consumerization</th><th>Exploratory Expansion of Mechanisms for IT Service Consumerization</th></tr>
<tr><td>



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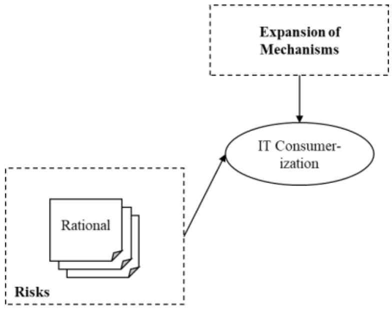

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<tr><td>

- Established better functionality as driver of usefulness and ease of use
- Provided qualitative insights regarding features and benefits
- Introduced IT Mindfulness as proxy for deliberate technology sensemaking

</td><td>

- Identified additional drivers and explanation for usage decisions from qualitative analysis, such as integration preference
- Deepened understanding for the small impact of privacy risks

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Table 2.2-5: Meta-Inferences of the Qualitative and Quantitative Strand of the Study

First and consistent with previous research on IT consumerization, we show that net-valence models of IT service consumerization are driven by benefits, which outweigh the risks attributed to the usage (e.g., Weeger et al. 2020). Regarding benefits and congruent with existing literature on IT use in general and IT consumerization in particular, we find constructs related to performance and ease of use to be the key drivers (e.g., Lee et al. 2017; Ortbach 2015; Venkatesh et al. 2003; Venkatesh et al. 2012, 2016b; Weeger et al. 2015). Contrary to some parts of the existing literature on IT device consumerization, we do not find IT security risks to be preventing employees from using IT service consumerization (e.g., Crossler et al. 2014). Yet, our findings are congruent with the empirical results of Gewald et al. (2017, p. 62) who stated that individuals "dramatically neglect the risks their actions might pose" in regards to IT consumerization. Prohibitions and sanctions play a role in the usage decisions, yet, their influence is limited. While these results are somewhat consistent with IT consumerization on a device level, they have substantially higher implications. This is because the usage of autonomous IT services cannot be feasibly governed through technical measures. Combined with the comparatively low impact of sanctions (and thus prohibitions), this highlights the need to focus on adequate business alternatives as a feasible way to govern the risks of IT service consumerization.

Secondly, extending on previous research, we suggest that IT service consumerization decisions are portfolio decisions where employees decide between multiple different solutions for the same task. They can either use the standard business solution or transfer their use of a private service to the work context. The dilemma that organizations are confronted with is that today, employees are familiar with innovative platforms and IT services for collaboration and communication from their private lives. They are aware of the productivity and performance gains such platforms can offer and are able to compare them to the existing business alternatives (Ortbach 2015). Thus, consistent with research on technology transition, we find that such IT service consumerization use decisions are deliberate portfolio decisions where users carefully analyze the comparative advantage of the alternatives that are available to them (Briggs et al. 1998; Junglas et al. 2019). Besides an overall sense of relative advantages, we show that this deliberation happens on a feature level and includes deliberations on the task-technology fit for the provided features (Jasperson et al. 2005).

Thirdly, in line with research on post-adoptive feature usage, we show that the assessment of better functionality relies in part on a form of technology sensemaking, which breaks habitual use (Jasperson et al. 2005). Post-adoption considers that the effect of intentionality on behavior becomes less important as technology use becomes habitual (Venkatesh et al. 2012). Prior work on post-adoption suggests that such habit can be broken through technology sensemaking, where users reflect on their usage behavior and make deliberate decisions (Jasperson et al. 2005). We approximate this with the construct of IT mindfulness, a personal characteristic of the individual that reflects such an awareness (Thatcher et al. 2018). By doing so, we are first to show the construct’s role in the context of IT consumerization. We find that the extent to which users think about their use does indeed drive the recognition of better functionality in the services. Based in parts on our qualitative strand, we extend this understanding by identifying an array of benefits that are driven by such better functionalities. These include added convenience, higher work speed, and more collaboration efficiency. We show that the provision of an adequate, ubiquitously accessible business solution which offers functionalities that are on par with consumer IT is the best way to govern the use private IT in the workplace. In other words, organizations need to invest in adequate solutions for communication and collaboration or they risk that employees take action themselves.

Fourth, our qualitative results show that aspects which are generally considered disadvantages of IT consumerization (such as IT security, a prerequisite of information privacy) are in fact drivers of IT consumerization for some individuals when the private IT is perceived to provide better functionality. Such individuals report that they consider the security features of private IT, e.g., end-to-end encryption, as reasons for their usage. A similar paradox was observed regarding privacy concerns: Employees report that they use private IT to avoid organizational channels and the recognition of supervisors. While this can hardly be governed it has scarcely been considered in research in IT consumerization. We suggest that it should be recognized as a possible factor interfering with the measurement of privacy risks, which have produced mixed results in the IT consumerization literature (e.g., Lee et al. 2017). Several respondents also mention that they make judgement calls based on their perception of boundaries between sensitive and unproblematic communication. This is potentially problematic, as it puts the decision of information criticality solely in the hands of the employees.

Lastly, our qualitative analysis provided hints regarding reasons for unexplained variance in our model. In particular, these are personal preferences regarding the use of only one solution, which we refer to as an integration preference that can be considered the opposite of a segmentation preference (Kreiner et al. 2009). In addition, some employees mention increased networking opportunities through the informal character of private IT and existing informal relationships as drivers for communication and collaboration through private channels. These findings provide avenues for future research.

2.2.5.2 Practical Implications

In an environment where IIS are largely autonomous and can be brought into the business context with or without consent of the organization, it becomes increasingly important to understand why users adopt private consumer IT services, rather than the provided business services. Such knowledge can help organizations to better manage IT consumerization. To contribute to this understanding, we examined drivers of IT service consumerization theoretically and empirically.

First, we point out that IT consumerization cannot be solely managed on a device level, but that IT services need to be considered to grasp the entire phenomenon which includes shadow IT. This means that individuals often choose between existing private technology that can be transferred to the work context and technology provided by the businesses. They only use business IT if they arrive at the conclusion that it is better fit from a net-valence perspective. This is particularly important as business alternatives are usually in an uphill battle against the habitually used existing private solutions.

Second, we confirm that IT consumerization usage decisions are largely driven by perceived benefits rather than potential risks. Still, previous research suggests that organizations define clear policies and guidelines for the use of IT consumerization and try to create a security-aware culture in order to control for the associated risks (Köffer 2015). However, our results indicate that it is not sufficient to only prohibit or sanction the usage of private consumer IT services. Although employees are aware of the risks associated with their actions, they do not comply with the rules, but make judgements call on where the usage of private IT may be acceptable or unproblematic. IT security literature suggests that there might be possible reasons for such a behavior. For example, that negative business impacts are not made clear enough and, therefore, policies are circumvented (Guo et al. 2011).

Third, to foster use, we show that organizations have to provide business alternatives for the IT services which offer similar performance on a feature level, as employees make deliberate portfolio decisions based on the comparison of the available alternatives. First, such alternatives need to be accessible ubiquitously, if they are to substitute private IT services. According to our qualitative results, they also should to provide adequate functionality to foster efficient collaboration, secure data transfer, and convenience of use to be assessed as the better IS.

Our findings also have implications for individuals. While it is understandable that benefits of IT consumerization outweigh the perceived associated risks, individuals should not disregard its risks entirely. Particularly with regards to file sharing, the storage of business data on external servers should not be taken lightly, as the theft of such data may imply severe consequences for the individual and the organization.

2.2.6 Limitations and Future Work

Our study has a number of limitations and leaves room for further research. In the empirical part, we use data from a single cross-sectional survey, which leads to limitations in testing robustness and generalizability of the results. Furthermore, we queried the participants on both IT services in a single survey. While this accounts for unobserved participant characteristics and increases comparability across data on the services, it might have biased the data in the direction of unwarranted consistency across the two services. Also, we restricted our data collection to two IT services – one communication and one collaboration service. While these are important service types available in most office suites and in many individuals' private IS, it does not consider additional services, such as emailing, and online social networks, which may impair generalizability of our results.

In the qualitative part of our analysis, we identified additional mechanisms, such as the integration preference, networking, and the fostering of informal contacts using private services. This indicates that there are more rationales focusing on individual preferences and social relationships between individuals. Future work should investigate the role of different IS used to foster such relationships in more detail. For example, moderating variables of use, such as segmentation or integration preferences concerning the private and business domain (cf. Sarker et al. 2012) may be considered.

One other particularly noteworthy observation from the qualitative part of our analysis is that there are multiple accounts of employees who value the security features of consumer IT (such as end-to-end encryption). Others, however, report that security concerns are strong inhibitors of use. This duality could be due to different positions, organizational cultures, or other perceptions of boundaries. Investigating the root of these differences should be subject to future research and would contribute to our understanding of IT policies and security related to IT consumerization.

2.2.7 Conclusion

This paper contributes to the understanding of the phenomenon of IT consumerization. With a focus on IT services, it complements extant literature on IT device consumerization. We investigated factors influencing individuals' behavior in whether or not they use private consumer IT services in a business context. To do so, we analyzed the relevant literature and developed a theoretical model based on benefit-risk assessments, which we tested in an empirical study with mixed quantitative and qualitative elements. Regarding risks, we find that a prohibition of IT service consumerization does not prevent individuals from using their private IT services for business purposes. Contrarily, we find benefits to be the driver of use and that users make deliberate decisions based on the assessment of the functionalities of the services. To this end, we have deepened the understanding of IT service consumerization and the reasons for use behavior in a post-adoptive phase. We urge practitioners to recognize the relevance of adequate business alternatives in order to manage IT service consumerization.

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2.2.9 Appendix

Appendix 2.2.A. Empirical Research Regarding IT Consumerization Antecedents

Author	Year	Title	Dependent Construct	Significant Antecedents	Theoretical Lens	N
Bautista et al.	2018	Predictors and Outcomes of Nurses' Use of Smartphones for Work Purposes	Intention/Use of smartphones for Work Purposes	Injunctive Norm, Descriptive Norm, Perceived Behavioral Control	own model based on TPB	517
Crossler et al.	2014	Understanding Compliance with Bring Your Own Device Policies Utilizing Protection Motivation Theory	Intentions/ Behavior to comply with BYOD Policy	Threat Severity, Self-Efficacy, Response Efficacy	Protection motivation theory	444
Degirmenci et al.	2019	Future of Flexible Work in the Digital Age: Bring Your Own Device Challenges of Privacy Protection	Behavioral Intention	BYOD Benefits, BYOD Risks, Privacy Concerns	Privacy calculus theory (risk-benefit analysis)	542
Gewald et al.	2017	Millennials' Attitudes Toward It Consumerization in the Workplace	Behavioral Intention (to participate in a BYOD program)	Perceived Risks (Performance, Privacy, Security), Perceived Benefits (Performance, Effort, Compatibility)	Net-valence model incl. UTAUT-constructs	402
Junglas et al.	2019	Innovation at work: The Relative Advantage of Using Consumer IT in the Workplace	IT Consumerization behavior	IT Empowerment, Relative Advantage, Permission to Use	own model	254
Lee et al.	2017	Implications of Monitoring Mechanisms on Bring Your Own Device Adoption	BYOD Adoption Intention	Information Privacy Concerns, Tasks Measured, Monitoring Frequency, Organizational Control, Job Performance Expectancy	own model based on TPB and UTAUT	275
Ortbach	2015	Unraveling the Effect of Personal Innovativeness on Bring-your-own-Device (BYOD) Intention	BYOD Intention	Personal Innovativeness in IT, Perceived Usefulness of Private IT, Perceived Ease of Use of Private/Enterprise Mobile IT	TAM	151
Weeger et al.	2015	IT Consumerization: BYOD Acceptance and its Impact on Employee Attractiveness	Behavioral Intention (to participate in BYOD program)	Performance Expectancy, Effort Expectancy, Social Influence, Perceived Business Threats	extended UTAUT	444
Weeger et al.	2020	Determinants of Intention to Participate in Corporate BYOD-Programs: The Case of Digital Natives	Behavioral Intention	Performance Risk, Safety Risk, Performance Expectancy, Effort Expectancy, Compatibility	Net-valence model	476

Note: Studies from 2014 to 2019 – older research is summarized by Ortbach (2015)

Appendix 2.2.B. Questionnaire

The questionnaire starts with a detailed explanation of the scope of communication and collaboration services and what consumerization of such services means:

> *Communication and collaboration services comprise software applications, mobile apps, or other online services like cloud storage. We examine two specific types of services in our study:*
>
> *- instant messaging*
>
> *- file sharing*
>
> *Instant messages are used for communication of shorter text messages and are sent in real time. File sharing, on the other hand, is used to share larger files such as documents, images, or videos with collaborators.*
>
> *Your private communication service is the service that you primarily use for private purposes, e.g., your private instant messaging service such as What's App, iMessage or WeChat.*

The questionnaire then proceeds with the item scales for all the models' constructs.

Note: When "instant messaging/file sharing" is written in italics, two separate questions were asked, one for each service.

IT Mindfulness (source: Thatcher et al. 2018)	
ITM01	I find it easy to create new and effective ways of using IT.
ITM02	I am very creative when using IT.
ITM03	I make many novel contributions to my work-related tasks through the use of IT.
ITM04	I am often open to learning new ways of using IT.
ITM05	I have an open mind about new ways of using IT.
ITM06	I like to investigate different ways of using IT.
ITM07	I am very curious about different ways of using IT.
ITM08	I like to figure out different ways of using IT.
ITM09	I often notice how other people are using IT.
ITM10	I attend to the 'big picture' of a project when using IT.
ITM11	I 'get involved' when using IT.
Better Functionalities of Private Service in contrast to Business Service (source: Lin & Huang 2008)	
	In helping me to perform my job,...
BF01	the functionalities of my private *instant messaging/file sharing* service are more adequate than the functionalities of my business *instant messaging/file sharing* service.
BF02	the functionalities of my private *instant messaging/file sharing* service are more appropriate than the functionalities of my business *instant messaging/file sharing* service.
BF03	the functionalities of my private *instant messaging/file sharing* service are more compatible with my job than the functionalities of my business *instant messaging/file sharing* service.

BF04	the functionalities of my private *instant messaging/file sharing* service are more helpful than the functionalities of my business *instant messaging/file sharing* service.
BF05	the functionalities of my private *instant messaging/file sharing* service are more sufficient than the functionalities of my business *instant messaging/file sharing* service.
BF06	the functionalities of my private *instant messaging/file sharing* service make my job easier than the functionalities of my business *instant messaging/file sharing* service.
BF06	In general, the functionalities of my private *instant messaging/file sharing* service are more fit my job than the functionalities of my business *instant messaging/file sharing* service.
Relative Usefulness of IT Service Consumerization (source: Venkatesh et al. 2012)	
UF01	I find using my private *instant messaging/file sharing* service for business purposes more useful in my daily life than using my business *instant messaging/file sharing* service.
UF02	Using my private *instant messaging/file sharing* service for business purposes helps me accomplish things more quickly than using my business *instant messaging/file sharing* service.
UF03	Using my private *instant messaging/file sharing* service for business purposes increases my productivity in contrast to using my business *instant messaging/file sharing* service.
Relative Ease of Use of IT Service Consumerization (source: Venkatesh et al. 2012)	
EoU01	Learning how to use my private *instant messaging/file sharing* service for business purposes is easier for me than learning how to use my business *instant messaging/file sharing* service.
EoU02	My interaction with my private *instant messaging/file sharing* service for business purposes is more clear and understandable than the interaction with my business *instant messaging/file sharing* service.
EoU03	I find my private *instant messaging/file sharing* service for business purposes easier to use than my business *instant messaging/file sharing* service.
EoU04	It is easier for me to become skillful at using my private i*nstant messaging/file sharing* service for business purposes than using my business *instant messaging/file sharing* service.
Perceived Sanction of IT Policy Breach (source: Herath & Rao 2009)	
SA01	The organization disciplines employees who break IT policies.
SA02	My organization terminates employees who repeatedly break IT policies.
SA03	If I were caught violating organizational IT policies, I would be severely punished.
Private Information Privacy Concerns with IT Service Consumerization (source: Cocosila et al. 2009; Dinev & Hart 2006; Featherman & Pavlou 2003)	
PIC01	Using my private *instant messaging/file sharing* service for business purposes would cause me to lose control over my private information.
PIC02	Using my private *instant messaging/file sharing* service for business purposes would lead to a loss of control over my private information because it could be used without my knowledge.
PIC03	Internet hackers (criminals) might take control of my private information if I used my private *instant messaging/file sharing* service for business purposes.
Business Information Privacy Concerns with IT Service Consumerization (source: Cocosila et al. 2009; Dinev & Hart 2006; Featherman & Pavlou 2003)	
BIC01	Using my private *instant messaging/file sharing* service for business purposes would cause me to lose control over my company's information.
BIC02	Using my private *instant messaging/file sharing* service for business purposes would lead to a loss of control over my company's information because it could be used without my knowledge.
BIC03	Internet hackers (criminals) might take control of my company's information if I used my private *instant messaging/file sharing* service for business purposes.

Attitude towards IT Service Consumerization (source: Degirmenci et al. 2019; Nysveen et al. 2005; Taylor and Todd 1995)	
	Using my private *instant messaging/file sharing* service for business purposes…
AT01	is a good idea.
AT02	is a wise idea.
AT03	is positive.
AT04	is beneficial.
AT05	is favorable.
AT06	I like the idea of using my private *instant messaging/file sharing* service for business purposes.
IT Service Consumerization Use Behavior (source: Carter and Petter 2015)	
	Thinking of your use of your private *instant messaging/file sharing* service during the past 3 weeks, please indicate how often you have used your private *instant messaging/file sharing* service for business purposes.
U01	not at all - once - a couple of times - several times - many times - very many times
Habit of IT Service Consumerization (source: Venkatesh et al. 2012)	
HA01	The use of my private *instant messaging/file sharing* service for business purposes has become a habit for me.
HA02	I am addicted to using my private *instant messaging/file sharing* service for business purposes.
HA03	I must use my private *instant messaging/file sharing* service for business purposes.
Social Influence of IT Service Consumerization (source: Venkatesh et al. 2012)	
SI01	People who are important to me think that I should use my private *instant messaging/file sharing* service for business purposes.
SI02	People who influence my behavior think that I should use my private *instant messaging/file sharing* service for business purposes.
SI03	People whose opinions that I value prefer that I use my private *instant messaging/file sharing* service for business purposes.
Hedonic Motivation of IT Service Consumerization (source: Venkatesh et al. 2012)	
HM01	Using my private *instant messaging/file sharing* service for business purposes is fun.
HM02	Using my private *instant messaging/file sharing* service for business purposes is enjoyable.
HM03	Using my private *instant messaging/file sharing* service for business purposes is very entertaining.
Facilitating Conditions of IT Service Consumerization (source: Venkatesh et al. 2012)	
FC01	I have the resources necessary to use my private *instant messaging/file sharing* service for business purposes.
FC02	I have the knowledge necessary to use my private *instant messaging/file sharing* service for business purposes.
FC03	Using my private *instant messaging/file sharing* service for business purposes is compatible with other technologies I use.
FC04	I can get help from others when I have difficulties using my private *instant messaging/file sharing* service for business purposes.
Price Value of IT Service Consumerization (source: Venkatesh et al. 2012)	
PV01	Using my private *instant messaging/file sharing* service for business purposes is reasonably priced.
PV02	Using my private *instant messaging/file sharing* service for business purposes is a good value for the money.
PV03	At the current price, using my private *instant messaging/file sharing* service for business purposes provides a good value.

General Computer Self-Efficacy (source: Marakas et al. 2007)	
CSE01	I believe I have the ability to describe how a computer works.*
CSE02	I believe I have the ability to install new software applications on a computer.
CSE03	I believe I have the ability to identify and correct common operational problems with a computer.*
CSE04	I believe I have the ability to unpack and set up a new computer.
CSE05	I believe I have the ability to remove information from a computer that I no longer need.
CSE06	I believe I have the ability to use a computer to display or present information in a desired manner.
Theoretically Unrelated Marker Questions for Control of CMV (source: self-developed)	
CMV01	I do not trust any classical and conventional medical therapies.
CMV02	I want to be independent from classical and conventional medical therapies.

* Item dropped after measurement model evaluation.

Appendix 2.2.C. Further Results for the Evaluation of the Measurement Models

Descriptive Statistics, Main Factor Loadings, Internal Consistency, and Average Variance Extracted for Control Variable for Consumerization of Instant Messaging

	# Items	Mean	SD	Loadings	Alpha	CR	AVE
Habit	3	4.540	2.183	0.873-0.916	0.867	0.918	0.789
Social Influence	3	4.103	1.888	0.947-0.958	0.947	0.966	0.903
Hedonic Motivation	3	4.483	1.975	0.948-0.954	0.948	0.966	0.905
Facilitating Conditions	4	5.680	1.473	0.782-0.842	0.825	0.883	0.653
Price Value	3	5.789	1.548	0.932-0.945	0.930	0.956	0.878
Computer-Self-Efficacy	4	6.245	1.146	0.689-0.904	0.873	0.890	0.671

Descriptive Statistics, Main Factor Loadings, Internal Consistency, and Average Variance Extracted for Control Variable for Consumerization of File Sharing

	# Items	Mean	SD	Loadings	Alpha	CR	AVE
Habit	3	3.986	2.270	0.905-0.930	0.901	0.938	0.835
Social Influence	3	3.861	2.035	0.955-0.976	0.966	0.978	0.936
Hedonic Motivation	3	4.029	2.033	0.944-0.964	0.952	0.969	0.912
Facilitating Conditions	4	5.360	1.760	0.852-0.892	0.894	0.925	0.754
Price Value	3	5.446	1.738	0.960-0.965	0.961	0.975	0.928
Computer-Self-Efficacy	4	6.245	1.146	0.759-0.927	0.873	0.897	0.687

Loadings for Consumerization of Instant Messaging (main loading in bold font)

		ITM	BF	UF	EoU	SA	IC	PIC	BIC	AT	HA	SI	HM	FC	PV	CSE
	ITM01	**0.816**	0.205	0.304	0.169	0.088	-0.185	-0.124	-0.224	0.297	0.350	0.270	0.290	0.345	0.354	0.336
	ITM02	**0.843**	0.227	0.319	0.142	0.039	-0.219	-0.177	-0.237	0.314	0.347	0.261	0.245	0.318	0.378	0.398
	ITM03	**0.848**	0.174	0.273	0.130	0.105	-0.132	-0.098	-0.150	0.274	0.308	0.263	0.231	0.324	0.289	0.406
	ITM04	**0.779**	0.131	0.185	0.062	0.064	-0.128	-0.145	-0.100	0.137	0.126	0.015	0.056	0.354	0.314	0.608
	ITM05	**0.792**	0.148	0.215	0.040	0.021	-0.206	-0.204	-0.187	0.141	0.132	0.037	0.085	0.372	0.316	0.658
IT Mindfulness	ITM06	**0.857**	0.197	0.277	0.130	0.019	-0.171	-0.147	-0.177	0.278	0.280	0.192	0.206	0.353	0.371	0.447
	ITM07	**0.856**	0.167	0.232	0.056	0.010	-0.173	-0.172	-0.156	0.243	0.275	0.166	0.163	0.350	0.391	0.472
	ITM08	**0.853**	0.198	0.233	0.120	0.037	-0.182	-0.166	-0.179	0.252	0.311	0.225	0.185	0.327	0.284	0.496
	ITM09	**0.726**	0.158	0.201	0.043	0.125	-0.172	-0.168	-0.159	0.231	0.260	0.143	0.198	0.228	0.225	0.367
	ITM10	**0.817**	0.181	0.243	0.061	0.100	-0.152	-0.142	-0.147	0.288	0.343	0.250	0.265	0.323	0.360	0.385
	ITM11	**0.827**	0.123	0.186	-0.010	0.138	-0.178	-0.166	-0.171	0.220	0.255	0.147	0.246	0.253	0.300	0.393
	BF01	0.153	**0.899**	0.545	0.660	0.097	-0.085	-0.047	-0.112	0.394	0.529	0.489	0.402	0.359	0.381	-0.072
	BF02	0.222	**0.866**	0.538	0.585	0.077	-0.176	-0.128	-0.204	0.489	0.541	0.514	0.461	0.346	0.350	-0.070
Better Functionalities	BF03	0.258	**0.907**	0.517	0.534	0.112	-0.191	-0.145	-0.215	0.408	0.548	0.519	0.429	0.353	0.353	-0.014
	BF04	0.195	**0.892**	0.518	0.626	0.043	-0.200	-0.166	-0.213	0.373	0.508	0.457	0.420	0.408	0.371	0.037
	BF05	0.158	**0.908**	0.519	0.620	0.098	-0.201	-0.147	-0.231	0.416	0.545	0.471	0.405	0.370	0.382	-0.065
	BF06	0.166	**0.852**	0.589	0.586	0.042	-0.216	-0.185	-0.223	0.411	0.538	0.410	0.381	0.462	0.352	0.026
	BF07	0.211	**0.916**	0.593	0.588	0.078	-0.211	-0.164	-0.233	0.481	0.614	0.555	0.464	0.420	0.340	-0.028
	UF01	0.189	0.560	**0.876**	0.547	0.063	-0.305	-0.257	-0.319	0.545	0.594	0.442	0.429	0.377	0.352	-0.048
Usefulness	UF02	0.288	0.545	**0.916**	0.547	-0.002	-0.319	-0.248	-0.353	0.554	0.628	0.510	0.474	0.446	0.395	0.082
	UF03	0.344	0.559	**0.924**	0.579	-0.037	-0.291	-0.231	-0.317	0.595	0.668	0.564	0.505	0.439	0.359	0.068
	EoU01	0.081	0.547	0.530	**0.912**	-0.005	-0.124	-0.079	-0.154	0.416	0.505	0.448	0.406	0.245	0.268	-0.109
Ease of Use	EoU02	0.119	0.630	0.529	**0.899**	-0.053	-0.183	-0.130	-0.213	0.399	0.483	0.421	0.360	0.316	0.282	0.030
	EoU03	0.133	0.623	0.600	**0.898**	-0.065	-0.149	-0.125	-0.155	0.493	0.528	0.468	0.412	0.422	0.325	0.037
	EoU04	0.080	0.645	0.576	**0.929**	-0.021	-0.109	-0.055	-0.148	0.451	0.515	0.487	0.407	0.307	0.297	-0.099
	SA01	0.032	0.008	-0.039	-0.087	**0.858**	0.134	0.094	0.158	0.043	0.060	0.100	0.120	-0.044	-0.081	-0.009
Sanction	SA02	0.103	0.109	0.007	-0.033	**0.931**	0.168	0.132	0.184	0.075	0.137	0.183	0.176	0.057	-0.006	-0.033
	SA03	0.068	0.090	0.027	-0.021	**0.957**	0.169	0.145	0.174	0.113	0.155	0.219	0.206	-0.024	-0.071	-0.077
	PIC01	-0.154	-0.138	-0.274	-0.089	0.132	**0.854**	**0.934**	0.694	-0.353	-0.235	-0.075	-0.160	-0.321	-0.199	-0.178
Private Information Privacy Concerns	PIC02	-0.150	-0.142	-0.255	-0.099	0.105	**0.869**	**0.939**	0.717	-0.354	-0.257	-0.096	-0.176	-0.267	-0.157	-0.125
	PIC03	-0.212	-0.151	-0.216	-0.106	0.150	**0.872**	**0.877**	0.781	-0.340	-0.260	-0.093	-0.185	-0.282	-0.227	-0.129

		ITM	BF	UF	EoU	SA	IC	PIC	BIC	AT	HA	SI	HM	FC	PV	CSE
Business Information Privacy Concerns	BIC01	-0.206	-0.233	-0.358	-0.160	0.194	**0.909**	0.763	**0.954**	-0.409	-0.292	-0.196	-0.249	-0.321	-0.240	-0.188
	BIC02	-0.219	-0.210	-0.344	-0.142	0.169	**0.912**	0.769	**0.954**	-0.403	-0.323	-0.184	-0.241	-0.318	-0.233	-0.159
	BIC03	-0.181	-0.206	-0.332	-0.221	0.170	**0.880**	0.732	**0.931**	-0.372	-0.316	-0.182	-0.216	-0.238	-0.174	-0.113
Attitude	AT01	0.263	0.430	0.556	0.446	0.091	-0.350	-0.317	-0.347	**0.950**	0.670	0.628	0.531	0.483	0.340	-0.101
	AT02	0.280	0.409	0.553	0.434	0.075	-0.391	-0.362	-0.379	**0.945**	0.647	0.590	0.506	0.474	0.335	-0.044
	AT03	0.309	0.446	0.581	0.451	0.093	-0.398	-0.360	-0.393	**0.970**	0.688	0.618	0.524	0.513	0.359	-0.031
	AT04	0.350	0.462	0.625	0.470	0.055	-0.452	-0.411	-0.446	**0.939**	0.689	0.559	0.531	0.532	0.429	0.042
	AT05	0.268	0.440	0.586	0.465	0.105	-0.398	-0.366	-0.387	**0.958**	0.697	0.596	0.546	0.442	0.353	-0.073
	AT06	0.264	0.516	0.641	0.489	0.110	-0.401	-0.344	-0.415	**0.923**	0.732	0.652	0.576	0.479	0.326	-0.078
Habit	HA01	0.288	0.583	0.704	0.524	0.026	-0.362	-0.317	-0.367	0.669	**0.876**	0.583	0.572	0.490	0.429	-0.023
	HA02	0.304	0.514	0.543	0.491	0.198	-0.206	-0.167	-0.222	0.596	**0.873**	0.617	0.618	0.270	0.219	-0.141
	HA03	0.322	0.531	0.596	0.473	0.166	-0.267	-0.232	-0.273	0.663	**0.916**	0.653	0.607	0.375	0.308	-0.133
Social Influence	SI01	0.176	0.511	0.525	0.482	0.169	-0.145	-0.088	-0.184	0.600	0.642	**0.947**	0.500	0.354	0.199	-0.156
	SI02	0.253	0.520	0.528	0.458	0.204	-0.175	-0.117	-0.211	0.604	0.660	**0.947**	0.510	0.377	0.242	-0.045
	SI03	0.234	0.529	0.541	0.491	0.193	-0.130	-0.072	-0.171	0.623	0.679	**0.958**	0.548	0.329	0.216	-0.131
Hedonic Motivation	HM01	0.199	0.427	0.471	0.394	0.160	-0.235	-0.202	-0.243	0.532	0.632	0.500	**0.953**	0.316	0.317	-0.172
	HM02	0.276	0.475	0.511	0.423	0.173	-0.218	-0.169	-0.241	0.535	0.629	0.513	**0.948**	0.371	0.396	-0.085
	HM03	0.232	0.452	0.499	0.428	0.219	-0.210	-0.170	-0.226	0.548	0.657	0.546	**0.954**	0.328	0.318	-0.144
Facilitating Conditions	FC01	0.313	0.333	0.367	0.241	0.013	-0.271	-0.256	-0.257	0.426	0.344	0.301	0.232	**0.842**	0.490	0.227
	FC02	0.383	0.303	0.244	0.245	-0.014	-0.213	-0.230	-0.175	0.303	0.212	0.153	0.117	**0.782**	0.537	0.421
	FC03	0.347	0.307	0.380	0.302	-0.042	-0.299	-0.287	-0.280	0.389	0.335	0.260	0.315	**0.813**	0.588	0.315
	FC04	0.265	0.436	0.464	0.353	0.026	-0.273	-0.249	-0.268	0.498	0.453	0.421	0.425	**0.793**	0.470	0.076
Price Value	PV01	0.348	0.378	0.381	0.298	-0.047	-0.203	-0.169	-0.214	0.352	0.347	0.247	0.350	0.595	**0.933**	0.157
	PV02	0.405	0.371	0.339	0.275	-0.057	-0.261	-0.255	-0.240	0.319	0.305	0.162	0.304	0.569	**0.932**	0.272
	PV03	0.376	0.390	0.419	0.333	-0.049	-0.195	-0.177	-0.191	0.386	0.372	0.231	0.359	0.619	**0.945**	0.163
Computer Self-Efficacy	CSE01	0.451	0.037	0.061	0.052	-0.031	-0.188	-0.164	-0.192	0.032	-0.036	-0.065	-0.058	0.338	0.282	**0.778**
	CSE02	0.412	-0.077	0.005	-0.068	-0.068	-0.128	-0.121	-0.121	-0.105	-0.173	-0.168	-0.191	0.206	0.115	**0.904**
	CSE03	0.463	0.004	0.022	-0.015	-0.001	-0.107	-0.135	-0.070	0.033	-0.018	-0.063	-0.056	0.250	0.192	**0.689**
	CSE04	0.571	0.009	0.056	-0.028	-0.022	-0.152	-0.148	-0.140	0.007	-0.018	-0.037	-0.064	0.287	0.224	**0.887**

Note: ITM = IT Mindfulness, BF = Better Functionalities, UF = Usefulness, EoU = Ease of Use, SA = Sanction, IC = Information Privacy Concerns, PIC = Private Information Privacy Concerns, BIC = Business Information Privacy Concerns, AT = Attitude, HA = Habit, SI = Social Influence, HM = Hedonic Motivation, FC = Facilitating Conditions, PV = Price Value, CSE = Computer Self-Efficacy

Loadings for Consumerization of File Sharing (main loading in bold font)

		ITM	BF	UF	EoU	SA	IC	PIC	BIC	AT	HA	SI	HM	FC	PV	CSE
	ITM01	**0.828**	0.233	0.323	0.211	0.088	-0.230	-0.178	-0.261	0.340	0.346	0.283	0.283	0.391	0.342	0.340
	ITM02	**0.850**	0.224	0.317	0.220	0.039	-0.243	-0.185	-0.279	0.325	0.313	0.271	0.260	0.348	0.325	0.382
	ITM03	**0.857**	0.197	0.283	0.179	0.106	-0.150	-0.112	-0.173	0.271	0.284	0.240	0.239	0.309	0.254	0.386
	ITM04	**0.749**	0.061	0.128	0.068	0.065	-0.112	-0.126	-0.088	0.163	0.083	0.007	0.031	0.282	0.273	0.587
	ITM05	**0.769**	0.099	0.167	0.077	0.024	-0.167	-0.159	-0.160	0.181	0.082	0.045	0.091	0.301	0.316	0.648
IT Mindfulness	ITM06	**0.847**	0.164	0.253	0.111	0.021	-0.179	-0.146	-0.197	0.264	0.223	0.182	0.217	0.278	0.307	0.445
	ITM07	**0.842**	0.124	0.194	0.093	0.012	-0.186	-0.167	-0.188	0.282	0.230	0.154	0.139	0.308	0.284	0.468
	ITM08	**0.843**	0.160	0.197	0.139	0.040	-0.198	-0.194	-0.186	0.266	0.263	0.216	0.203	0.282	0.241	0.469
	ITM09	**0.734**	0.175	0.201	0.080	0.126	-0.158	-0.141	-0.161	0.241	0.230	0.174	0.193	0.264	0.208	0.362
	ITM10	**0.829**	0.219	0.280	0.152	0.102	-0.165	-0.153	-0.163	0.326	0.323	0.249	0.292	0.346	0.348	0.361
	ITM11	**0.837**	0.157	0.240	0.048	0.139	-0.209	-0.189	-0.211	0.266	0.237	0.141	0.265	0.303	0.260	0.376
	BF01	0.202	**0.921**	0.621	0.679	0.126	-0.282	-0.230	-0.308	0.495	0.655	0.535	0.530	0.480	0.478	-0.083
	BF02	0.213	**0.904**	0.589	0.638	0.126	-0.322	-0.266	-0.347	0.529	0.670	0.586	0.567	0.433	0.420	-0.085
Better Functionalities	BF03	0.221	**0.929**	0.655	0.692	0.160	-0.293	-0.232	-0.326	0.542	0.658	0.633	0.542	0.504	0.435	-0.132
	BF04	0.200	**0.926**	0.597	0.698	0.106	-0.308	-0.252	-0.335	0.486	0.581	0.508	0.517	0.504	0.445	-0.055
	BF05	0.171	**0.938**	0.606	0.702	0.103	-0.290	-0.242	-0.312	0.492	0.626	0.539	0.493	0.483	0.466	-0.055
	BF06	0.214	**0.885**	0.654	0.678	0.083	-0.318	-0.273	-0.334	0.558	0.651	0.526	0.519	0.597	0.503	-0.045
	BF07	0.192	**0.931**	0.624	0.674	0.134	-0.331	-0.274	-0.357	0.548	0.703	0.636	0.604	0.501	0.428	-0.156
	UF01	0.271	0.589	**0.887**	0.581	0.101	-0.293	-0.259	-0.300	0.578	0.645	0.500	0.524	0.489	0.421	-0.006
Usefulness	UF02	0.286	0.645	**0.941**	0.591	0.052	-0.389	-0.339	-0.404	0.673	0.673	0.534	0.493	0.508	0.430	-0.023
	UF03	0.298	0.650	**0.960**	0.638	0.080	-0.333	-0.275	-0.361	0.672	0.700	0.574	0.551	0.520	0.448	-0.091
	EoU01	0.164	0.689	0.601	**0.935**	0.096	-0.215	-0.169	-0.241	0.515	0.565	0.526	0.480	0.486	0.438	-0.060
Ease of Use	EoU02	0.142	0.685	0.609	**0.944**	0.059	-0.196	-0.156	-0.217	0.501	0.529	0.552	0.462	0.466	0.399	-0.082
	EoU03	0.195	0.720	0.642	**0.933**	0.078	-0.260	-0.217	-0.280	0.549	0.587	0.533	0.452	0.542	0.450	-0.013
	EoU04	0.128	0.679	0.576	**0.935**	0.097	-0.201	-0.149	-0.232	0.458	0.517	0.556	0.443	0.438	0.385	-0.062
	SA01	0.039	0.047	0.043	0.068	**0.855**	0.154	0.110	0.183	0.030	0.063	0.112	0.110	0.114	-0.003	-0.010
Sanction	SA02	0.109	0.135	0.060	0.087	**0.941**	0.148	0.116	0.166	0.079	0.126	0.213	0.161	0.166	0.048	-0.030
	SA03	0.079	0.139	0.105	0.083	**0.951**	0.165	0.154	0.162	0.096	0.188	0.217	0.206	0.108	-0.026	-0.078
Private Information Privacy Concerns	PIC01	-0.162	-0.270	-0.319	-0.169	0.093	**0.888**	**0.945**	0.759	-0.433	-0.317	-0.214	-0.263	-0.352	-0.247	-0.072
	PIC02	-0.178	-0.253	-0.289	-0.167	0.151	**0.881**	**0.943**	0.749	-0.398	-0.299	-0.182	-0.231	-0.313	-0.224	-0.091
	PIC03	-0.212	-0.151	-0.216	-0.106	0.150	**0.872**	**0.877**	0.781	-0.340	-0.260	-0.093	-0.185	-0.282	-0.227	-0.129

		ITM	BF	UF	EoU	SA	IC	PIC	BIC	AT	HA	SI	HM	FC	PV	CSE
Business Information Privacy Concerns	BIC01	-0.206	-0.344	-0.377	-0.236	0.184	**0.922**	0.804	**0.956**	-0.469	-0.386	-0.307	-0.299	-0.331	-0.283	-0.048
	BIC02	-0.249	-0.358	-0.376	-0.256	0.172	**0.924**	0.815	**0.950**	-0.493	-0.409	-0.313	-0.309	-0.343	-0.279	-0.062
	BIC03	-0.234	-0.325	-0.338	-0.249	0.156	**0.893**	0.761	**0.945**	-0.391	-0.339	-0.269	-0.297	-0.259	-0.254	-0.083
Attitude	AT01	0.304	0.525	0.644	0.498	0.067	-0.445	-0.417	-0.433	**0.963**	0.664	0.562	0.567	0.562	0.407	-0.064
	AT02	0.303	0.537	0.666	0.522	0.134	-0.425	-0.382	-0.429	**0.961**	0.672	0.599	0.575	0.555	0.407	-0.066
	AT03	0.303	0.525	0.657	0.491	0.067	-0.458	-0.407	-0.467	**0.965**	0.656	0.536	0.544	0.557	0.419	-0.026
	AT04	0.378	0.554	0.693	0.531	0.023	-0.445	-0.392	-0.457	**0.951**	0.667	0.539	0.547	0.617	0.448	0.031
	AT05	0.334	0.538	0.661	0.510	0.083	-0.466	-0.427	-0.464	**0.960**	0.682	0.599	0.582	0.553	0.408	-0.020
	AT06	0.331	0.575	0.642	0.549	0.104	-0.459	-0.403	-0.474	**0.933**	0.699	0.609	0.574	0.601	0.406	-0.002
Habit	HA01	0.291	0.702	0.737	0.584	0.038	-0.391	-0.345	-0.401	0.678	**0.905**	0.612	0.620	0.588	0.514	-0.061
	HA02	0.285	0.611	0.614	0.537	0.212	-0.280	-0.214	-0.319	0.600	**0.906**	0.662	0.675	0.429	0.335	-0.155
	HA03	0.296	0.621	0.629	0.492	0.175	-0.348	-0.298	-0.366	0.650	**0.930**	0.656	0.646	0.459	0.377	-0.196
Social Influence	SI01	0.285	0.603	0.573	0.563	0.215	-0.252	-0.191	-0.289	0.585	0.672	**0.955**	0.588	0.476	0.326	-0.061
	SI02	0.236	0.587	0.552	0.551	0.203	-0.286	-0.226	-0.319	0.582	0.680	**0.972**	0.568	0.421	0.279	-0.156
	SI03	0.200	0.600	0.553	0.565	0.197	-0.250	-0.178	-0.297	0.578	0.689	**0.976**	0.590	0.403	0.284	-0.200
Hedonic Motivation	HM01	0.241	0.547	0.531	0.448	0.173	-0.306	-0.274	-0.310	0.555	0.672	0.568	**0.957**	0.430	0.399	-0.188
	HM02	0.297	0.558	0.548	0.480	0.155	-0.276	-0.236	-0.291	0.562	0.664	0.555	**0.944**	0.451	0.441	-0.139
	HM03	0.242	0.574	0.530	0.478	0.201	-0.284	-0.234	-0.308	0.578	0.689	0.598	**0.964**	0.418	0.403	-0.199
Facilitating Conditions	FC01	0.335	0.437	0.412	0.405	0.114	-0.320	-0.332	-0.282	0.479	0.401	0.337	0.335	**0.875**	0.597	0.229
	FC02	0.362	0.384	0.372	0.425	0.137	-0.241	-0.261	-0.202	0.441	0.369	0.280	0.279	**0.855**	0.591	0.266
	FC03	0.343	0.481	0.481	0.469	0.095	-0.330	-0.328	-0.305	0.532	0.498	0.385	0.413	**0.892**	0.613	0.127
	FC04	0.309	0.546	0.565	0.477	0.144	-0.322	-0.294	-0.321	0.592	0.551	0.490	0.486	**0.852**	0.507	0.055
Price Value	PV01	0.341	0.459	0.439	0.417	-0.008	-0.268	-0.253	-0.261	0.398	0.425	0.289	0.399	0.634	**0.960**	0.170
	PV02	0.335	0.481	0.454	0.445	-0.003	-0.288	-0.273	-0.279	0.423	0.420	0.273	0.412	0.619	**0.964**	0.137
	PV03	0.345	0.486	0.452	0.430	0.029	-0.285	-0.258	-0.286	0.435	0.452	0.319	0.441	0.648	**0.965**	0.146
Computer Self-Efficacy	CSE01	0.433	-0.006	0.006	0.036	-0.030	-0.078	-0.054	-0.094	0.076	-0.049	-0.079	-0.080	0.249	0.224	**0.792**
	CSE02	0.389	-0.153	-0.088	-0.111	-0.066	-0.057	-0.069	-0.042	-0.108	-0.213	-0.196	-0.251	0.071	0.059	**0.927**
	CSE03	0.447	-0.010	-0.007	-0.022	0.000	-0.067	-0.073	-0.057	0.035	-0.066	-0.079	-0.065	0.161	0.177	**0.759**
	CSE04	0.551	-0.009	0.034	0.010	-0.022	-0.092	-0.113	-0.065	0.077	-0.023	-0.005	-0.038	0.264	0.226	**0.828**

Note: ITM = IT Mindfulness, BF = Better Functionalities, UF = Usefulness, EoU = Ease of Use, SA = Sanction, IC = Information Privacy Concerns, PIC = Private Information Privacy Concerns, BIC = Business Information Privacy Concerns, AT = Attitude, HA = Habit, SI = Social Influence, HM = Hedonic Motivation, FC = Facilitating Conditions, PV = Price Value, CSE = Computer Self-Efficacy

Inter-Factor-Correlations for Consumerization of Instant Messaging (square root of AVE in the diagonal)

	ITM	BF	UF	EoU	SA	IC	PIC	BIC	AT	HA	SI	HM	FC	PV	CSE
IT Mindfulness	0.820														
Better Functionalities	0.218	0.892													
Usefulness	0.303	0.613	0.905												
Ease of Use	0.114	0.674	0.616	0.910											
Sanction	0.079	0.087	0.008	-0.040	0.917										
Information Privacy Concerns	-0.212	-0.205	-0.337	-0.155	0.174	0.883									
Private Information Privacy Concerns	-0.188	-0.157	-0.271	-0.107	0.140	0.944	0.917								
Business Information Privacy Concerns	-0.214	-0.229	-0.364	-0.184	0.188	0.952	0.797	0.946							
Attitude	0.305	0.477	0.624	0.485	0.093	-0.421	-0.380	-0.417	0.947						
Habit	0.342	0.613	0.697	0.559	0.141	-0.318	-0.274	-0.328	0.726	0.889					
Social Influence	0.232	0.547	0.559	0.502	0.198	-0.157	-0.096	-0.198	0.641	0.694	0.951				
Hedonic Motivation	0.248	0.475	0.519	0.436	0.193	-0.232	-0.189	-0.249	0.566	0.672	0.546	0.951			
Facilitating Conditions	0.394	0.436	0.465	0.358	0.000	-0.330	-0.316	-0.309	0.514	0.433	0.371	0.356	0.808		
Price Value	0.401	0.405	0.407	0.323	-0.055	-0.233	-0.212	-0.229	0.377	0.366	0.230	0.362	0.635	0.937	
Computer-Self-Efficacy	0.540	-0.030	0.038	-0.037	-0.053	-0.169	-0.157	-0.162	-0.050	-0.108	-0.118	-0.140	0.293	0.208	0.819

Note: ITM = IT Mindfulness, BF = Better Functionalities, UF = Usefulness, EoU = Ease of Use, SA = Sanction, IC = Information Privacy Concerns, PIC = Private Information Privacy Concerns, BIC = Business Information Privacy Concerns, AT = Attitude, HA = Habit, SI = Social Influence, HM = Hedonic Motivation, FC = Facilitating Conditions, PV = Price Value, CSE = Computer Self-Efficacy

Inter-Factor-Correlations for Consumerization of File Sharing (square root of AVE in the diagonal)

	ITM	BF	UF	EoU	SA	IC	PIC	BIC	AT	HA	SI	HM	FC	PV	CSE
IT Mindfulness	0.818														
Better Functionalities	0.220	0.919													
Usefulness	0.307	0.676	0.930												
Ease of Use	0.169	0.740	0.649	0.937											
Sanction	0.090	0.130	0.083	0.088	0.916										
Information Privacy Concerns	-0.229	-0.333	-0.365	-0.233	0.168	0.899									
Private Information Privacy Concerns	-0.195	-0.275	-0.314	-0.186	0.141	0.955	0.926								
Business Information Privacy Concerns	-0.242	-0.360	-0.383	-0.259	0.180	0.960	0.835	0.951							
Attitude	0.341	0.568	0.691	0.541	0.083	-0.471	-0.424	-0.475	0.955						
Habit	0.318	0.706	0.724	0.588	0.153	-0.374	-0.315	-0.398	0.705	0.914					
Social Influence	0.247	0.616	0.577	0.578	0.211	-0.272	-0.205	-0.312	0.601	0.703	0.968				
Hedonic Motivation	0.272	0.586	0.562	0.490	0.185	-0.302	-0.259	-0.317	0.591	0.707	0.601	0.955			
Facilitating Conditions	0.385	0.545	0.544	0.517	0.142	-0.354	-0.351	-0.328	0.601	0.540	0.447	0.453	0.869		
Price Value	0.353	0.494	0.466	0.447	0.007	-0.291	-0.271	-0.286	0.435	0.449	0.305	0.434	0.658	0.963	
Computer-Self-Efficacy	0.501	-0.095	-0.045	-0.057	-0.051	-0.079	-0.086	-0.067	-0.025	-0.150	-0.146	-0.184	0.176	0.156	0.829

Note: ITM = IT Mindfulness, BF = Better Functionalities, UF = Usefulness, EoU = Ease of Use, SA = Sanction, IC = Information Privacy Concerns, PIC = Private Information Privacy Concerns, BIC = Business Information Privacy Concerns, AT = Attitude, HA = Habit, SI = Social Influence, HM = Hedonic Motivation, FC = Facilitating Conditions, PV = Price Value, CSE = Computer Self-Efficacy

Heterotrait-Monotrait Ratios for Consumerization of Instant Messaging

	ITM	BF	UF	EoU	SA	IC	PIC	BIC	AT	HA	SI	HM	FC	PV	CSE
IT Mindfulness															
Better Functionalities	0.223														
Usefulness	0.320	0.663													
Ease of Use	0.115	0.711	0.675												
Sanction	0.092	0.082	0.052	0.059											
Information Privacy Concerns	0.222	0.215	0.367	0.165	0.183										
Private Information Privacy Concerns	0.204	0.169	0.302	0.116	0.148	1.024									
Business Information Privacy Concerns	0.221	0.241	0.398	0.198	0.202	1.007	0.863								
Attitude	0.307	0.492	0.668	0.506	0.089	0.438	0.404	0.434							
Habit	0.227	0.465	0.554	0.473	0.025	0.320	0.301	0.313	0.715						
Social Influence	0.365	0.670	0.786	0.621	0.158	0.346	0.303	0.358	0.785	0.725					
Hedonic Motivation	0.233	0.575	0.608	0.534	0.196	0.166	0.104	0.211	0.666	0.554	0.767				
Facilitating Conditions	0.253	0.499	0.565	0.464	0.196	0.245	0.204	0.263	0.588	0.433	0.743	0.577			
Price Value	0.455	0.478	0.524	0.398	0.069	0.369	0.365	0.343	0.555	0.422	0.481	0.396	0.380		
Computer-Self-Efficacy	0.423	0.429	0.446	0.345	0.063	0.250	0.233	0.245	0.394	0.291	0.398	0.243	0.384	0.733	

Note: ITM = IT Mindfulness, BF = Better Functionalities, UF = Usefulness, EoU = Ease of Use, SA = Sanction, IC = Information Privacy Concerns, PIC = Private Information Privacy Concerns, BIC = Business Information Privacy Concerns, AT = Attitude, HA = Habit, SI = Social Influence, HM = Hedonic Motivation, FC = Facilitating Conditions, PV = Price Value, CSE = Computer Self-Efficacy

Heterotrait-Monotrait Ratios for Consumerization of File Sharing

	ITM	BF	UF	EoU	SA	IC	PIC	BIC	AT	HA	SI	HM	FC	PV	CSE
IT Mindfulness															
Better Functionalities	0.209														
Usefulness	0.306	0.714													
Ease of Use	0.159	0.769	0.691												
Sanction	0.092	0.124	0.084	0.092											
Information Privacy Concerns	0.232	0.346	0.388	0.243	0.181										
Private Information Privacy Concerns	0.208	0.292	0.341	0.197	0.151	1.024									
Business Information Privacy Concerns	0.241	0.376	0.409	0.272	0.199	1.010	0.896								
Attitude	0.335	0.582	0.726	0.558	0.079	0.486	0.447	0.492							
Habit	0.196	0.560	0.632	0.525	0.076	0.283	0.273	0.274	0.701						
Social Influence	0.312	0.755	0.793	0.633	0.155	0.400	0.344	0.429	0.748	0.740					
Hedonic Motivation	0.232	0.637	0.612	0.603	0.209	0.282	0.218	0.326	0.617	0.534	0.755				
Facilitating Conditions	0.258	0.610	0.600	0.514	0.186	0.317	0.278	0.334	0.612	0.562	0.764	0.627			
Price Value	0.414	0.569	0.579	0.550	0.156	0.377	0.385	0.345	0.626	0.447	0.579	0.462	0.470		
Computer-Self-Efficacy	0.366	0.511	0.495	0.466	0.033	0.304	0.289	0.299	0.448	0.329	0.480	0.317	0.453	0.714	

Note: ITM = IT Mindfulness, BF = Better Functionalities, UF = Usefulness, EoU = Ease of Use, SA = Sanction, IC = Information Privacy Concerns, PIC = Private Information Privacy Concerns, BIC = Business Information Privacy Concerns, AT = Attitude, HA = Habit, SI = Social Influence, HM = Hedonic Motivation, FC = Facilitating Conditions, PV = Price Value, CSE = Computer Self-Efficacy

Appendix 2.2.D. Test for Common Method Variance

We tested for CMV by applying the correlational marker technique as post hoc detection method (Lindell and Whitney 2001; Richardson et al. 2009). First, we partialled out the smallest shared variance in bivariate correlations among substantive exogenous latent variables. This did not affect significance of any bivariate correlation among the variables. Second, we implemented the correlational marker technique with a theoretically unrelated marker variable (Lindell and Whitney 2001; Richardson et al. 2009). The correlation observed between the marker variable and the theoretically unrelated variable is interpreted as an estimate of CMV (Lindell and Whitney 2001). The maximum shared variance of the marker variable with other latent variables is only 10.9 % for the instant messaging model and 16.3 % for the file sharing model. Again, partialling out the smallest shared variance between the marker and the substantive exogenous variables resulted in no substantial changes in significance of bivariate correlations. In summary, we do not find hints towards an issue with CMV and, thus, assume that CMV is less of a concern in this study.

Appendix 2.2.E. Empirical Results for Control Variables

	Instant Messaging		**File Sharing**	
Habit → Use	0.405	***	0.424	***
Social Influence → Use	0.039		-0.040	
Hedonic Motivation → Use	-0.120		0.028	
Facilitating Conditions → Use	0.059		0.031	
Price Value → Use	-0.031		-0.038	
Computer-Self-Efficacy → Use	-0.057		-0.105	

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Appendix 2.2.F. Explained Variance in the Structural Equation Models

	Instant Messaging		**File Sharing**	
	R^2	R^2 Adj.	R^2	R^2 Adj.
Better Functionalities of Private IT Service	0.047	0.043	0.048	0.044
Relative Usefulness of IT Service Cons.	0.451	0.446	0.506	0.501
Relative Ease of Use of IT Service Cons.	0.454	0.452	0.548	0.546
Attitude towards IT Service Cons.	0.481	0.472	0.553	0.545
IT Service Cons. Use Behavior	0.583	0.565	0.594	0.576

3 Technostress as a Negative Outcome of Individual Information Systems Use

3.1 A Dark Side of IT Consumerization: How Mixed IT Portfolios with Private and Business IT Components Cause Unreliability

Abstract

With increasing mobile work and work-from-home in the wake of the COVID-19 pandemic, the usage and relevance of consumer IT for business purposes have substantially increased. In many instances, the adoption of IT consumerization has been due to the bare necessity of having no adequate alternative. In this light, an understudied area of IT consumerization, the adverse outcomes for employees using consumer IT for business purposes, is of major importance. We conduct a mixed-methods study to investigate the adverse outcomes of IT consumerization. We build on prior studies and own end-user interviews to draw connections between IT consumerization and techno-unreliability. A subsequent quantitative survey of 162 full-time employees shows that IT consumerization is indeed associated with an increase in techno-unreliability. The emergence of this type of stress is moderated by the users' general computer-self efficacy and leads to various job-related and health-related outcomes. We show that perceived unreliability is driven by users' experience while trying to integrate private and business IT components for business purposes. We follow up on this observation through a qualitative analysis of open-ended survey questions to detail users' experience. Our findings emphasize the need to examine the dark side of IT consumerization, despite its well-studied positive effects. We suggest that organizations should strive to integrate business and private IT as much as IT security constraints allow for, to reduce the technostress of their employees.

Keywords: IT Consumerization, BYOD, Technostress, Self-Efficacy, Integration

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Status: Working paper under review for publication.

3.1.1 Introduction

Today, many IT users are responsible for their entire individual information system. Such individual information systems include infrastructure (e.g., WiFi, mobile data plans), devices (e.g., smartphones and laptops), as well as applications and services that run on these devices (e.g., instant messengers) (Baskerville 2011). Many times, such IT portfolios involve substantial amounts of mobile, fast, and innovative. User experience with such privately-owned IT raises the bar for business IT. It has long caused employees to bring their own IT into the workplace, referred to as IT consumerization (Niehaves et al. 2012). IT consumerization has been studied widely with an emphasis on organizational advantages, such as increased innovation and productivity (e.g., Bautista et al. 2018; Junglas et al. 2019) and organizational disadvantages, such as security and privacy risks (e.g., Gewald et al. 2017), as well as end-user advantages and reasons for adoption (e.g., Ortbach 2015). Adverse outcomes for the end-users, however, have been studied scarcely (Köffer et al. 2014). Two recent developments emphasize a renewed need to do so.

First and foremost, we are currently experiencing a substantial increase in mobile work and work-from-home sparked by global social distancing measures in the wake of the COVID-19 pandemic. Particularly the need for digital communication and collaboration has risen during the pandemic. These circumstances have forced many end-users into mobile work regardless of individual IT adoption decisions. Furthermore, this development has caught many organizations off guard and without adequate IT to meet the needs of an entire organization working remotely. Thus, many employees have felt the need to use their private infrastructure, devices, and applications to fill those voids. This increase of involuntary mobile work will undoubtedly highlight the disadvantages of IT consumerization, particularly for its end-users. Two known disadvantages are increased workload and IT-related stress (Niehaves et al. 2012). We expect that also in post-pandemic times, we will see higher levels of mobile work and work-from-home than we saw before COVID-19.

Second, a recent literature analysis and call for research has highlighted the need to understand better the creative and innovative use of IT (Tarafdar et al. 2019), which has been associated with IT consumerization (Junglas et al. 2019). While there are certainly opportunities for future research regarding positive psychological outcomes of IT consumerization, researchers also need to understand the potential adverse outcomes to view such opportunities in the right light. One aspect relevant in the context is understanding the interplay between the technologies (in this case, consumer IT) and the end-user. Research has suggested that both the mitigation of adverse effects (e.g., Shu et al. 2011; Tarafdar et al. 2015) and the fostering of positive effects (Salo et al. 2018) are related to the individual capabilities of the end-users. Nevertheless, organizations have a responsibility to provide their employees with adequate IT.

Related to the current increase in work-from-home and the associated increase in consumer IT use, we take a detailed look at the negative side of using mixed IT portfolios consisting of both privately-owned and business-owned IT components. To do that, we conduct a concurrent nested mixed-methods study with a dominant quantitative strand. With this, we aim to answer the following research question:

> *How does IT consumerization use behavior affect perceived unreliability, and what factors drive the relationship?*

Our study finds that poor integration between the privately-owned and business-owned components of a mixed IT portfolio is a major driver of unreliability, leading to adverse outcomes. These outcomes include switching exhaustion, transition costs, and dissatisfaction with the IT portfolio. We further find that particularly users with low computer self-efficacy are prone to experiencing such issues. In our qualitative strand, we provide concrete categories of problems that may arise and that organizations should be aware of when designing their IT consumerization policies.

3.1.2 Theoretical Background

3.1.2.1 IT Consumerization

An information system (IS) is a socio-technical system comprising technology, information, and social artifacts (Lee et al. 2015). Increasingly, individuals build, administrate, and use their own IT (Baskerville 2011). Because of this new autonomy, individuals can bring their own IT components wherever they go, including the workplace. This phenomenon is known as IT consumerization – the use of privately-owned IT components for business purposes (Niehaves et al. 2012). There have been many studies investigating this phenomenon in the past years. Research has covered four areas: advantages for employees, disadvantages for employees, organizational advantages, and organizational risks (Niehaves et al. 2012).

Regarding advantages for employees, studies have focused on the antecedents of use decisions. This focus has led to a thorough understanding of why employees participate in bring your own device programs or bring their privately-owned devices to work. Many of these studies build upon established technology acceptance and use literature, such as UTAUT, TAM, and TPB (e.g., Bautista et al. 2018; Gewald et al. 2017; Ortbach 2015). These studies find that primarily the benefits for work purposes, such as increased usefulness and ease of use, drive adoption decisions.

From an organizational perspective, outcomes of IT consumerization use behavior are increased productivity and work quality (e.g., Bautista et al. 2018). Furthermore, advantages such as increased creativity, innovativeness, mobility, and flexibility (Behrens 2009; Gewald et al. 2017; Junglas et al. 2019; Ortbach 2015) are associated with IT consumerization. Many of these advantages are advantageous for organizations and the employees themselves. Lastly, indirect organizational benefits, such as increased employer attractiveness (Gewald et al. 2017) and organizational commitment (Doargajudhur and Dell 2019), have been added to the list of benefits. There is also a stream of research that has focused on the negative sides of IT consumerization from an organizational point of view. Such risks mainly include IT security and data privacy issues (e.g., Gewald et al. 2017) and a loss of organizational control (Behrens 2009).

Direct connections between negative consequences for the individual and IT consumerization have been scarcely investigated. These include that organizational encouragement for IT consumerization increases work-to-life conflict (Köffer et al. 2014). In addition, qualitative results exist from user interviews (Niehaves et al. 2013b), case studies (Niehaves et al. 2013a; Ortbach et al. 2013), and analyses of practitioner literature (Niehaves et al. 2012). All of which points into the direction that IT consumerization indeed leads to adverse outcomes for the individual. The studies raise evidence for an increase in stress levels regarding the use of consumer IT. An observation that is closely related to research on technostress. To the best of our knowledge, no empirical studies exist that have investigated the harmful effects of mixed IT portfolios concerning actual use behavior quantitatively and in-depth.

3.1.2.2 A Dark Side of IT Consumerization

Studies have previously connected IT consumerization research with technostress. Early on, evidence in practitioner literature regarding IT consumerization hints at stress as a possible outcome (Niehaves et al. 2012). Technological ubiquity and blurring of boundaries between private and work life were identified as potential reasons. Others found that organizational encouragement for dual use of mobile IT does indeed translate to both work overload and work-to-life conflict (Köffer et al. 2014). IT consumerization may lead to a higher workload due to ubiquitous access, resulting in stress (Niehaves et al. 2013a).

This was echoed in an interview study that found increased reachability, lack of competence, workflow changes, and system redundancies to be drivers of adverse outcomes of IT consumerization (Ortbach et al. 2013). System redundancies are described as frequent changes of systems, multi-system usage, and redundancy of data.

In summation, extensive research has focused on reachability with aspects, such as increased work-home conflict. Aspects related to the mixed IT portfolio itself, such as workflow changes and system redundancies, have seen little attention. There is also little evidence of how these factors interplay with a lack of competence.

3.1.2.3 Negative Psychological Effects of IT Use

The findings regarding the dark side of IT consumerization can be closely related to research on psychological stress. Stress results from the interplay between environmental demands and personal resources, in which the demands tax or exceed the person's resources (Lazarus and Folkman 1984). Studies regarding stress due to digital technologies date back to the clinical psychologist Craig Brod (1982), who introduced the term technostress in 1982, which he described as a failure of employees to adapt to modern office technology, which leads to stressful experiences. Based on that, technostress is defined as "stress that users experience as a result of their use of IS in the organizational context" (Tarafdar et al. 2015, p. 103). In this paper, we thus focus on the organizational context rather than the private one.

Technostress is a consequence of technology use (Ayyagari et al. 2011). Email use has been identified as a driver of stress, the effect of online social network use on technostress has been investigated, and use has been included as a control variable (Stich et al. 2019) in stress research. Specific demanding conditions during IT use create technostress. These demands must be met using personal resources. Research has identified several technostress creators, such as invasion, overload, complexity, uncertainty, insecurity (Ragu-Nathan et al. 2008), and unreliability (Adam et al. 2017; Ayyagari et al. 2011).

Technostress has been associated with a negative impact on the organizational commitment of an individual (i.e., how strongly an employee is involved in the organization and how strongly he or she identifies with it), the identification with the employer's values and goals, and ultimately commitment to the workplace (continuance commitment, i.e., an employee's attachment to an organization). Further, (techno)stress has adverse effects on the individual's health and well-being, such as increased exhaustion and burnout (Galluch et al. 2015). Similarly, the impact of technostress on IS-related outcomes has been investigated. Among others, these include satisfaction with IS (Tarafdar et al. 2010) and discontinued usage intention (Maier et al. 2015).

In summary, while technostress and IT consumerization are rich research streams, the overlap has been studied scarcely. However, with the recent advent of work-from-home, consumer technologies have seen renewed interest. Thus, an investigation of the overlap is both topical and relevant to organizations and employees alike.

3.1.3 Mixed-Methods Design and Pre-Study

3.1.3.1 Mixed-Methods Design

We conduct a pre-study as applicability check of the problem at hand based on semi-structured interviews. After that, the main study follows a mixed-methods approach (Venkatesh et al. 2013; Venkatesh et al. 2016) with the purpose of completeness. In the quantitative strand, we test hypotheses derived from the literature. In the qualitative stream, we derive insights based on qualitative data collected as part of our survey. This stream helps us provide a more meaningful picture and richer explanations of the phenomenon and more detailed insights for practice. The quantitative strand is the dominant part – it uses a structural equation model based on survey data. The qualitative part uses coding principles from grounded theory to analyze the open-ended questions (Strauss and Corbin 1990). Table 3.1-1 sketches the overall design. We draw meta-inferences over both the qualitative and quantitative strands in the discussion.

Study	**Pre-Study**	**Main Study**	
Data collection	semi-structured interviews (n = 5)	structured online survey (n = 161)	
Strand	qualitative (less dominant)	quantitative (dominant)	qualitative (less dominant)
Analysis method	coding	PLS-SEM	coding
Key inference	stimulus and applicability check for hypothesis development	statistical hypothesis testing	further assessment of quantitative findings

Table 3.1-1: Overview of Mixed-Methods Design

3.1.3.2 Qualitative Pre-Study

Issues regarding workflow changes and system redundancies in mixed IT portfolios are scarce. Thus, we aim at understanding relevant moderators and individual-level outcomes for the context of IT consumerization. We interview users of a knowledge-intense service organization regarding their negative experiences related to such issues while using consumer IT for business purposes. Upon receiving descriptions of stressful user experiences, we followed up with questions regarding stress creators, resources, individual characteristics, and technology characteristics. The interviews were recorded and transcribed. The transcripts were coded. Contrary to grounded theory, this coding iteration was a deductive approach based on the authors' domain knowledge. The interviewees' experience centered around the technostress creator unreliability. Regarding resources and other influencing factors, our interviewees mentioned general computer self-efficacy and IT portfolio integration to be important. The results are presented in Table 3.1-2.

Construct	Example based on the Data
Unreliability	
"degree to which features and capabilities provided by the [digital] technology are [not] dependable" (Ayyagari et al. 2011, p. 837)	*"I was working on a document on the business laptop, pressed the save button and closed the laptop. At home, I opened my private laptop, opened the file and all my changes were unavailable. Saving or synchronization did not work, I have no idea."* *"We were both working on the same presentation and the next day I opened it [on my private laptop] and part of the progress was gone. And then there was an error message."*
General Computer Self-Efficacy	
"an individual's perception of efficacy in performing specific computer-related tasks" (Marakas et al. 1998, p. 127)	*"I would describe myself as a tech-savvy person and able to deal with digital technologies. […] Therefore, such situations are less stressful for me than for someone in whom these characteristics are less pronounced."* *"I would not consider myself incompetent in IT, but at that moment I lacked the knowledge to deal with the specific situation without any problems. Now I know better."*
IT Portfolio Integration	
The ability to integrate data, communication and collaboration technologies, and other applications and services within one's individual information system (based on Rai and Tang 2010)	*"The problem that printing [from my private laptop] didn't work was that there was no VPN connection and the printer only allows devices from the network."* *"I had two computers that I worked with. The private computer was not integrated into the business IT infrastructure, which means that I had no access to emails and data from the business computer and then always had to transfer everything from the business computer to the other computer."*

Table 3.1-2: Results of Qualitative User Interviews

3.1.4 Hypotheses Development

We aim to shed light on the relationship between IT consumerization use behavior and the users' perception of unreliability. Prior literature and our interviews show that this relationship is of interest regarding adverse outcomes of IT consumerization. Relevant influencing factors are identified in the interviews. First, the impact of the degree of integration between privately-owned and business-owned components of the IT portfolio used for business purposes. We define an IT portfolio for business purposes as the composition of private and business IT components (such as devices, applications, and services) used for business purposes (cf. Junglas et al. 2019). Second, the users' computer self-efficacy is considered a resource to mitigate the adverse impact of IT consumerization. In addition, three adverse outcomes of unreliability in the specific context of IT portfolios consisting of private and business IT for business purposes were identified: dissatisfaction with IT portfolio, transition costs, and switching exhaustion.

The following sub-sections develop our hypotheses in more detail. Figure 3.1-1 summarizes the research model.

3.1.4.1 IT Consumerization and Unreliability

System redundancies can be a source of stress in the context of IT consumerization (Ortbach et al. 2013). We propose that this is because they cause the perception of unreliability (Adam et al. 2017), which is defined as the "degree to which features and capabilities provided by the technology are [not] dependable" (Ayyagari et al. 2011, p. 837). This definition focuses on individual technologies and not necessarily their interplay. However, in our interviews, switching between privately-owned and business-owned components of an IT portfolio for business purposes was the most frequently reported source of stress related to IT consumerization. The users reported occasions where the integration of data collected or processed through privately-owned IT caused problems when they were transferred to business IT solutions and vice versa. For example, one interviewee mentioned that using a privately-owned cloud solution was necessary to transfer data, which causes technical problems and may result in the loss of work progress. Another interviewee reported that a small computer program written for business purposes using privately-owned IT could not be tested on the business-owned IT due to restrictive security settings. Upon the analysis of these stressful situations, we suggest that this is related to perceived unreliability. We hypothesize:

H1: IT consumerization use behavior increases unreliability.

3.1.4.2 The Effect of Portfolio Integration

Switching from privately-owned IT to business-owned IT is generally possible but associated with data transfer or information exchange between the different components, which we refer to as a lack of portfolio integration (Rai and Tang 2010). Our interviewees mentioned a seamless integration of the different components of their IT portfolio to be one of the most important factors for effective IT consumerization. They frequently report issues regarding integration that lead to the perception of unreliability. For example, barriers related to the transfer of data and access to an organization's network through private IT components were reported to create the necessity for workarounds. Such workarounds are a source of unreliability and cause frustration. Nevertheless, when organizations provide seamless integration of the various privately-owned and business-owned components, such issues decrease. Hence, we hypothesize:

H2: IT portfolio integration reduces unreliability.

3.1.4.3 The Effect of General Computer Self-Efficacy

Personal resources play an essential role in the perception of stress. Relevant personal resources are digital literacy (Tarafdar et al. 2019) or technology competence (Tarafdar et al. 2015). This role is echoed by IT consumerization literature that finds an association with easier problem solving for people with high technological competence (Niehaves et al. 2013b). Further, the lack of competence is mentioned as the most frequent antecedent of technostress when engaging in IT consumerization (Ortbach et al. 2013).

In our interviews, respondents explained how they coped with stressful situations through creative solutions and workarounds. For example, one interviewee suggested that he lacked the technological competence to deal with data loss while transferring files between multiple components of his mixed IT portfolio. On the contrary, another employee stated that his background in IT helps him be calmer and more resilient when it comes to overcoming issues with IT. Such digital problem-solving competencies are strongly related to general computer self-efficacy (Shu et al. 2011). This suggests a direct effect of general computer self-efficacy on technostress creators, such as unreliability:

H3: General computer self-efficacy reduces unreliability.

3.1.4.4 The Effect of Unreliability on Outcomes

Our interviews suggest that problems arising from integrating privately-owned and business-owned components of an IT portfolio and the resulting perception of unreliability increase the individuals' dissatisfaction with their IT portfolio (cf. Au et al. 2008). Dissatisfaction with IT portfolio is the user's affective and cognitive evaluation of a consumption-related lack of need fulfilment experienced with the IT portfolio (Au et al. 2008). For example, one interviewee suggested that technical restrictions are a limiting factor of successful integration and that there would be better technical ways to facilitate it.

H4a: Unreliability increases dissatisfaction with the IT portfolio.

Another result of switching between different technologies, such as online social networks, are heightened transition costs (Maier et al. 2015). Previous research finds that a lack of integration between different social media sites leads to high transition costs, which reflect the time and effort required in such situations. As pointed out, switching from privately-owned IT to business-owned IT components is generally possible but associated with data transfer and communication efforts, referred to as portfolio integration (Rai and Tang 2010). Thus, we propose:

H4b: Unreliability increases transition costs.

Technostress has several adverse outcomes regarding the individuals' well-being. Particularly the effect on psychological strain has been studied extensively (e.g., Ayyagari et al. 2011; Galluch et al. 2015; Maier et al. 2015). Strain is one of the most important long-term problems that arise from stressful situations. To isolate the psychological effects of switching between different IT, switching exhaustion has been conceptualized (Maier et al. 2015). In other words, "the cause of the perception of exhaustion [is] the switching process" (Maier et al. 2015, p. 291). While the construct was developed in the context of online social network use, we adapt it to the context of IT consumerization and hypothesize:

H4c: Unreliability increases switching exhaustion.

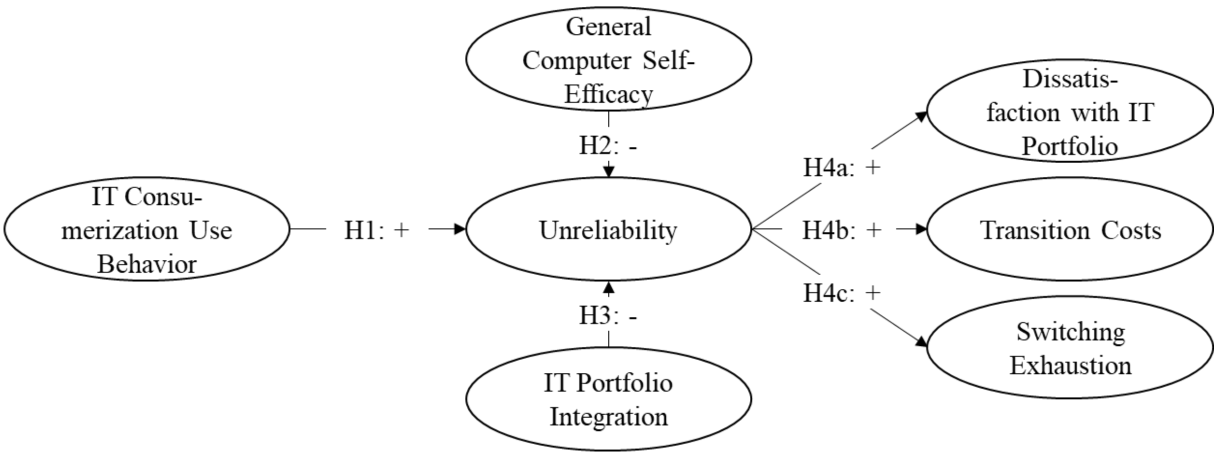

Figure 3.1-1: Research Model

3.1.5 Quantitative Empirical Analysis

3.1.5.1 Survey Design and Procedures

To test the model empirically, we design an online survey. The questionnaire starts with an explanation of the survey's scope and explains the use of private and business IT for business purposes. Participants indicate their level of IT consumerization use behavior (Junglas et al. 2019). We further measure unreliability (Ayyagari et al. 2011) as well as its outcomes (Au et al. 2008; Maier et al. 2015). Lastly, computer self-efficacy (Marakas et al. 2007) and perceived IT portfolio integration (Rai and Tang 2010) are measured. All scales are reflective. We measure all items on a seven-point Likert scale. Where necessary, we adapt the items to the IT consumerization context. Appendix 3.1.A provides an overview of all items. We furthermore asked an open-ended question regarding stressful or frustrating situations from switching between private IT to business IT and vice versa.

We restrict participation to full-time employees and distribute the survey via the online crowdsourcing market Amazon Mechanical Turk (MTurk) in April 2020, during the first wave of the COVID-19 pandemic. Such internet-based platforms allow the recruiting of participants for surveys and other tasks (Steelman et al. 2014). MTurk's participant pool is closer to the U.S. population than traditional university subject pools (Paolacci et al. 2010). Further, MTurk has been frequently used in IS research before (e.g., Kehr et al. 2015). Participants received a monetary reward of USD 1.30 for completing the survey. To ensure data quality, we implemented several measures. Next to a traditional attention check ("If you are answering this survey cautiously, tick the second box from the left.") and an instructional manipulation check (Oppenheimer et al. 2009), we assessed open-ended questions to identify "unusual comments" (Chmielewski and Kucker 2020).

3.1.5.2 Results

162 participants completed our survey and passed our quality gates, of which 32.7 % are female, 65.4 % male. Three participants stated to be of another gender. The average age of respondents was 39 years. We assess our research model through structural equation modeling (PLS-SEM) using SmartPLS 3.2. We start with the evaluation of the measurement model before assessing the structural model and testing our hypotheses.

Evaluation of the Measurement Model

Regarding internal consistency reliability (ICR), all scales exceed the threshold of 0.708 with a minimum of 0.800 for Cronbach's Alpha (Alpha) and a minimum of 0.879 for composite reliability (CR). For convergent validity, we examine indicator reliability and average variance extracted (AVE). Convergent validity is satisfactory as the minimum of all indicators' outer loadings is 0.780, and the minimum AVE is 0.708. For discriminant validity, we first examine each indicator's cross-loadings with all other constructs to check whether they are lower than the indicator's outer loading on the construct. Our data meets this criterion. Second, each construct's square root of the AVE is higher than the highest correlation with other constructs (Fornell-Larcker criterion). Thus, discriminant validity is supported. Table 3.1-3 shows means, standard deviations (SD), Alpha, CR, and AVE for all constructs. Information on (cross-)loadings and the Fornell-Larcker criterion can be found in Appendix 3.1.B and Appendix 3.1.C.

	# Items	Mean	SD	Loadings	Alpha	CR	AVE
IT Consumerization Use Behavior	3	4.844	1.853	0.780-0.892	0.800	0.879	0.708
Unreliability	3	5.287	1.272	0.951-0.966	0.957	0.972	0.920
Perceived IT Portfolio Integration	4	2.745	1.791	0.843-0.892	0.896	0.927	0.761
General Computer Self-Efficacy	6	6.069	1.295	0.824-0.934	0.944	0.954	0.777
Dissatisfaction with IT Portfolio	4	2.455	1.239	0.913-0.923	0.938	0.956	0.844
Transition Costs	3	3.434	1.712	0.926-0.957	0.941	0.946	0.962
Switching Exhaustion	4	3.091	1.850	0.939-0.953	0.962	0.963	0.973

Table 3.1-3: Descriptive Statistics, Main Factor Loadings, Internal Consistency, and Average Variance Extracted

Evaluation of Structural Model and Hypotheses Testing

Collinearity is not an issue since all variance inflation factors of the constructs are lower than 5.0 (max. of 1.262). Figure 3.1-2 presents the path estimates for the model, including their significance level.

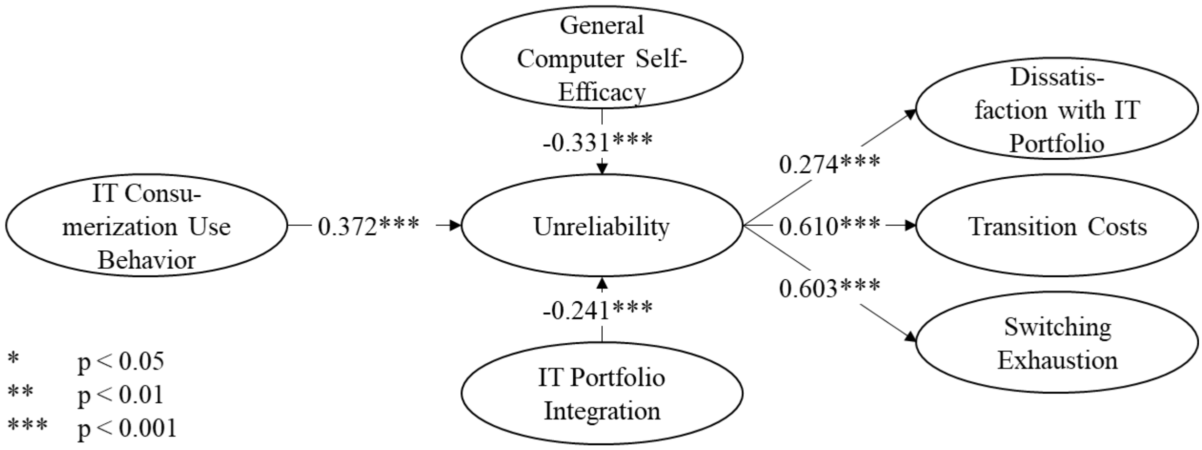

Figure 3.1-2: Model Results

Table 3.1-4 displays the corresponding R^2 and R^2 adjusted values.

	R^2	R^2 Adj.
Unreliability	0.255	0.240
Dissatisfaction with IT Portfolio	0.075	0.069
Transition Costs	0.372	0.368
Switching Exhaustion	0.364	0.360

Table 3.1-4: Explained Variance in the Structural Equation Model

We find that IT consumerization use behavior is positively related to unreliability, which supports H1. Also, the general computer self-efficacy and IT portfolio integration are found to have a significant and negative association with unreliability. This finding supports H2 and H3. Lastly, H4a-H4c are supported as unreliability is positively related to dissatisfaction with the

IT portfolio, transition costs, and switching exhaustion. Table 3.1-5 summarizes our hypotheses and their respective empirical results.

Theoretical Hypotheses			Empirical Results	
H1	pos.	IT Consumerization Use Behavior → Unreliability	supported	++
H2	neg.	Perceived IT Portfolio Integration → Unreliability	supported	-
H3	neg.	General Computer Self-Efficacy → Unreliability	supported	-
H4a	pos.	Unreliability → Dissatisfaction with IT Portfolio	supported	+
H4b	pos.	Unreliability → Transition Costs	supported	+++
H4c	pos.	Unreliability → Switching Exhaustion	supported	+++

Note: plus signs indicate a significant and positive effect, minus signs a significant and negative effect, n.s. would indicate a non-significant effect at the 5 % level. For significant effects, +/- indicates a small ($f^2 \geq 0.02$), ++/-- a medium ($f^2 \geq 0.15$), and +++/--- a large ($f^2 > 0.35$) effect size.

Table 3.1-5: Overview of Hypotheses and Empirical Results

Evaluation of the Qualitative Survey Data

For the qualitative strand of our main study, we asked the respondents to name stressful or frustrating situations from switching between privately-owned and business-owned IT and vice versa. We collected 130 valid responses to this question. These answers were inductively coded using open coding. Initial codes were then reorganized into broader categories, a process that can be described as axial coding (Strauss and Corbin 1990). Our findings are presented in Table 3.1-6.

Description	Example based on the Data
Lack of Reliable Access	
Difficulties, such as unreliability and slow speeds, with accessing business resources from private devices – particularly through secure connections via VPNs.	*"Accessing the shared server through VPN can be difficult if there are server problems or network issues. Sometimes the server can be down for hours and I cannot access files."* *"I was unable to maintain a stable connect[ion] with my VPN for work but a technician talked me through it and it was eventually resolved."*
Issues Primarily Related to Data Transfer	
Tedious File Transfer	
Transferring data from one device to another is perceived as tedious. Lack of speed and time-consuming workarounds cause frustration.	*"I have found it difficult to have a particular software on my business IT working. So I use my private device to complete the job. But it is almost not possible to upload the results to the server of my company from a private IT component without the approval of the IT personnel [...]. So I have to forward this result to my business IT before uploading which turns out to be an extra effort."* *"I have Photoshop on my business laptop but use my personal desktop for most of my work. When I download a photo that needs editing, I have to email it to myself to my laptop so I can use Photoshop."*
Data Inconsistencies and Redundancies	
Unsuccessful syncing of applications between private and business IT devices creates frustration, particularly where inconsistent data must be managed redundantly.	*"Working from home, there have been some glitches where some applications are not talking to one another. There should be no time [gap] when I update one database which should then carry over to other applications."* *"I had some issues syncing up emails between three devices because one of the devices was on an older operating system. This laptop cannot be upgraded any further so it's causing me some issues."*

Loss of Data while Switching	
Loss of data while transferring data from private to business component and vice versa, particularly when unreliable workarounds are necessary.	*“The last time I had to switch from an IT component to the other, I ended up losing almost all my files because it was not well backed up. It was so frustrating that I had to call the company to help find a way to recover some of the important documents.”* *“I lost my flash drive on which I put the data [I wanted to transfer]. It was very frustrating.”*
Issues Primarily Related to IT Usage	
Incompatibility	
Incompatibility of private and business IT. Mainly because of different operating systems and specific file types that cannot be accessed.	*“Sometimes some files are not compatible across devices, especially between Mac and PC. It is annoying to try to figure out how to convert them.”* *“I have my work saved on my [private] laptop and I want to access that work on my business phone, but not all of the data is fully transferable. I.e., Excel documents are only on my laptops.”*
Inability to Use same Software	
Problems with the installation of business applications on the private device or vice versa cause undesired barriers. This can be due to incompatible hardware and software, IT policies, licenses, or a lack of admin rights.	*“I am not allowed to use email on my private IT component so when my manager uses instant messaging to alert me that I have to check my email I need to use my business IT component (laptop).”* *“Trying to log on to our all-employee virtual meeting using Microsoft Teams – I couldn’t get the native app on my PC to work, so switched to the app on my phone, and then the Web app.”*

Table 3.1-6: Coding Scheme of Qualitative Survey Data

We find several aspects that contribute to the perception of unreliability due to a lack of IT portfolio integration. First, a lack of reliable access to company resources is reported to be a source of frustration. Such a perception can be caused by slow VPN connections, unavailable business servers, or network issues. This creates problems while trying to cross the boundaries from private to business IT. Second, we find several aspects related to data and file transfer that are a source of unreliability for many employees. File transfer is perceived as tedious, particularly when direct options are unavailable and workarounds, such as file forwarding via email, have to be employed to switch from business to private solutions and vice versa.

Similarly, a lack of seamless integration between private and business IT components can cause data inconsistencies or the need to manage data redundantly. This is particularly the case when options for automatic synchronization are missing or not working properly. In extreme cases, the need for workarounds or manual file transfer can result in data loss. This is a major source of frustration as a productivity loss often accompanies it. Lastly, incompatibility between different operating systems in a mixed IT portfolio consisting of unaligned private and business IT components creates issues. Workarounds, such as file converters, have to be employed by the individuals, hindering their workflow. Third, known routines can be adversely affected due to the inability to use the same software on private and business IT. This can be caused by incompatibility between technologies or by deliberate decisions by organizations, such as IT policies. It creates boundaries between the components, which take up additional time and are undesired by the employees.

While these categories help gain a detailed understanding of users' experience, they are not without interrelations and interdependencies. For example, loss of data could result from a tedious file transfer workaround gone wrong, and incompatibility could result in an inability to use the same software. However, the categories can also occur independently. For example, the inability to use the same software can be due to IT policies. Despite these limitations, we consider the list a good overview of the underlying issues of unreliability due to a lack of integration between business and private IT that may guide decisions in practice.

3.1.6 Discussion

Our research was motivated by two major recent developments. First, the COVID-19 pandemic and its social distancing measures force employees into more mobile work and work-from-home. This has specifically increased the need for digital communication and collaboration. This development was frequently accompanied by a need for IT that is not provided by the employer and, thus, resulted in increased IT consumerization. Second, prior research has stated the need to better understand innovative IT use associated with IT consumerization (Tarafdar et al. 2019). However, adverse effects on the individual have been studied scarcely. This scarcity is particularly true for the role of mixed IT portfolios and the integration of privately-owned and business-owned IT components. Thus, we build a theoretical model and analyze the effect of IT consumerization on unreliability as well as associated outcomes and the influence of computer self-efficacy and perceived portfolio integration. We use a qualitative pre-study to inform our theorizing and test the theoretical model quantitatively through survey data. The data supports our hypotheses. Qualitative data from open-ended survey questions adds richness to the understanding of the relationships. Such reasons lie in the lack of access to company resources, data and file transfer issues, and the inability to use the same software on private and business systems. The resulting technostress leads to dissatisfaction with the IT portfolio, switching exhaustion, and transition costs that hamper performance. Such negative effects of IT consumerization are mitigated for users with high general computer self-efficacy.

3.1.6.1 Theoretical Contribution

We find that IT consumerization and the use of mixed IT portfolios that are poorly integrated have multiple negative consequences. Based on extant literature and qualitative interviews, unreliability is a major mediator of this relationship. This is important to notice since prior research on IT consumerization has found higher usefulness and ease of use to be the key drivers for individuals' IT adoption decisions in general (Venkatesh et al. 2012) and IT consumerization in particular (Ortbach 2015). The perception of IT to not behave consistently and its features to not be dependable tends to go against classical antecedents of technology acceptance like perceived ease of use and perceived usefulness. Here, we see a need for a deeper investigation to understand this paradox.

As a first step to deepening this understanding, we find that perceived IT portfolio integration is a crucial factor for the seamless operation of IT portfolios for business purposes, including private IT components. To the best of our knowledge, this perception has not been considered in the IT consumerization literature so far, and we contribute to it by raising this issue. We find that issues with integration between multiple components of a mixed IT portfolio lead to a higher perception of unreliability. While the duality of IT components certainly raises issues with integration, which we show in this study, such issues can also emerge between multiple heterogeneous IT components provided by the business. For example, different manufacturers of IT and their respective operating systems might cause such issues, which, thus, should be regarded in future research. While poor integration may be an issue with IT portfolios consisting of only business-owned IT components, their management is easier and lies in the hand of IT departments. This is different for mixed IT portfolios, where users are administrating their privately-owned components.

Thus, it is apparent that the general computer self-efficacy of the users also plays a vital role in this relationship. We find that general computer self-efficacy influences the effect of IT consumerization on technostress creators in several ways. This is congruent with the transactional model of stress that most technostress research is based on. Here, stress emerges when external demands tax or exceed the resources an individual can use to meet the demands (Lazarus and Folkman 1984). General computer self-efficacy is such a resource. This finding is also important for the individuals themselves when deciding whether to engage in IT consumerization. This yields several practical implications that we discuss in the next section.

We extend upon our findings through a qualitative analysis of users' experience of poor integration of privately-owned and business-owned IT. We find a host of different problems that can arise, which center around universal access to company resources, data transfer, synchronization, and compatibility issues. These insights also extend our understanding of the technostress phenomenon and may guide future work on mitigating technostress related to IT consumerization.

3.1.6.2 Practical Implications

When employees increasingly use privately-owned IT for business purposes, it is crucial to understand the personal consequences of this adoption decision. Our qualitative investigation reveals several issues that employees face when business IT and private IT are poorly integrated. Some of these issues can be overcome by the organization: For example, seamless solutions for data transfer that employees can integrate onto their private devices may help with issues with data loss or data redundancies. Many cloud-based office suits offer such integration that can be made available to private devices based on the organizations' IT policies. Several of these changes come as a tradeoff between IT security and user-friendliness. With recent security incidents which have gained global attention, and home-office workers becoming an increasingly popular gateway for hackers, many companies tend to the side of caution with their IT policies. However, they should be aware that restricting access to company resources causes stress in employees. This stress is associated with adverse health effects, decreased satisfaction with IT, and decreased productivity due to transition costs.

Our findings further show that such stressful situations are particularly problematic for IT users that lack personal IT-related resources, measured as general computer self-efficacy, to overcome such issues. Thus, we conclude that IT consumerization is only reasonable if individuals can handle the technologies of their IT portfolio and the complexity introduced by the interplay of privately-owned and business IT components. Thus, IT consumerization should be cautiously used by employees that lack the resources to deal with its additional demands.

Further, privately-owned IT components usually receive less organizational support, which is an essential external resource for inhibiting technostress. In order to prevent the identified negative consequences of IT consumerization, organizations would be well-advised to start offering support for privately-owned IT. This would allow both the organization and its employees to benefit from the advantages associated with IT consumerization without risking their employees' well-being and productivity. Alternatively, organizations may offer all relevant IT components, with high quality and ease of use, that their employees need for mobile work and work-from-home to reduce IT consumerization and its adverse outcomes. Yet, this naturally hampers its benefits.

In summation, both restrictive as well as laissez-faire IT consumerization policies may have adverse effects on users that struggle with IT. Organizations should thus embrace IT consumerization, offer technical support as well as adequate technological integration of private IT devices into their portfolio in order to reap the benefits and mitigate the risks of IT consumerization.

3.1.7 Limitations and Conclusion

Our study has a number of limitations that leave room for further research. In the quantitative empirical part, we use data from a single cross-sectional survey in times of the COVID-19 pandemic, which leads to limitations in testing the robustness and generalizability of results. Future research should follow up with generating additional data sets to test robustness and generalizability. Particularly the relationship between IT portfolio integration and technostress seems promising for future research and should be further validated.

Further, in our research, we emphasize the role of unreliability, which has been scarcely studied in the context of IT consumerization. We show that IT portfolio integration plays a significant role in this relationship. While we elicit several reasons why IT consumerization creates such problems, for example, through a lack of strategic alignment of the components, we do not think that the outlined problems are limited to this domain. Poorly managed or historically grown business IT portfolios may have similar issues. Future research could thus explore the impact of integration on technostress within other IT portfolios.

Previous work has raised research questions regarding different types of stress, particularly challenge stress (Tarafdar et al. 2019). One element mentioned to create challenging situations for users is innovative work behavior (Tarafdar et al. 2019). This factor is said to be facilitated by IT consumerization (Junglas et al. 2019). While unreliability is likely a hindrance or a threat to most individuals, future research should look into ways that IT consumerization can contribute to the bright side of technostress. Despite these suggestions for future research, the paper at hand contributes to the scholarly discourse on both the effects of IT consumerization and the antecedents of technostress. It provides several suggestions for practitioners to govern and manage IT consumerization and mixed IT portfolios.

In conclusion, our research sheds light on the adverse effects of IT consumerization concerning technostress and its consequences. We find unreliability to be particularly relevant in this context. With a mixed-methods design, we detail why a mixed IT portfolio of business and private IT components creates a sense of unreliability. Our research further contributes concrete issues that users experience and suggests how these effects can be attenuated on an organizational and individual level. We conclude that IT consumerization needs to be adequately managed and integrated into the existing business-owned IT landscape to reduce individual exhaustion, increase satisfaction with the IT portfolio, and reduce transition costs that inhibit performance. We further suggest that IT consumerization makes the most sense for users with a high level of IT-related resources to successfully overcome the remaining boundaries between privately-owned and business-owned IT.

3.1.8 References

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3.1.9 Appendix

Appendix 3.1.A. Measurement Items

IT Consumerization Use Behavior (source: Junglas et al. 2019)	
ITC01	I use my private devices (e.g., smartphone, iPad, or private laptop computer) for business purposes.
ITC02	I use mobile applications downloaded from the Web for business purposes.
ITC03	I use my private services (e.g., Skype, Twitter, Facebook, text messaging) for business purposes.
Unreliability (source: Ayyagari et al. 2011)	
UNR01	The features provided by components of my IT portfolio for business purposes are not dependable.
UNR02	The capabilities provided by components of my IT portfolio for business purposes are not reliable.
UNR03	Components of my IT portfolio for business purposes do not behave in a highly consistent way.
Perceived IT Portfolio Integration (source: Rai and Tang 2010)	
PPI01	My IT portfolio for business purposes easily accesses data from its various components.
PPI02	My IT portfolio for business purposes provides seamless connection between its various components (e.g., devices, services, data).
PPI03	My IT portfolio for business purposes has the capability to exchange real time information between its various components.
PPI04	My IT portfolio for business purposes easily aggregates relevant information from its various data sources (e.g., file storage, messaging, email, office suite).
General Computer Self-Efficacy (source: Marakas et al. 2007)	
CSE01	I believe I have the ability to describe how a computer works.
CSE02	I believe I have the ability to install new software applications on a computer.
CSE03	I believe I have the ability to identify and correct common operational problems with a computer.
CSE04	I believe I have the ability to unpack and set up a new computer.
CSE05	I believe I have the ability to remove information from a computer that I no longer need.
CSE06	I believe I have the ability to use a computer to display or present information in a desired manner.
Dissatisfaction with IT Portfolio (source: Au et al. 2008)	
DIS01	I am very contented with my IT portfolio for business purposes.*
DIS02	I am very pleased with my IT portfolio for business purposes.*
DIS03	I feel delighted with my IT portfolio for business purposes.*
DIS04	Overall, I am very satisfied with my IT portfolio for business purposes.*
Transition Costs (source: Maier et al. 2015)	
TC01	It takes a lot of time to maintain the level of information exchange with my business environment using different components of my IT portfolio for business purposes.
TC02	It takes a lot of time to maintain the level of communication with my business environment using different components of my IT portfolio for business purposes.
TC03	Overall, it takes a lot of time to maintain the established level of socializing with my business environment when using different components of my IT portfolio for business purposes.
Switching Exhaustion (source: Maier et al. 2015)	
SE01	Switching from one component of my IT portfolio for business purposes to one or more other components stresses me out.
SE02	I feel tired by switching from one component of my IT portfolio for business purposes to one or more other components.
SE03	Switching from one component of my IT portfolio for business purposes to one or more other components is a strain for me.
SE04	I feel drained from activities involved in switching from one component of my IT portfolio for business purposes to one or more other components.

* reverse-coded

Appendix 3.1.B. Factor Loadings (main loadings in bold font)

		ITC	UNR	PPI	CSE	SAT	TC	SE
ITC	ITC01	**0.780**	0.114	0.281	0.279	-0.227	0.105	0.033
	ITC02	**0.892**	0.221	0.306	0.280	-0.186	0.150	0.170
	ITC03	**0.848**	0.183	0.168	0.068	-0.151	0.145	0.252
UNR	UNR01	0.209	**0.966**	-0.286	-0.267	0.243	0.610	0.606
	UNR02	0.178	**0.951**	-0.315	-0.327	0.266	0.591	0.565
	UNR03	0.236	**0.961**	-0.317	-0.228	0.280	0.553	0.563
PPI	PPI01	0.273	-0.312	**0.882**	0.384	-0.513	-0.208	-0.162
	PPI02	0.260	-0.272	**0.873**	0.322	-0.526	-0.220	-0.121
	PPI03	0.272	-0.295	**0.892**	0.388	-0.428	-0.242	-0.208
	PPI04	0.218	-0.217	**0.843**	0.317	-0.508	-0.183	-0.090
CSE	CSE01	0.268	-0.144	0.328	**0.824**	-0.209	-0.121	-0.150
	CSE02	0.206	-0.313	0.360	**0.934**	-0.325	-0.207	-0.251
	CSE03	0.250	-0.217	0.406	**0.871**	-0.321	-0.150	-0.220
	CSE04	0.164	-0.194	0.315	**0.844**	-0.177	-0.231	-0.284
	CSE05	0.193	-0.278	0.322	**0.899**	-0.268	-0.222	-0.264
	CSE06	0.224	-0.293	0.423	**0.913**	-0.331	-0.236	-0.270
DIS	DIS01	-0.205	0.271	-0.524	-0.315	**0.917**	0.206	0.201
	DIS02	-0.234	0.239	-0.560	-0.367	**0.923**	0.172	0.178
	DIS03	-0.157	0.209	-0.450	-0.223	**0.913**	0.105	0.146
	DIS04	-0.188	0.276	-0.524	-0.256	**0.922**	0.099	0.166
TC	TC01	0.137	0.616	-0.245	-0.213	0.171	**0.957**	0.604
	TC02	0.134	0.571	-0.243	-0.212	0.165	**0.954**	0.550
	TC03	0.193	0.538	-0.209	-0.219	0.115	**0.926**	0.605
SE	SE01	0.149	0.562	-0.187	-0.333	0.178	0.556	**0.939**
	SE02	0.203	0.596	-0.197	-0.308	0.199	0.622	**0.948**
	SE03	0.183	0.556	-0.120	-0.220	0.175	0.576	**0.953**
	SE04	0.214	0.571	-0.145	-0.190	0.166	0.595	**0.952**

Note: ITC = IT Consumerization Use Behavior, UNR = Unreliability, PPI = Perceived IT Portfolio Integration, CSE = General Computer Self-Efficacy, DIS = Dissatisfaction with IT Portfolio, TC = Transition Costs, SE = Switching Exhaustion

Appendix 3.1.C. Inter-Factor-Correlation (square root of AVE in the diagonal)

	ITC	UNR	PPI	CSE	DIS	TC	SE
ITC	0.841						
UNR	0.216	0.959					
PPI	0.296	-0.319	0.872				
CSI	0.241	-0.286	0.408	0.881			
DIS	-0.215	0.274	-0.563	-0.318	0.918		
TC	0.162	0.610	-0.246	-0.227	0.160	0.946	
SE	0.198	0.603	-0.172	-0.277	0.190	0.620	0.948

Note: ITC = IT Consumerization Use Behavior, UNR = Unreliability, PPI = Perceived IT Portfolio Integration, CSE = General Computer Self-Efficacy, DIS = Dissatisfaction with IT Portfolio, TC = Transition Costs, SE = Switching Exhaustion

3.2 Considering Characteristic Profiles of Technologies at the Digital Workplace: The Influence on Technostress

Abstract

Workplaces develop more and more to digital workplaces. However, this may lead to technostress. An understanding of the profiles of technologies used at the digital workplace, their interplay, and how they influence technostress is valuable as it can assist developers of technologies and designers of workplaces to prevent technostress. Therefore, we analyze literature and conduct expert interviews to identify ten characteristics of digital technologies that relate to technostress. By analyzing data from 4,560 employees, we evaluate the characteristics. Furthermore, we develop characteristic profiles of multiple technologies used at the respondent's digital workplace. Lastly, we investigate their influence on technostress creators using structural equation modeling. We find that the different portfolios of technology profiles influence technostress creators in different manners. Our contributions are identifying additional characteristics of digital technologies, showing the importance of investigating workplaces as a whole, and highlighting design opportunities for health-oriented workplaces that alleviate technostress.

Keywords: Digital Technologies, Characteristics of Digital Technologies, Digital Workplace, Technostress, Digital Stress, Mixed-Methods Research, Structural Equation Modeling

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3.2.1 Introduction

Digitalization, driven by a wide variety of digital technologies, has led to multifaceted changes for individuals, economies, and society (Fitzgerald et al. 2013; Gimpel et al. 2018a). Digital technologies are ubiquitous in private but also in business lives. They have changed the workplace from a narrowly defined and time-bound place to a partly virtual and temporally and locally independent existence (Zuppo 2012). At the beginning of the year 2020, the COVID-19 pandemic led to the imposition of confinement or contact restrictions in many countries. Work was transferred to home offices where possible. For many, this meant a new level of virtual work. This may have a long-term impact on the equipment of many workplaces with digital technologies and their use even after the end of the pandemic.

Digital technologies include devices like smartphones or tablets but also applications that can facilitate business processes by providing tools for inter- and intra-organizational communication and collaboration (Zuppo 2012). Today's workplace does not only consist of a single digital technology but many, which enable effective ways of working, defined as a digital workplace (Gartner 2020). The design of the digital workplace has become an important factor in increasing the productivity of knowledge workers (Köffer 2015). However, the increased usage of digital technologies in the changing world of work may cause stress, leading to potentially negative reactions in individuals. Research has noted this specific form of stress as technostress (Ayyagari et al. 2011; Tarafdar et al. 2007; Tarafdar et al. 2011; Tarafdar et al. 2019), which has first been introduced by clinical psychologist Craig Brod as "a modern disease [caused by one's] inability to cope with new computer technologies in a healthy manner" (Brod 1984, p. 16).

In the last years, researchers focused on different aspects of technostress including technostress creators (e.g., Tarafdar et al. 2007), strains (e.g., Gimpel et al. 2018b), technostress inhibitors (e.g., Ragu-Nathan et al. 2008) and coping behaviors (e.g., Pirkkalainen et al. 2019). Ayyagari et al. (2011) emphasized the question of which role the different characteristics of digital technologies play in terms of technostress. The characteristics of digital technologies refer to the functional and non-functional features perceived by the user, which can be pursued directly or indirectly. Many other researchers followed the call of Ayyagari et al. (2011) that their list of proposed characteristics might not be exhaustive and that the introduction of new technologies in the future might also result in new characteristics. Therefore, Maier et al. (2015) analyzed characteristics of enterprise resource planning (ERP) systems, Salo et al. (2019) focused on characteristics of social network services, and Hung et al. (2015) regarded mobile phone characteristics influencing technostress. In summary, there exist additional characteristics resulting from further research focusing on specific technologies or contexts that extend the list of Ayyagari et al. (2011). However, to eliminate the black box phenomenon between technologies and technostress, further research is needed. Currently, there is no research that uses the extended list of characteristics to analyze their influence on technostress and no review of whether there are also other characteristics beyond that.

Furthermore, Ayyagari et al. (2011) analyzed the influence of technology characteristics on technostress by incorporating all digital technologies that are used at the workplace of their respondents without referring to a specific technology. Therefore, it is not ensured that respondents only think about one digital technology they use at work when answering the questionnaire. Instead, it is conceivable that the respondents mix their perception of using many different digital technologies, maybe even with those they use at home. This is also one of the significant drawbacks that Ayyagari et al. (2011) mentioned by themselves in their limitations section. However, analyzing the relation between the characteristics of one specific technology and technostress might seem to be by far more precise and concrete, as it does not mix-up and allow for bias when participants have different technologies in mind. On the other side, it does not properly reflect reality. Typically, people use a combination, and hence, the assessment of technostress incorporates the experiences with multiple digital technologies and not only with a specific technology. However, there are no considerations to assess the characteristics of specific digital technologies building digital technology profiles in order to summarize these across all technologies used at the user's workplace to explain the connection with technostress. Research on the design of digital workplaces examined people-focused and process-focused design approaches, in which information exchange and sharing documents or project support was regarded, without the impact on technostress (Williams and Schubert 2018). Therefore, an understanding of characteristics of digital technologies, their interplay at the workplace, and how they influence technostress will be valuable as it can assist developers of digital technologies and designers of workplaces in a way that can prevent technostress.

Therefore, we aim to add to technostress literature by addressing the following three research questions (RQ):

RQ1) Which characteristics of digital technologies with relation to technostress exist?

RQ2) How does the characteristic profile of specific digital technologies look like?

RQ3) What is the influence of characteristic profiles of digital technologies used at the workplace on technostress?

In order to answer our research questions, we apply mixed methods. First, we conceptualize the relevant characteristics of digital technologies based on extant literature and qualitative research. Next, to be able to evaluate the characteristics quantitatively, we collect existing items scales, develop new multi-item scales where necessary, and perform an initial reliability and validity test of our scales via card-sorting and a quantitative pre-test. Then, we further validate the scales in a large-scale survey with both exploratory (EFA) and confirmatory factor analyses (CFA). Based on survey data, we develop characteristic profiles of multiple specific technologies used at the respondent's workplace and determine their influence on technostress using structural equation modeling (SEM).

Our paper is structured as follows: Section 3.2.2 introduces the theoretical background, including the characteristics of digital technologies that have already been found to influence technostress. Section 3.2.3 presents the methodology, while Section 3.2.4 describes the development of the digital technology profiles based on interviews with experts and focus groups as well as a survey with 4,560 users of digital technologies in different organizations. Section 3.2.5 analyzes the relationship between the developed digital technology profiles of specific technologies with technostress. Finally, section 3.2.6 discusses these results and concludes the paper.

3.2.2 Theoretical Background and Related Work

Digital workplaces are characterized by the set of digital technologies provided to execute one's work effectively, irrespective of the location, and whether the task is performed alone or with others (Williams and Schubert 2018). Bharadwaj et al. (2013, p. 471) define digital technologies as "combinations of information, computing, communication, and connectivity technologies" and refer to the importance of the interplay of digital technologies. Digital technologies include social, mobile, analytics, and cloud technologies, as well as the internet of things, and are known by the SMACIT acronym (Sebastian et al. 2017). Vial (2019) also includes platforms, the internet, software, and blockchain to the term of digital technologies, whereas only platforms are mentioned frequently in research articles (Tan et al. 2015; Tiwana et al. 2010). Elements of a digital workplace include digital technologies accessible by every stakeholder and interaction is possible without any physical limitations (Dahlan et al. 2018). The objective of digital workplaces is to improve collaboration and communication in the organization and has gained relevance in the past years (Yalina 2020). The design of a digital workplace is crucial for the worker's productivity, especially for knowledge workers (Köffer 2015; Yalina 2020). People-focused and process-focused design principles exist, dealing with information exchange and project support issues (Williams and Schubert 2018). Dery et al. (2017) illustrated how one can successfully design digital workplaces to drive organizational success. They mention that positive employee experiences of collaborating with others and dealing with the complexity of digital workplaces enable innovation and name possible improvements for the digital workplace, including fast log-in and mobility, but do not consider the possible effects on the individuals' well-being.

Besides the positive effects of the use of digital technologies including an increase in productivity, effectiveness, and efficiency (Bharadwaj et al. 2013; Melville et al. 2004), research has shown the potential of digital technologies to cause technostress, as a specific form of stress that is perceived by end-users of digital technologies (Brod 1984; Ragu-Nathan et al. 2008). Technostress is not created by the technology itself but emerges from the interaction of human users with digital technologies. Whether technostress emerges depends on the user's resources, capabilities, assessments, and the type of technology (Gimpel et al. 2019). Ayyagari et al. (2011) developed a technostress framework consisting of the main concepts of stress (technostress creators and strains) and the IT artifact consisting of technology characteristics (see Figure 3.2-1). Following this framework, a user's perception of features and attributes of a digital technology (technology characteristics) can lead to stress-creating stimuli which again create responses and outcomes for the user (strains) (Ayyagari et al. 2011; Salo et al. 2019).

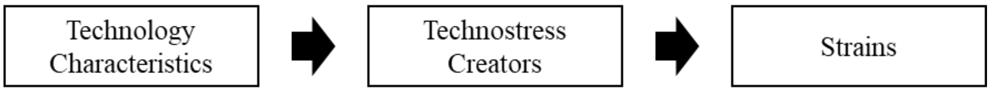

Figure 3.2-1: Technostress Framework by Ayyagari et al. (2011)

Digital technologies can be characterized in different ways depending on the point of view, e.g., along with their physical components, approaches, and concepts (Berger et al. 2018). Concerning the link of digital technologies with technostress, prior research analyzed characteristics of single digital technologies (Hung et al. 2015; Salo et al. 2019; Westermann et al. 2015) or digital technologies in general (Ayyagari et al. 2011; Tarafdar et al. 2007). Analyzing social networking services as one digital technology, Salo et al. (2019) found two main characteristics: (1) self-disclose features regarding information about oneself and (2) information cue paucity referring to the limited, one-sided information delivery. Hung et al. (2015) characterized mobile technologies by high accessibility, mobility, ubiquity, and connectivity. Additionally, Westermann et al. (2015) found that push notifications are often assessed to be disturbing, which can also be seen as a characteristic. Ayyagari et al. (2011) defined characteristics of digital technologies in general based on how individuals perceive them in use. Ayyagari et al.

(2011) found six characteristics categorized in usability, dynamic, and intrusive features. Usability features are usefulness, complexity, and reliability. The single dynamic feature is the pace of change. Intrusive features are presenteeism and anonymity. Adding to these six characteristics, Tarafdar et al. (2019) mention mobility.

Regarding technostress creators, Tarafdar et al. (2007) and Ragu-Nathan et al. (2008) developed and empirically validated scales for five factors, which create technostress among individuals. The first dimension is techno-overload, describing situations where greater workload and higher speed are caused by digital technologies. Secondly, techno-invasion describes the effect of being constantly reachable and connected, leading to a blurring boundary between work and private life. The third creator is called techno-complexity, which describes the feeling of not having the needed skills and experiences to deal with the complexity of digital technologies and being forced to spend time and effort in learning it. Techno-insecurity describes the fear of losing one's jobs due to automation or missing skills to deal with digital technologies. Lastly, techno-uncertainty refers to the feeling of having to constantly develop one's abilities and knowledge due to continuing technology changes and upgrades.

Prior research has also pointed out the outcomes of technostress. The most recorded strain is the negative effect on end-user satisfaction, followed by job satisfaction, performance, productivity, and organizational commitment (Sarabadani et al. 2018). Tarafdar et al. (2007) stated that higher technostress results in lower productivity. Ragu-Nathan et al. (2008) showed that technostress creators decrease job satisfaction as well as organizational and continuance commitment. Both are emphasized by Tu et al. (2005), who found that next to lower productivity, also higher employee turnover can result out of technostress. Concerning individuals' health, Mahapatra and Pati (2018) found that, in an Indian context, techno-invasion and techno-insecurity can lead to burnout which, in turn, is associated with several negative outcomes on the organizational and individual level including lower productivity, job satisfaction, and higher absenteeism as well as depression and anxiety (Maslach et al. 2001). For German employees, Gimpel et al. (2018b) found that higher levels of technostress go along with a higher number of people reporting to suffer from headaches, fatigue, sleeping problems, and exhaustion, for example.

3.2.3 Research Process

As we strive to answer three interconnected questions, our research process is divided into three parts, each of them applying a combination of various methods. We conduct a mixed-methods approach, as described by Venkatesh et al. (2013). It includes and integrates qualitative as well as quantitative investigations, which, according to Venkatesh et al.'s (2013) scheme, serve developmental purposes.

First of all, we aim to identify the characteristics of digital technologies that relate to technostress. For identifying and conceptualizing the characteristics of digital technologies, we follow steps one to six of the process of MacKenzie et al. (2011). We conduct a literature research and interviews with experts and focus groups. Based on this, we develop multi-item survey scales for the characteristics of specific digital technologies. The scales and individual items are refined based on results from card-sorting regarding their content and face validity. Next, we perform a pre-test and an exploratory factor analysis (EFA) and, again, refine the scales and individual items.

Second, the resulting scales are then used in a large-scale quantitative survey. For the validation, the data is split into two random subsets. On the first subset, an additional EFA is carried out to examine the revised items. Finally, a confirmatory factor analysis (CFA) is performed on the second subset to validate the scales. Furthermore, we used the data to calculate a normed characteristics profile for specific technologies by aggregating the answers across many respondents.

Third, as we argue that technostress does not solely depend on the usage of a single technology but on the combination of all technologies used at the workplace, we, hence, use in the further course the digital technology profiles of the used technologies at the respondents' workplace. Therefore, we use covariance-based structural equation modeling (SEM) to estimate the effect on technostress.

3.2.4 The Development of Digital Technology Profiles

3.2.4.1 Theoretical Conceptualization

In order to build the foundation for our research, in a first step, we conducted a literature search. The focus was to identify technologies and their characteristics in relation to technostress (creators). To cover the full picture, the search additionally comprised literature of linked outcomes like stress and strain (including health and well-being). The list covered a broad picture of literature in different areas. Databases, namely EBSCO Business Source Premier, EBSCO Academic Search Premier, EBSCO Psych, Web of Science, and PubMed, were searched in the languages English and German. Because the seminal paper by Tarafdar et al. (2007) was published in 2007, only publications from this year onwards were included. The list of search strings is available in Appendix 3.2.A. Types of publications that were considered are (academic) journals, reviews, proceedings, books, book chapters, and dissertations. Overall, 273 articles relevant for our research were identified.

To enrich the insights from the literature research, we interviewed practitioners and experts. The semi-structured interview guideline included questions about technostress creators, technologies for which usage may cause stress, and technology characteristics, which the subjects believed to cause stress and stressful usage behaviors. The complete interview guideline can be found in Appendix 3.2.B. In total, 15 people participated in face-to-face interviews, including employee and employer representatives, experts from occupational health management, ethics, ergonomics, informatics, and human resource management. Each interview lasted between 30 and 90 minutes. The number of interviews was determined by content saturation, meaning interviews were conducted until no new aspects were identified and named by our experts. Interviews were audio-recorded, transcribed, and continuously analyzed through MAXQDA with a formalized coding strategy. Categories were built deductively because the interviews were structured in sections with questions concerning technologies, their characteristics, and how these exactly relate to technostress. These particular aspects guided the analysis to gain a better understanding of the relationship.

Following on from this, six focus groups were conducted (between 5 and 8 participants each) consisting of employees and managers from four different organizations (n = 33). The groups covered different occupational groups and hierarchies. Participants were contacted by a responsible from the respective company and were asked to take part voluntarily. The groups almost got identical task descriptions to the experts. First, they named the technologies they use at the workplace and their characteristics. They rated which of these caused the most stress. Besides, they were asked for (short-term and long-term) consequences and successful strategies to cope with the stress. The guideline for the focus group workshop is available in Appendix 3.2.C. The aim was to get insights from the practical perspective and collect examples for aspects that were named by our experts. All group discussions were recorded by an observer and the results documented in a picture protocol. Again, the results were written down, coded, and aggregated. For the technologies, for example, categories were identified when they named one specific software product (e.g., Edge as an example for an Internet browser).

The result of these steps is a conceptual understanding of nine characteristics of digital technologies relating to technostress. See Table 3.2-1 for their definition. Please note that in a later quantitative pre-test, one characteristic (information provision) was split into two (push and pull). For brevity of presentation, Table 3.2-1 already shows this split. Simplicity of use refers to the characteristic complexity by Ayyagari et al. (2011). It was renamed to avoid confusion with the technostress creator techno-complexity (Ragu-Nathan et al. 2008). Reachability refers to the characteristic presenteeism by Ayyagari et al. (2011) and was renamed to avoid confusion with a common psychological phenomenon describing the feeling of obligation by employees to go to work even though they are ill.

Characteristic	Definition
Anonymity	Degree to which the use of a digital technology stays anonymous and cannot be identified by others (in accordance with Ayyagari et al. 2011).
Intangibility of Results	Degree to which results of the work with a digital technology are immaterial in nature and therefore intangible (self-developed).
Mobility	Degree to which a digital technology is usable independent of the location and enables to work from almost anywhere (self-developed).
Pace of Change	Degree to which a digital technology changes dynamically and rapidly (in accordance with Ayyagari et al. 2011).
Pull[2]	Degree to which information of a digital technology is provided only on request (self-developed).
Push[2]	Degree to which a digital technology automatically provides new information while using it (in accordance with Westermann et al. 2015).
Reachability	Degree to which a digital technology enables the individual to be contacted by third parties (in accordance with presenteeism in Ayyagari et al. 2011).
Reliability	Degree to which a digital technology works reliably and is free of errors and crashes (in accordance with Ayyagari et al. 2011).
Simplicity of Use	Degree to which a digital technology can be used without major effort or training (in accordance with complexity in Ayyagari et al. 2011).
Usefulness	Degree to which a digital technology supports the accomplishment of tasks and enhances job performance (in accordance with Ayyagari et al. 2011).

Table 3.2-1: Characteristics of Digital Technologies, their Source, and Definition

To sum up, we identified characteristics of digital technologies that – according to literature and qualitative empirical research – relate to technostress. This answers RQ1.

3.2.4.2 Operationalization and Evaluation of Characteristics

For the development of scales for the characteristics of digital technologies, we followed the guidelines of MacKenzie et al. (2011). Based on this, we collected items for already existing characteristics and further created items for newly identified characteristics resulting in the first draft of our scales. We created our items to be short and simple and use appropriate language for employees. During the development, we carefully made sure that the items only address one

[2] Please note that pull and push were first conceptualized as one characteristic with pull and push at opposite ends of the continuum. It was revised in later steps. Notifications may, only in some cases for some features, be configured by the user for certain technologies. Hence, individual settings of the users were not considered, and items were phrased with a general wording.

single aspect (i.e., no connection of different statements in one item) in order to prevent a confusion of the respondent. Thereby, we also considered recommendations proposed by Podsakoff et al. (2003) to avoid common method bias by “improving scale items” (Podsakoff et al. 2003, p. 888). We used the anchor points of the existing rating scales to retain the interpretability and comparability of the results with the existing studies.

To evaluate content validity, we conducted a card-sorting via an online matching task with fellow researchers (n = 39) in which they were asked to map items to characteristics (definition of the constructs) (Moore and Benbasat 1991). 85 % correct matches were defined as the minimum boundary for the retainment of an item. Out of the 26 items, 22 were mapped correctly to the related construct by more than 85 % of the persons, so we did not change them. The remaining four items were matched correctly by less than 85 % of the participants. Thus, we changed the wording of these items to fit the corresponding construct better, provide more clarity, and reduce ambiguity. This step of item generation finished with the revised scales.

To evaluate the structure of our scales and validate our reworked items, we conducted a pretest. 445 respondents who were acquired via an online panel took part in the study. The data was collected anonymously as far as possible (some socio-demographic questions were included to evaluate the quality of the intended sample). Participants were instructed to respond honestly and gave informed consent to participation. This was done to further minimize common-method bias by “protecting respondent anonymity and reducing evaluation apprehension“ (Podsakoff et al. 2003, p. 888). This principle was applied to all data collection processes. To get a better understanding of the participant’s digital workplace, each respondent of our survey stated his or her usage of 40 technologies (Nüske et al. 2019), evaluated by 0 = “no usage”, 1 = “monthly usage”, 2 = “weekly usage”, 3 = “daily usage”, and 4 = “several times a day”. The list of technologies included common hardware used at the workplace like a printer, laptop or stationary phone, software like text, table, and presentation programs, simulation programs, statistical and analysis tools, networks like cloud systems, intranet, WiFi, and technologies like virtual augmented reality and mixed reality. Participants evaluated their perception regarding the characteristics of one randomly selected technology that they used at least weekly. We decided to give each participant only one technology to reduce dropouts due to the length of the survey.

We performed an EFA (parallel analysis revealed nine factors that were extracted using principal axis factoring with an oblimin rotation) to carefully assess the quality of our questionnaire and did a preliminary analysis of all scales. The result of this EFA properly reflected our assumption of the factor structure of the scales with nine underlying technology characteristics. However, we faced some problems. First of all, we observed a few severe cross-loadings between the constructs simplicity of use and reliability. Also, we originally derived a bipolar construct “information provision” that contained aspects about how digital technologies provide users with information distinguishing whether the information has to be requested explicitly by the user (pull) or whether they are provided automatically when available (push). Regarding the issues with the properties of the items of this characteristic, we decided to redefine it and created two separate scales for push and pull as they seem to be more than two ends of one construct. The two scales refer to the original settings of the technologies. Items were phrased with a general wording, that did not consider the individual settings of the user. In some cases, of course, it is possible to adjust the individual settings (e.g., turn off notifications on the lock screen of the smartphone) but this does not apply to all devices and features. In addition, organizational policies possibly interact with personal preferences (e.g., a user may be able to set his stationary telephone on mute, but he does not use this option because the supervisor expects him/her to be reachable on the phone for customers). Finally, we revised the items accordingly.

To go on in our evaluation and validation process, we conducted a large-scale study distributing a questionnaire that, among other things, contained our scales on characteristics of digital technologies. These were assessed with the same procedure as in the pre-test: each participant rated the characteristics of one randomly drawn technology from the list of 40, which (s)he uses. To evaluate the respondent's technostress level, the items belonging to the five technostress creators introduced by Tarafdar et al. (2007) and Ragu-Nathan et al. (2008), namely techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty were included in the survey. This served the last step of our research to test for the influence of technology profiles on technostress. We acquired respondents for the surveys via an external research panel focusing on German employees. Respondents were paid for participation in the study. We included control variables to review the representability of our sample. These comprised gender, employment status, occupational title and sector, number of hours worked per week, and education. The sample for the evaluation consisted of 4,560 respondents. The distribution of participants was representative of the German working population with respect to the control variables age, gender, and occupational sector.

We used a five-point Likert-type rating scale from 0 = “I do not agree at all” to 4 = “I totally agree” to measure the technostress creators as well as the characteristics of digital technologies. All questions were presented in German. If necessary, the items were translated. Therefore, multiple German native speakers translated the questions in parallel. They met afterward to resolve discrepancies and agree on the most suiting translation. For more detailed information about the final scales used in this study and their sources, see Appendix 3.2.D. For a list of the technologies, see Appendix 3.2.E.

As the EFA in the pre-test showed few severe cross-loadings between some constructs, we reinvestigated the factor structure with an EFA in the data set of the main study. Therefore, we split our study population into two evenly large subsets. On the first subset (n = 2,280), we performed the EFA (parallel analysis revealed ten factors that were extracted using principal axis factoring with an oblimin rotation). This time no problematic cross-loadings of the items on a competing construct were observed. For more detailed information on the results of this EFA see Appendix 3.2.F. Following the EFA, we performed a CFA on the second subset (n = 2,280) with maximum likelihood estimation of fifteen latent factors (ten characteristics of digital technologies, five technostress creators) that were allowed to intercorrelate in the model to analyze our measurement model further. The descriptive statistics, item reliabilities, and internal consistency are presented in Table 3.2-2.

Construct	**No. of Items**	**Mean**	**Standard Deviation**	**Loadings**	**Cronbach's α**	**AVE**
Anonymity	4	1.78	1.10	0.76-0.92	0.89	0.82
Intangibility of Results	6	1.58	1.10	0.60-0.90	0.92	0.80
Mobility	5	2.55	1.27	0.76-0.93	0.93	0.85
Pace of Change	4	1.78	1.15	0.92-0.94	0.96	0.93
Pull	3	2.47	1.00	0.74-0.89	0.83	0.80
Push	3	2.07	1.17	0.75-0.85	0.85	0.81
Reachability	4	2.71	1.24	0.92-0.95	0.97	0.94
Reliability	3	2.92	0.89	0.86-0.93	0.93	0.90
Simplicity of Use	3	3.13	0.89	0.81-0.92	0.90	0.87
Usefulness	4	2.81	1.05	0.82-0.90	0.92	0.86
Techno-Complexity	5	1.23	1.23	0.81-0.88	0.90	0.71
Techno-Insecurity	4	1.24	1.29	0.78-0.86	0.83	0.66
Techno-Invasion	3	1.28	1.35	0.75-0.90	0.80	0.72
Techno-Overload	4	1.63	1.30	0.79-0.90	0.88	0.74
Techno-Uncertainty	4	1.81	1.23	0.81-0.88	0.87	0.72

Table 3.2-2: Statistical Quality of the Measures used in the Study: Descriptive Statistics, Item Reliabilities, Internal Consistency, and AVE

All loadings of the items on their respective latent factors in the CFA were above the value of 0.71, which indicates that more than 50 % of the variance of this item is explained by the underlying construct. Only for the intangibility of results, lower loadings were observed. However, since the average variance extracted (AVE) of intangibility of results (and for all other constructs) was above 0.50, we did not consider it critical and retained the indicators. Cronbach's Alpha showed values of at least 0.80 for all scales indicating internal consistency.

In the next step, we assessed discriminant validity based on the Fornell-Larcker criterion (Fornell and Larcker 1981) as Cronbach's Alpha relies on correlations of the items and, thus, does not account for dimensionality of constructs. The Fornell-Larcker criterion compares the size of the correlations of the latent constructs to the AVE. The square root of each construct‘s AVE was higher than the correlations with the other constructs (see Appendix 3.2.G). Another, newer criterion to asses discriminant validity is the heterotrait-monotrait ratio introduced by (Henseler et al. 2015). It sets the average correlation of items measuring different constructs (heterotrait-heteromethod) in relation to the average correlations of items measuring the same construct (monotrait-heteromethod). If the indicators of one construct correlate higher with each other than with the indicators of different constructs, the ratios should be small. Ratios close to 1 indicate a lack of discriminant validity. The ratios were obtained for the characteristics of digital technologies and the technostress creators as they are used in the model to analyze for our second research question. All ratios were below 0.85, indicating that discriminant validity is good. For more detailed information on the results, see Appendix 3.2.G. Overall, we consider discriminant validity as given.

In the last step of validating our measurement instrument, we evaluated the fit of our model to gain further information about our assumptions on the data structure. The fit was judged according to the following guidelines: The root mean square error of approximation (RMSEA) indicates good model fit at values smaller than 0.6. The square root mean residual (SRMR) should show values smaller than 0.05. Comparative fit index (CFI) and Tucker-Lewis index (TLI) indicate a satisfactory model fit if they are higher than 0.90 and good fit at values above 0.95. We did not consider chi-square for the evaluation of the model fit, because the indicator has shown to be sensible to sample size in simulation studies (Boomsma 1982). For our model, CFI (0.956) and TLI (0.951) were above 0.95, indicating good fit of the initial model with ten latent, correlating characteristics. Both SRMR (0.036) and RMSEA (0.044) showed only small deviations of the estimated from the expected covariance matrix with values below 0.05 and/or 0.06, respectively. Therefore, we argue that we finally validated our measurement model. To sum up, we now have validated measurement scales for the identified characteristics of digital technologies that – according to literature and qualitative empirical research – relate to technostress.

To confirm this ten-factor structure, a nested model comparison was conducted. The simpler model comprised nine latent factors (interim result from the first EFA in pre-test, reapplied to data from the main study) where all items of the two factors simplicity of use and reliability loaded on the same, common construct. A chi-square difference test revealed significant better fit ($\chi^2_{Model1} = 5277.18$, $\chi^2_{Model2} = 3327.98$, $df_{Model1} = 651$, $df_{Model2} = 657$, $\Delta\chi^2 = -1949.20$) of the model with ten latent factors. The fit indices are displayed in Table 3.2-3.

Model	CFI	TLI	RMSEA	SRMR
Nine Factors – Model 1	0.924	0.914	0.059	0.041
Ten Factors – Model 2	0.956	0.951	0.044	0.036

Table 3.2-3: Nested-Model Comparison of the Measurement Model for the Technology Characteristics

3.2.4.3 Profiles of Digital Technologies based on their Characteristics

To get a better understanding of the differences between technologies with respect to their characteristics, we created a profile for each of the 40 digital technologies from our list. Each profile line consists of the means of all ten characteristics that were evaluated for this one specific technology. We argue that the characteristic of a digital technology that is used more frequently has a higher impact on the overall perceived characteristics of digital technologies. Therefore, we only regarded the responses of persons that used this specific technology at least once a day. We then calculated a mean score for the ten characteristics. See Table 3.2-4 for examples.

From the overall list of 40 technologies, some had to be excluded for the profiles. Due to the randomized choice which technology the respondent was asked to evaluate, group sizes were in some cases below 30. These were considered too small to provide unbiased information. For example, 86 used augmented, virtual and mixed reality daily, but only ten respondents were asked to evaluate its characteristics due to the randomized sampling. All profiles with means and standard deviations are provided in Table 3.2-4. The table shows how different technologies are perceived by users. It is important to note that these perceptions are from users, that is, they are conditional on the respondent working in a job where the employer assumes a task-technology fit and, thus, provides the technology. Cash systems have a higher perceived usefulness than statistics software to pick just one example. Likely, only few people use both types of systems. The perceptions originate from different people in different jobs. Five profiles are visually displayed in Figure 3.2-2 to highlight similarities and differences. For example, smartphones enable mobile working represented by high values of mobility. The same applies to emails because usually, these can be checked on the run with the smartphone. However, in contrast to smartphones, emails have a rather low pace of change. A new smartphone is released almost every other week by different companies, whereas the functionality of the email program remains the same as ten years ago (Figure 3.2-2).

To sum up, we now have profiles of the 26 most important (i.e., common and frequently used) workplace technologies along with the characteristics that – according to literature and qualitative empirical research – relate to technostress. This answers RQ2.

Technology	n	Usefulness M	Usefulness SD	Simplicity of Use M	Simplicity of Use SD	Reliability M	Reliability SD	Anonym-ity M	Anonym-ity SD	Mobility M	Mobility SD	Reacha-bility M	Reacha-bility SD	Pace of Change M	Pace of Change SD	Pull M	Pull SD	Push M	Push SD	Intangi-bility M	Intangi-bility SD
Administrative Software	69	3.02	0.98	2.79	1.00	2.82	0.89	1.50	1.15	2.18	1.39	2.19	1.34	1.90	1.01	2.47	1.20	1.71	1.15	1.38	1.13
Cash System	41	3.08	1.10	3.49	0.73	3.19	0.73	1.80	1.39	2.14	1.68	1.37	1.57	1.53	1.38	2.46	1.37	1.69	1.53	1.64	1.50
Cloud Computing	54	2.60	1.04	2.73	1.01	2.44	1.03	1.64	1.13	2.88	1.16	2.53	1.25	2.16	0.96	2.49	1.16	1.97	1.22	1.66	1.17
Database	134	2.86	1.05	2.60	1.04	2.71	0.96	1.61	1.16	2.15	1.37	1.92	1.32	1.88	1.09	2.44	1.18	1.92	1.29	1.46	1.22
Email	311	3.10	1.07	3.68	0.68	3.41	0.72	1.50	1.27	3.31	1.21	3.70	0.62	1.15	1.14	2.45	1.31	2.38	1.38	1.57	1.32
Headset	69	2.89	1.17	3.35	0.98	3.16	1.00	1.78	1.45	2.32	1.48	2.97	1.18	1.18	1.28	1.75	1.41	1.69	1.39	1.83	1.35
Internet	220	3.10	0.97	3.42	0.76	2.88	0.84	1.86	1.22	3.25	1.06	3.22	0.95	2.10	1.07	2.61	1.10	2.10	1.20	1.65	1.12
Knowledge Management	91	2.86	1.07	2.92	1.05	2.70	1.00	1.91	1.28	2.55	1.33	2.36	1.25	2.21	1.08	2.54	1.12	1.86	1.22	1.68	1.19
Laptop	125	3.07	1.15	3.55	0.74	3.29	0.78	1.79	1.28	3.23	1.15	3.03	1.07	1.73	1.18	2.65	1.10	2.06	1.30	1.23	1.23
Logistics System	33	3.05	0.91	2.94	0.95	2.65	1.00	1.92	1.23	1.96	1.45	1.86	1.42	2.04	1.28	2.60	1.09	1.99	1.31	1.45	1.33
Management Information Software	42	2.66	0.99	2.60	0.88	2.62	0.89	1.69	1.36	2.53	1.25	2.53	1.29	2.40	1.06	2.64	1.12	1.91	1.38	1.65	1.40
Mobile Phone	62	2.35	1.37	3.46	0.97	2.98	1.18	1.75	1.35	2.79	1.46	3.54	0.80	1.15	1.20	2.23	1.24	1.88	1.39	2.10	1.13
Network Hardware	82	2.78	1.07	2.69	0.95	2.56	0.94	1.58	1.16	2.55	1.29	3.01	1.03	2.07	1.07	2.35	1.12	1.93	1.26	1.58	1.13
Office Software	188	3.33	0.85	3.09	0.91	3.12	0.86	1.95	1.21	2.98	1.22	1.83	1.37	1.64	1.15	2.13	1.23	1.45	1.30	1.21	1.27
PC	301	3.17	1.04	3.27	0.85	3.01	0.85	1.51	1.23	1.48	1.52	2.92	1.13	1.80	1.20	2.64	1.10	1.98	1.32	1.33	1.20
Printer	303	3.25	0.96	3.57	0.70	3.24	0.82	1.74	1.35	1.87	1.57	2.39	1.47	1.27	1.19	2.20	1.34	1.72	1.44	1.07	1.21
Production Planning	30	2.77	1.14	2.46	0.98	2.46	1.09	1.75	1.26	1.91	1.43	1.73	1.30	1.70	1.28	2.34	1.30	1.71	1.37	1.81	1.24
Realtime Communication	50	2.89	1.11	3.19	1.00	2.84	1.08	1.81	1.38	2.68	1.44	3.22	0.89	2.05	1.15	2.46	1.16	2.41	1.30	1.94	1.18
Security Background	94	2.18	1.28	2.55	1.02	2.79	0.94	2.00	1.11	2.93	1.18	2.13	1.27	1.94	1.19	2.39	1.16	2.12	1.24	2.08	1.27
Security Interaction	150	1.68	1.30	2.99	1.00	2.87	0.91	1.79	1.23	2.49	1.37	1.96	1.36	1.74	1.29	2.53	1.14	1.81	1.29	1.75	1.25
Smartphone	151	2.56	1.26	3.25	0.92	2.91	0.95	1.74	1.14	3.16	1.13	3.55	0.81	2.37	1.08	2.56	1.15	2.32	1.26	1.78	1.24
Social Collaboration	71	2.46	1.14	2.77	0.92	2.27	1.00	1.63	1.12	2.93	1.09	3.19	0.87	2.19	0.99	2.38	1.05	2.32	1.15	2.03	1.06
Statistics Software	32	2.85	0.96	2.58	0.99	2.77	1.00	2.36	1.23	2.44	1.32	2.29	1.35	2.26	1.08	2.37	0.98	1.99	1.29	1.72	1.42
Tablet	58	2.68	1.29	3.47	0.87	2.81	1.14	1.73	1.25	3.09	1.21	2.76	1.32	1.83	1.27	2.64	1.24	2.15	1.40	1.69	1.40
Telephone	246	2.79	1.14	3.60	0.75	3.42	0.81	1.48	1.40	1.23	1.53	3.50	0.82	0.83	1.16	2.15	1.38	1.64	1.45	1.90	1.37
Wireless Network	164	2.94	1.13	3.21	0.90	2.74	0.92	1.91	1.22	2.85	1.23	3.34	0.85	2.01	1.17	2.49	1.17	2.29	1.23	1.64	1.26

Table 3.2-4: Profiles of Digital Technologies: Mean and Standard Deviation for each Characteristic for each Digital Technology[3]

[3] We do not provide a characteristics profile for content management systems, creative- and design-software, medical software, augmented, virtual and mixed reality, digital cash flows systems, sensory systems, artificial intelligence, automatic productions systems, e-commerce systems, product/software development tools, voice interaction technologies, systems for localization and distance determination, and simulation/ modelling software (n < 30).

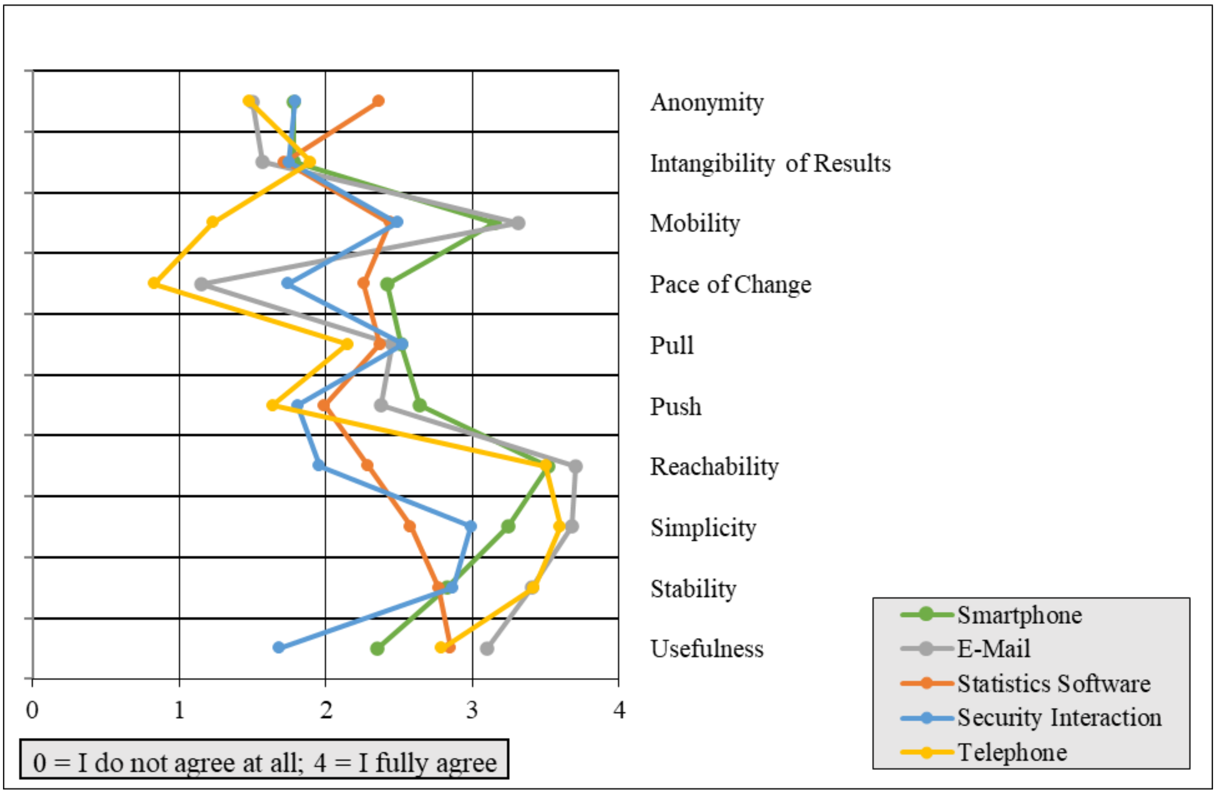

Figure 3.2-2: Profiles of Five Different Digital Technologies Based on their Characteristics

3.2.5 The Influence of Technology Profiles on Technostress

Technostress at work arises from a workers' interaction with typically a range of digital technologies. It does not depend on a single digital technology but on the portfolio of digital technologies at the workplace and their characteristics profiles. Thus, in order to investigate the influence of technology profiles on technostress, we aggregated the profiles of the digital technologies to digital workplace portfolios. For example, for a respondent who uses a smartphone, laptop, emails, social collaboration software, and wireless networks for work, we took the characteristic profiles of these five digital technologies and averaged them to build one mean "portfolio" score across the five digital technologies for each of the ten characteristics.

We set up a covariance-based structural equation model (SEM) to measure the influence of the ten characteristics of the digital technology portfolio at the workplace on the five technostress creators techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty (Ragu-Nathan et al. 2008; Tarafdar et al. 2007). We conducted Harman's single factor test, which showed that about 11 % is the highest proportion of variance attributed to one factor, which suggests that common-method bias is not a problem. Next, we statistically controlled for common-method bias by modeling a method factor (Podsakoff et al. 2003). The comparison of the results of the structural model with and without method factor showed no substantial differences (ΔCFI = 0,029). Researchers (Cheung and Rensvold 2002; Little 1997) have suggested that differences in the CFI less than .05 are acceptable and indicate the equivalence of measurement models. Thus, common-method bias seems not to be a major concern for our data. The model showed good fit to the data (CFI = 0.972, TLI = 0.962, SRMR = 0.031, RMSEA = 0.036).

Hypotheses were tested two-tailed because we did not have specific directional hypotheses about the influence of the characteristics of the digital workplace on technostress. Table 3.2-5 displays the results. For a detailed list of all paths and their respective t-statistics, including the p-values see Appendix 3.2.H.

TS Creator / Characteristic	Techno-Complexity	Techno-Insecurity	Techno-Invasion	Techno-Overload	Techno-Uncertainty
Anonymity	-0.16**	-0.27**	-0.40***	-0.10	-0.17
Intangibility	0.16**	0.34***	0.31***	0.25***	0.30***
Mobility	0.08	0.18***	0.28***	0.12**	0.14**
Pace of Change	-0.04	0.04	0.31***	0.10	0.07
Pull	-0.16	-0.18	-0.40**	-0.23	-0.17
Push	0.11	-0.08	-0.28**	-0.14	0.03
Reachability	-0.20*	-0.16	-0.18*	-0.13	-0.17*
Reliability	-0.18	-0.25	-0.46**	-0.07	0.11
Simplicity	0.08	-0.19	0.40*	-0.18	-0.50**
Usefulness	0.00	0.22**	0.14	0.11	0.07
R^2	0.11	0.20	0.22	0.12	0.16

Note: * p < 0.05, ** p < 0.01, *** p < 0.001; '+' indicates that a higher value of the characteristic within the digital workplace portfolio is associated with a higher level of the technostress creator and '-' is vice versa

Table 3.2-5: Digital Workplace Portfolio: The Influence of the Characteristic Profiles of Digital Technologies on the Five Technostress Creators

In this final step of the analysis, we answer RQ3, which asked how the profiles of digital technologies used at the workplace influence technostress. Results of the structural model reveal that not all portfolios of characteristics at the digital workplace influence technostress in the same manner, but each of the characteristics is significantly linked to at least one technostress creator.

3.2.6 Discussion and Conclusion

We investigated the characteristics of digital technologies that are related to technostress. Therefore, we did a literature search and qualitative interviews in order to expand the understanding of characteristics that have previously been presented in the literature. To validate the characteristics as well as their relationship with technostress, we conducted a quantitative survey study. We used structural equation modelling to reveal the characteristics' relationship with technostress creators. The results answer our three research questions by showing the existence of ten characteristics of digital technologies related to technostress, profiling 26 common workplace technologies along the ten characteristics, and relating the digital workplace portfolio with technostress creators.

In terms of revealing characteristics of digital technologies with relation to technostress creators, we found evidence for ten different characteristics. Each technology characteristic relates to at least one technostress creator and each technostress creator to at least two characteristics.

In this dense web of relationships, we found that anonymity is negatively related to complexity, insecurity, and invasion. For insecurity, for example, this means that if the users may use their technologies anonymously without leaving traces of their usage behavior, employees fear to lose their jobs less as they less feel their work activities to be monitored. Intangibility of results is positively associated with all five technostress creators. Again, for insecurity, this relationship is understandable as employees experience more fear of losing their jobs if they do not see the results of their work and thereby feel no progress in accomplishing their tasks. Regarding these two results concerning insecurity in combination this could be interpreted in the following way: With high intangibility of results, employees might experience a lack of productivity and they fear losing their job because this seemingly poor performance could be controlled or traced, for example by the supervisor, if a system does not allow anonymous usage. For mobility, we found positive relations with insecurity, invasion, overload, and uncertainty. With regard to invasion, this may be because mobile workplaces allow individuals for more flexibility in doing their tasks. Therefore, they may experience a stronger feeling of blurring boundaries between job and private life, resulting in higher levels of perceived invasion. Pace of change is only related to invasion and the relationship is positive, meaning that a high pace of change increases the feeling of one's life being invaded with digital technologies. This may be because employees have to use their non-work times (e.g., weekends) in order to deal with the newly changed digital technologies and learn how to use them and, thus, feel their private lives as being invaded by digital technologies. In contrast to pace of change, pull as well as push is negatively linked with invasion. For pull, this relationship may be because individuals actively have to access information via their digital workplace portfolio and, thus, are more in control of when they want to do so. For push, however, in the first sense, one would expect a positive link to invasion. But we argue that, if individuals know that their digital technologies will notify the individuals about important work issues, they do not have to constantly check their smartphone or other digital technologies for important updates and, thus, can mentally disconnect from their job when being with their family. Reachability is negatively associated with complexity, invasion, and uncertainty. One possible interpretation of the decreasing uncertainty could be that people who are well reachable (i.e., due to their position) will inevitably interact and deal with the technology permanently, which means that they have little uncertainty in using it. For reliability, we only found a negative relation to invasion. Simplicity is linked with invasion and uncertainty. For invasion, the relation is positive, whereas, for uncertainty, it is negative. Interestingly, simplicity does not affect complexity. Lastly and unexpectedly, usefulness is positively related to insecurity. At this point, further research is needed to better understand and interpret the relationship.

Our paper contributes to theory in several ways. Our first contribution is the identification and definition of further characteristics of digital technologies that affect technostress at an individual's workplace, including measurement scales for the newly added characteristics. Placing these newly identified characteristics side by side with the ones from extant literature (esp. from Ayyagari et al. 2011), our paper presents the most holistic set of technology characteristics related to technostress. Further, to the best of our knowledge, we are the first to combine the characteristics of Ayyagari et al. (2011) with the technostress creators of Ragu-Nathan et al. (2008) and thereby can show their relationships. With this broader understanding of characteristics, future research can investigate the influence of digitalization on technostress in more detail.

Second, we show that it is important to investigate the workplace as a whole based on the portfolio of technologies at the workplace. Prior research either investigates individual technologies (e.g., Hung et al. 2015; Maier et al. 2015; Salo et al. 2019) or the entire digital workplace without considering the individual technologies at work (e.g., Ragu-Nathan et al. 2008; Tarafdar et al. 2007). We take an intermediate way considering all major individual digital technologies at the workplace. We build technology profiles on the individuals' perception of characteristics and not by asking technology experts. Stress is a construct that builds on the perception of a situation and the individual's own ability to cope with a certain situation. Therefore, from the individual's point of view, the perceived characteristics of digital technologies at the workplace are key because stress is neither solely anchored in the environment and its demands nor solely in the person characteristics (Lazarus and Folkman 1984). Asking users rather than design experts seems appropriate according to adaptive structuration theory (DeSanctis and Poole 1994). Outcomes of the use of advanced information technology do not only depend on the structure of the technology but also the social interaction of the user with the technology (which can be different than intended by the designer also depending on the organizational practices and norms). These profiles were put together to an individual portfolio consisting the mean characteristics of the different technologies each employee uses at his/her own workplace. This provides a more holistic picture than looking at only a single technology; further, it allows to trace the effects on technostress back to characteristics and from there to individual technologies rather than considering technologies at the workplace as monolithic.

Third and last, we give evidence on the relationship of the characteristics with different technostress creators instead of technostress in general. This more detailed understanding can help future research to develop specific preventive measures and coping strategies for concrete technostress creators at concrete workplaces. In sum, the identification and measurement of characteristics of digital technologies along with knowledge on their effect on technostress enable future research to cluster technologies and evaluate different technologies and workplaces based on their impact on technostress. Future research could consider whether the technology profiles prove to be consistent among demographic and cultural differences. Also, the size of the technology profile combined with the intensity of usage or additional moderating characteristics influencing technostress can be analyzed.

The results of this study also provide implications for practice. Since prior research has shown the negative effects of technostress, including lower productivity and lower job satisfaction, organizations should aim to prevent and lower the level of technostress of their employees. Based on our developed items for characteristics of digital technologies, digital workplaces can be evaluated on their possible susceptibility to technostress, by for example identifying technologies that outshine the positive characteristics of other digital technologies in terms of technostress. This is important as we were able to show that the combination of technologies and their aggregated mean characteristics are associated with technostress creators. The combination of technologies matters as one technology with its characteristics can distort the overall sensation and lead to technostress.

Workplace designers should focus on usability features, including usefulness, simplicity of use, and reliability, but also on technologies that enable mobility and pull configurations. When individual technostress creators are of specific concern for a given workplace or company, the guidance becomes more nuanced on which characteristics to look out for and which technologies have a favorable profile regarding these characteristics. Besides, individuals can affect their levels of technostress by adjusting their workplace technologies. Therefore, employers also should give their employees the flexibility of configuring their digital technologies in a way that is most beneficial for each individual.

However, there are limitations to our research. Each respondent to the survey assessed only the characteristics of one digital technology and not the characteristics of the digital technologies at her or his entire workplace. However, since our sample is of a high number, we were able to assign the perception of the characteristics between subjects.

Despite these limitations, our results add to a broader understanding of characteristics of digital technologies at an individual’s workplace, not only by extending the number of characteristics that were already known but also by revealing the structure among them as well as their effect on technostress creators.

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3.2.8 Appendix

Appendix 3.2.A. Search Strings for the Literature Research

Please note that for some databases operators were adjusted due to different logic.

Area	Specification	Search String
1 Technologies		(reality NEAR/4 (augmented OR virtual OR artificial) OR "Artificial Intelligence" OR "virtual environment") OR (digital NEAR/4 (device OR technology OR system OR machine OR assistant)) OR (technology NEAR/4 (new OR information OR communication) OR "ICT" OR robot* OR (crowd OR click OR smart) AND worker) OR (device NEAR/4 (wearable OR mobile OR smart) OR wearables OR (head NEAR/2 mounted NEAR/2 display) OR "hmd") OR (smartwatch OR smart NEAR/4 (watch OR phone OR glass*) OR mobile NEAR/4 (phone OR computing OR "based solution" OR business OR service) OR "pda") OR (tablet NEAR/2 (computer OR PC) OR touchscreen OR laptop OR notebook OR computer)
2 NOT		child* OR smoking OR smoke* OR animal OR electromagnetic OR radiation OR base-station OR "base station" OR drug* OR electrosmog OR economic OR *oscopy* OR incontinence OR elastomer* OR polymer* OR *fiber* OR fabrication OR treatment OR therap* OR "PTSD" OR war OR trier OR financial OR "mechanic* stress*" OR "deformation* stress*" OR chemical* OR crystal* OR temperatur* NEAR/3 (high* OR low*) OR arthroplast* OR piezoelect* OR metal OR transistor* OR corrosion* OR microstructur* OR biomechanic* OR oxid* OR genom* OR composit* OR bone* OR diabet* OR road
3 Context		(work* OR occupation* OR job OR employ*)
A Outcome: Stress and Strain	General and Symptoms of Illness	strain OR stress OR complaint OR affliction OR distress OR irritation OR irritability OR discomfort OR disorder NEAR/4 (mood OR psychiatric OR sleep OR affect*) OR (mental NEAR/4 (illness OR symptom* OR satiation OR health OR tension OR disorder))
	Fatigue	fatigue OR exhaustion OR satiation
	Well-Being	affect* NEAR/4 (negative OR positive OR symptom* OR tension)) OR "well being" OR "well-being" OR wellbeing OR "irritable mood"
	Technostress Creators	(techno* NEAR/4 (invasion OR uncertainty OR overload OR unreliability OR complexity OR insecurity OR stress)) OR technostress OR Technikstress
	Stress Prevention	coping OR "Boundary Management" OR "online intervention" OR care OR mhealth OR "mobile health" OR mHealth OR therapy OR rehabilitation OR treatment OR screening OR "monitoring") und/oder Lernaspekte ("mobile learning" or mlearning or m-learni
B Outcome: Detachment	Usage Behavior	"phantom ringing" OR "phantom vibration" OR "internet dependency" OR "mobile dependency" OR "phone dependency" OR "technology dependency" OR "internet addiction" OR "mobile addiction" OR "phone addiction" OR "technology addiction" OR "daily interruptions" OR ringxiety OR "ringing syndrome" OR "impulsive use" OR "obsessive use" OR "invasion of privacy" OR "privacy invasion" OR "role ambiguity"
	Work-Life Conflict	"work-home interference" OR "work-home segmentation" OR "work home conflict" OR "work-home conflict" OR "work-life balance" OR "work life balance" OR "work-life conflict" OR "life-to-work-conflict" OR "life to work conflict" OR "work-to-life-conflict" OR "work to life conflict" OR "work-family-conflict" OR "work family conflict"

Area	Specification	Search String
C Outcome: Surveillance		(surveillance NEAR/2 (performance OR computer* OR e- OR electronic*)) OR (monitoring NEAR/2 (performance OR computer* OR e- OR electronic*)) OR "performance observation"
D Outcome: Cultural Diversity in the Workplace		((backround NEAR/2 (cultural OR ethical OR national OR management)) OR (intercultural NEAR/2 (communication OR competence OR awareness)) OR (cultural NEAR/2 (differences OR distance OR norms OR habits OR values OR customs OR gap)) OR (work NEAR/4 (migration OR migrants OR immigrants OR refugees OR discrimination OR acculturation)) OR (diversity NEAR/2 (workforce OR management OR cultural)) OR "intercultural management")
E Outcome: Cognition		((cognit* OR mental* OR informat*) NEAR/2 (load OR overload OR workload)) OR overus* OR "over-us*" OR ((cognit* OR mental*) NEAR/2 (speed OR perform* OR attent* OR inattent* OR distract* OR judg* OR evaluat* OR reason* OR comput* OR (problem NEAR/2 solv*) or (deci* NEAR/2 mak*) OR comprehend* OR alert* OR aware* OR multitask*)) OR ((cognit* OR mental*) NEAR/4 (know* OR memor* OR forget* OR interrupt* OR "executive function*" OR concentrat*))
F Outcome: Acceptance		(acceptance OR satisfaction OR willingness OR trust OR reliability OR accessibility OR preference OR compliance) AND (*stress OR strain)

Appendix 3.2.B. Guideline for the expert interviews in the qualitative part of the study for a conceptual understanding of technostress

Name of the interviewer:	Date of the interview:	Position and expertise of interviewee:
____________________	____________________	____________________

(Relevant items to be marked by interviewer) Yes No

Did interviewee sign data protection sheet? ____ ____

Did interviewee sign declaration of consent? ____ ____

Didi interviewee approve documentation? ____ ____
(if "yes" turn on audio recording device)?

ID:

	I. Introduction	**Notes**
Introduction	Thank you very much for taking the time to participate in this interview concerning healthy work with digital technologies. You are in expert in the field and we are kindly interested in your opinion and hearing your experiences regarding this topic.	
Anonymity	The interview solely serves research purposes. None of your statements are traced back to you as a person, your employees or business partners.	
Documentation	Do you approve that the interview will be recorded for the purpose of documentation? Please sign the declaration of consent and the data protection declaration before the interview begins.	
	II. Research Questions	**Notes**
General	Can you think of examples of digital technologies and media which were introduced in German companies and small and medium sized enterprises (SME) in the last couple of years? What effect did the introduction have? *(Background information)* *There are different definitions and models of stress. Stress is basically a normal and adaptive response to challenges. Stress is caused by certain triggers (stressors), e.g., excessive demands, conflicts, shift work, perfectionism. In addition, stress is associated with various reactions, such as feelings (e.g., fear, anger), behaviors (e.g., increased consumption of alcohol / nicotine, social withdrawal) and physical reactions (e.g., sweating, breathlessness), but also cognitive impairments (e.g., concentration, memory).* *However, people differ in which stressors are experienced as stressful. Whether a person experiences a situation as stressful depends heavily on how the person evaluates it, whether, for example, he sees it as personally relevant or threatening, and what "tools" or resources the person has at hand to deal with the situation. Stress does not necessarily have to be negative but can, to a certain extent, also be experienced as positive and improve performance. Stress is therefore a very individual process. In everyday language, stress often refers to the negative consequences that stressors have. (Based on the transactional model by Lazarus and Folkman 1984) Technostress (respectively digital stress) refers to stress that is triggered by digital technologies and is associated with certain reactions and consequences on the physical, emotional, cognitive, and behavioral level.* *Digital technologies (also information technology (IT), information and communication technology (ICT), information systems (IS) or just called computers) enable the storage and processing of data, the transfer of information and different types of electronically mediated communication (based on Zuppo 2012). Digital technologies can be divided into hardware, software and networks. Hardware includes, for example, workstations, laptops, tablets, projectors or smartphones. Software includes, for example, Skype for Business, Microsoft Office, Google Drive or Dropbox. Intranet or social networks belong to the generic term of networks.*	
Causes	In your opinion, what causes technostress among employees? • Which technologies and media may cause stress? • Which characteristics or use cases of digital technologies may cause stress? (Examples are that a technology often evolves or that the technology can be used in a flexible manner away from the workplace or outside of working hours.) • Which occupational groups are particularly affected?	

	• Do employees differ with respect to what causes technostress for example persons with different age, gender, full-time/half-time employment, care of elderly persons/children? • Do employees differ with respect to what causes technostress due to their cultural background?	
Conse-quences	In your opinion, what are the consequences of technostress for employees? • How do these consequences manifest?	
Coping	In your experience, how do employees and the company / SME handle technostress. It means how do they cope? • Do employees differ with respect to how they cope with tech-nostress for example persons with different age, gender, full-time/half-time employment, care of elderly persons/children? • Do employees differ with respect to how they cope with tech-nostress due to their cultural background? • Does coping differ between different digital technologies and media which are sued, are they handled differently? • Does the handling of technostress differ from other forms of stress and if so in what way?	
Coping Suc-cess	How successful do you think are those strategies to cope with technostress? • What do you believe is an effective way and what is a less ef-fective way to cope? • Is this way of coping more successful/less successful than dealing with other forms of stress? In what way?	
Resources	By what means or resources, e.g., features, abilities and charac-teristics can the assessment of technostress and the effective handling of it be supported? *(Possible areas)* • *Organizational characteristics (autonomy, social support etc.)* • *Personal characteristics (IT-skills, self-efficacy, resilience, etc.)*	
	III. Structuring Variables	**Notes**
Areas of Ex-pertise	In your opinion, which areas of expertise are relevant in the ex-amination of technostress?	
Occupa-tional Groups	In your opinion, which occupational groups should eb included in focus groups investigating technostress? Are different hierar-chy levels of relevance?	
Cultural Background	In your opinion, should employees with different cultural back-grounds be regarded separately in focus groups?	
	IV. Conclusion	**Notes**
Further In-formation	With this question we conclude our interview. Is there anything that comes to your mind which seems important in this context which we have not talked about yet?	
End Note	Thank you very much for taking the time to support the research in our project!	

Appendix 3.2.C. Guideline for the focus groups in the qualitative part of the study for a conceptual under-standing of technostress

Time: 1.5-2h

Execution: 1 moderator, 1 person to record workshop

	I. Introduction	Actions and Comments
Introduction	Today, we would like to talk about your usage of digital technologies for work. Thank you for in participating in this group session. We are kindly interested in your opinions and hearing your experiences.	• Keep it general • Don't name specific technologies, stressors, or consequences to avoid priming
Digital Technologies	Which digital technologies do you use for work? *(Background information)* *Digital technologies (also information technology (IT), information and communication technology (ICT), information systems (IS) or just called computers) enable the storage and processing of data, the transfer of information and different types of electronically mediated communication (based on Zuppo 2012). Digital technologies can be divided into hardware, software and networks. Hardware includes, for example, workstations, laptops, tablets, projectors or smartphones. Software includes, for example, Skype for Business, Microsoft Office, Google Drive or Dropbox. Intranet or social networks belong to the generic term of networks.*	• Individual work (5 mins) • Avoid "at the workplace" use "work" • Participants write down what comes to their mind without evaluation or judgement of importance, relevance, or frequency • Collect cards, spread them out on the floor and stack duplicates on top of each other (3 mins)
	II. Research Questions	**Actions and Comments**
Stress	How much do(es) the named technology(ies) stress you out?	• Scale from "not at all" to "totally" • Each participant gets sticky points for the rating to glue them on the pin board (10 mins)

Causes	What usage and/or characteristics of this specific technology stresses you out exactly?	• Group discussion
		• Comparison of triads:
		  o 2 "less stressful" technologies vs. 1 "highly stressful" technology
		  o 3 heterogeneously stressful technologies
		  o Other interesting combinations
		• Moderator puts characteristics on pin board

Stress, Potential Characteristics	How strongly do these specific aspects stress you out? How strongly does this aspect stress you compared to the others?	• Template with the results from the afore steps is put on pin board • Moderators explains al-ready known techno stressors • Group discussion (15 mins) • Participants get sticky points to glue them be-hind the characteristics on the pin board • Moderators lets participants prioritize the characteristics according to the rating

Conse-quences	What triggers this in you and your environment? (besides feeling stressed) What can you observe in your colleagues? How does it manifest itself in behavior (at work, at home, among friends...)? *(Additional Question)* • *Are there positive aspects?*	• Participants write on cards for each characteristic • Show matrix afterwards (short/long term consequences, psychological/physiological…) • Leave room for group discussion (15 mins) • Moderator should ask to be more precise and specific if necessary
Coping	What can you personally do about it (meaning cope with it)? What can the organization/environment do about it? What can be done about it from a technological point of view? What are your experiences / wishes here?	• Do not skip! Essential part for the participants and company’s motivation that their employees take part in the focus group • Group discussion (15 mins)
	III. Conclusion	**Actions and Comments**
Further Information	With this question we conclude our workshop. Is there anything that comes to your mind which seems important in this context which we have not talked about yet?	
End Note	Thank you very much for taking the time to sup-port the research in our project!	

Appendix 3.2.D. Measurement Items

Construct	Item	Mean	SD	Est	Source
Usefulness	Use of {selected technology} enables me to accomplish tasks more quickly.	2.97	1.14	0.82	Ayyagari et al. 2011
	Use of {selected technology} improves the quality of my work.	2.65	1.18	0.83	
	Use of {selected technology} makes it easier to do my job.	2.88	1.13	0.90	
	Use of {selected technology} enhances my effectiveness on the job.	2.75	1.16	0.89	
Simplicity of Use (Complexity)	Learning to use {selected technology} is easy for me.	3.21	0.95	0.87	Ayyagari et al. 2011
	{selected technology} is easy to use.	3.20	0.95	0.92	
	It is easy to get results that I desire from {selected technology}.	3.01	0.99	0.80	
Reliability	The features provided by {selected technology} are dependable.	2.93	0.95	0.91	Ayyagari et al. 2011
	The capabilities provided by {selected technology} are reliable.	2.93	0.94	0.93	
	{selected technology} behaves in a highly consistent way.	2.92	0.96	0.86	
Anonymity	It is easy for me to hide how I use {selected technology}.	1.85	1.22	0.80	Ayyagari et al. 2011
	I can remain anonymous when using {selected technology}.	1.79	1.29	0.80	
	It is easy for me to hide my {selected technology} usage.	1.72	1.23	0.92	
	It is difficult for others to identify my use of {selected technology}.	1.75	1.22	0.76	
Mobility	The use of {selected technology} is not limited to the workplace.	2.68	1.42	0.76	Self-developed with input from Tarafdar et al. 2019
	The use of {selected technology} is not restricted to a certain location.	2.61	1.44	0.86	
	It is possible to use {selected technology} on the go.	2.53	1.50	0.93	
	{selected technology} is accessible from anywhere.	2.51	1.43	0.89	
	{selected technology} enables me to work anywhere.	2.40	1.41	0.80	
Reachability	The use of {selected technology} enables others to have access to me.	2.69	1.31	0.92	Ayyagari et al. 2011
	{selected technology} makes me accessible to others.	2.67	1.32	0.95	
	The use of {selected technology} enables me to be in touch with others.	2.74	1.29	0.95	
	{selected technology} enables me to access others.	2.77	1.28	0.95	
Pace of Change	I feel that there are frequent changes in the features of {selected technology}.	1.82	1.24	0.92	Ayyagari et al. 2011
	I feel that characteristics of {selected technology} change frequently.	1.74	1.20	0.94	
	I feel that the capabilities of {selected technology} change often.	1.78	1.22	0.94	
	I feel that the way {selected technology} works changes often.	1.70	1.21	0.92	

Construct	Item	Mean	SD	Est	Source
Pull	{selected technology} displays information only when I actively interact with it.	2.04	1.29	0.75	Self-developed
	To receive information through {selected technology}. I need to actively request it.	2.03	1.35	0.83	
	Information is provided by {selected technology} only on request.	2.11	1.33	0.85	
Push	{selected technology} displays information. whilst I am otherwise engaged.	2.36	1.18	0.75	Self-developed
	I only receive notifications through {selected technology} if I request it.	2.48	1.13	0.89	
	{selected technology} uses push notifications to provide information.	2.59	1.15	0.74	
Intangibility of Results	The result of my work with {selected technology} is not tangible.	1.53	1.27	0.89	Self-developed
	The result of my work with {selected technology} is not clearly visible.	1.55	1.25	0.90	
	{selected technology} creates products that are not tangible.	1.56	1.26	0.84	
	The result of working with {selected technology} is not noticeable.	1.46	1.24	0.88	
	Results from the use of {selected technology} are not visible to third parties.	1.69	1.27	0.65	
	Third parties can not immediately see changes caused by using {selected technology}.	1.89	1.26	0.60	

Table 3.2-6: Item Means, Standard Deviation and Factor Loadings oft he Final Scales Used in the Main Study (N = 4,560)

Appendix 3.2.E. Taxonomy of Digital Technologies

Category	Technology	Category	Technology
Standard Technologies	Laptop PC Telephone Mobile Smartphone Tablet Printer Headset	Subject-Specific Applications	Product Development Design Software Simulation Software Statistics Software Medical Software Database
		Management- and Enterprise-Applications	Management Information Software Decision Support Systems Administrative Software
New Technologies	Artificial Intelligence Augmented Reality Language Interaction	Payment Transaction and E-Commerce	Cash Systems Digital Cash E-Commerce
Standard Applications	Office Software Knowledge Management Internet CMS	Networks	Wireless Network Network Hardware
		Productions and Logistics	Production Planning Manufacturing System Logistics System
Communication Interaction and Collaboration	Email Realtime Communication Social Collaboration Cloud Computing	Environmental Recognition	Sensor Systems Localization
Security	Security Background Security Interaction		

Appendix 3.2.F. Results of the EFA

Rotated Components Matrix From the Split Sample of the Main Study

N = 2,280. Extraction method: Principal Axis Factoring (PAF) with oblimin rotation.

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
I1	0.81									
I2	0.84									
I3	0.90									
I4	0.90									
I5		0.91								
I6		0.89								
I7		0.61								
I8			0.89							
I9			0.95							
I10			0.80							
I11				0.75						
I12				0.86						
I13				0.94						
I14				0.73						
I15					0.77					
I16					0.91					
I17					0.93					
I18					0.86					
I19					0.71					
I20										
I21						0.93				
I22						0.96				
I23						0.94				
I24						0.94				
I25							0.92			
I26							0.95			
I27							0.91			
I28							0.91			
I29								0.67		
I30										
I31								0.75		
I32								0.91		
I33									0.65	
I34									0.92	
I35									0.72	
I36										0.85
I37										0.87
I38										0.81
I39										0.86
I40										0.75
I41										0.68

Appendix 3.2.G. Assessment of Discriminant Validity

Latent Correlations of the Constructs in the Study Obtained From Confirmatory Factor Analysis of the Constructs

Square root of the AVE printed in the diagonal (N = 4,560)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Anonymity	0.82														
Intangibility	0.30	0.80													
Mobility	0.26	0.08	0.85												
Pace of Change	0.40	0.36	0.30	0.93											
Pull	0.17	0.11	0.20	0.25	0.80										
Push	0.29	0.28	0.42	0.44	0.13	0.81									
Reachability	0.12	0.12	0.32	0.19	0.13	0.49	0.94								
Reliability	0.19	-0.14	0.18	-0.13	0.24	0.12	0.28	0.90							
Simplicity of Use	0.10	-0.14	0.21	-0.15	0.20	0.12	0.35	0.67	0.87						
Usefulness	0.21	-0.09	0.18	0.10	0.22	0.23	0.33	0.52	0.44	0.86					
Techno-Complexity	0.11	0.38	0.00	0.29	0.02	0.14	-0.03	-0.24	-0.35	-0.12	0.81				
Techno-Insecurity	0.22	0.34	0.09	0.34	0.06	0.25	0.03	-0.12	-0.25	-0.02	0.65	0.76			
Techno-Invasion	0.24	0.39	0.13	0.36	0.04	0.27	0.03	-0.14	-0.22	-0.02	0.62	0.72	0.78		
Techno-Overload	0.07	0.31	0.04	0.28	0.06	0.15	-0.01	-0.17	-0.25	-0.11	0.67	0.73	0.66	0.82	
Techno-Uncertainty	0.21	0.22	0.12	0.37	0.09	0.25	0.08	-0.05	-0.15	0.03	0.42	0.63	0.47	0.56	0.80

Heterotrait-Monotrait Ratios (HTMT) of the Constructs in the Study

Calculations done with the corrected formula of the HTMT which uses the absolute values of the item correlations (N = 4,560)

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**
Anonymity															
Intangibility	0.34														
Mobility	0.29	0.07													
Pace of Change	0.39	0.37	0.28												
Pull	0.21	0.14	0.18	0.26											
Push	0.30	0.32	0.44	0.43	0.17										
Reachability	0.09	0.12	0.32	0.15	0.17	0.48									
Reliability	0.20	0.12	0.18	0.16	0.25	0.12	0.29								
Simplicity of Use	0.12	0.13	0.21	0.15	0.24	0.14	0.38	0.71							
Usefulness	0.20	0.09	0.20	0.12	0.24	0.22	0.30	0.50	0.47						
Techno-Complexity	0.11	0.36	0.02	0.24	0.03	0.13	0.04	0.21	0.30	0.12					
Techno-Insecurity	0.25	0.32	0.09	0.34	0.07	0.24	0.03	0.14	0.22	0.04	0.61				
Techno-Invasion	0.20	0.37	0.16	0.32	0.04	0.26	0.04	0.16	0.19	0.04	0.58	0.73			
Techno-Overload	0.07	0.27	0.05	0.24	0.05	0.15	0.02	0.17	0.21	0.09	0.60	0.70	0.67		
Techno-Uncertainty	0.17	0.21	0.10	0.35	0.07	0.24	0.08	0.08	0.12	0.03	0.39	0.62	0.49	0.57	

Appendix 3.2.H. Results of the Structural Model

Standardized Regression Weights, Test Statistics and p-Values of the Structural Model

Evaluating the influence of profiles of digital technologies on technostress (N = 4,560)

	Techno-Complexity			Techno-Insecurity			Techno-Invasion			Techno-Overload			Techno-Uncertainty		
	Est	t	p	Est	t	p	Est	t	p	Est	t	p	Est	t	p
Anonymity	-0.16	-1.56	.12	-0.27	-2.62	.01	-0.40	-3.84	.00	-0.10	-0.98	.33	-0.17	-1.63	.10
Intangibility	0.16	2.78	.01	0.34	5.97	.00	0.31	5.55	.00	0.25	4.41	.00	0.30	5.26	.00
Mobility	0.08	1.80	.07	0.18	4.15	.00	0.28	6.50	.00	0.12	2.76	.01	0.14	3.12	.00
Pace of Change	-0.04	-0.52	.60	0.04	0.50	.61	0.31	3.80	.00	0.10	1.23	.22	0.07	0.89	.37
Pull	-0.16	-1.24	.21	-0.18	-1.39	.17	-0.40	-3.10	.00	-0.23	-1.73	.08	-0.17	-1.29	.20
Push	0.11	1.03	.30	-0.08	-0.80	.42	-0.28	-2.66	.01	-0.14	-1.35	.18	0.03	0.27	.79
Reachability	-0.20	-2.33	.02	-0.16	-1.91	.06	-0.18	-2.12	.03	-0.13	-1.58	.11	-0.17	-2.08	.04
Reliability	-0.18	-1.12	.26	-0.25	-1.55	.12	-0.46	-2.87	.00	-0.07	-0.40	.68	0.11	0.72	.47
Simplicity of Use	0.08	0.49	.63	-0.19	-1.10	.27	0.40	2.33	.02	-0.18	-1.05	.30	-0.50	-2.87	.00
Usefulness	0.00	0.00	1.00	0.22	2.60	.01	0.14	1.67	.09	0.11	1.35	.18	0.07	0.80	.42

3.3 Extending the Concept of Technostress: The Hierarchical Structure of Digital Stress

Abstract

Increasing use of digital technologies at workplaces has led to technostress. Research conceptualizing technostress dates to over a decade ago. Given that digital technologies are now present in unprecedented variety, pervasiveness, and usage intensity, the question arises whether the current technostress concept is still up to date. To answer this question we designed a sequential qualitative-quantitative mixed-methods study that includes interviews, focus group discussions, and multiple surveys, using over 5,000 participants drawn from members of the German workforce. Key results are as follows: Based on theoretical reasoning and empirical data, we present a holistic framework of twelve demands from work relating to digital technology use and present a valid and reliable survey-based measurement model to assess the demands. The twelve demands integrate nine demands described as technostress creators and related concepts in previous literature, as well as three newly identified demands. Our data suggest a hierarchical structure with four second-order factors underlying the demands. Further, we embed the hierarchical model in a nomological net that reveals work- and health-related effects. Finally, given the magnitude of change regarding the considered stress creators and the context of digital transformation, we suggest the concept of "digital stress" as an updated extension of technostress.

Keywords: Technostress, Digital Stress, Digital Work, Demands, Multilevel Structure, Mixed-Methods

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3.3.1 Introduction

Recent sociotechnical developments caused by ongoing digitalization (e.g., artificial intelligence, robotic process automation, anthropomorphic systems) have dramatically changed the work environment and culture. The COVID-19 pandemic has further intensified this change by necessitating an increasing amount of virtual collaborations and employees working remotely. Digital and smart workplace technologies are facilitating business processes and providing efficient communication and collaboration tools, “increasing the productivity of the workforce in the information age” (Attaran et al. 2019, p. 1).

However, the use of digital technologies also has significant downsides: for example, information flows across many different channels, frequent interruptions, and blurred boundaries between work and private life (Tarafdar et al. 2010). Such demands may cause a specific form of stress, identified already in the 1980s when Brod (1982, 1984) coined the term technostress to describe the human cost of the computer revolution. However, the intensity of use and diversity of digital technologies and virtual collaboration available in the business context has changed dramatically since the 1980s. The contemporary perspective of technostress was shaped more than two decades later by seminal papers such as Tarafdar et al. (2007), Ragu-Nathan et al. (2008), and Ayyagari et al. (2011). The core framework centers on a misfit between demands arising from digital technology use and a person’s resources to cope with these demands. Many consider the five technostress creators introduced by Tarafdar et al. (2007) and Ragu-Nathan et al. (2008) to be the standard concept of technostress (e.g., Benlian 2020; Califf et al. 2020). Although these papers also identify the bright sides of IT use, including productive challenges, high performance, learning, personal growth, and positive emotions (Benlian 2020; Califf et al. 2020; Tarafdar et al. 2019a), we focus on the dark side of technostress in this paper.

IT use behavior necessitates the investigation of technostress. Tarafdar et al. (2007, p. 304) suggested that “given the proliferation of ICTs in the workplace in recent years, there are a number of ways in which their use can create stress for people using them.” Likewise, Ayyagari et al. (2011, p. 831) stated that “with the proliferation and ubiquity of information and communication technologies, it is becoming imperative for individuals to constantly engage with these technologies in order to get work accomplished.” About a decade after the publication of these seminal works, Fischer et al. (2019, p. 1822) argued that they “see no reason why this development would have stopped.”

Ragu-Nathan et al.’s (2008) paper was first submitted to Information Systems Research in July 2005; however, the data were acquired earlier. At that point in time, IT-enabled work was shaped by a wide diffusion of PCs and the Internet. However, Facebook was only a year old and social computing was in its infancy, with the term Web 2.0 becoming popular by the end of 2005. Google's CEO first used the term "cloud computing" in August 2006 (Regalado 2011) and mobile computing began to emerge in 2007 with the release of the first iPhone. Work and IT use for work have arguably changed substantially since these times. Technologies related to social, mobile, analytics, cloud, and the internet of things – summarized in the popular SMACIT acronym (Sebastian et al. 2017) – are now widely available at workplaces. Further, some workplaces feature the use of artificial intelligence, augmented and virtual reality, 3D printing and other advanced digital technologies. These digital technologies do not merely represent the world, they shape our world and lead to fundamental changes at work (Baskerville et al. 2020).

Tarafdar et al. (2019a, p. 7) recently argued that technostress is a "continually evolving phenomenon as new types of IS […] and their use persistently emerge and reveal novel aspects of it." Similarly, La Torre et al. (2019) stated that the definition of technostress has changed over time. Tarafdar et al. (2019a) acknowledged this dynamism by updating their core conceptualization of technostress by assigning new dimensions to known technostress creators.

This dynamism of technostress concepts can be seen, for example, in a literature study on technostress conducted by Nisafani et al. (2020), who found indications for additional technostress creators, which, however, refer less to the technology itself than how it is handled and users' expectations (e.g., role ambiguity, flexibility). However, Fischer et al. (2019) remarked that it is disputable whether new aspects can simply be added to a small set of known technostress creators (e.g., techno-invasion, techno-insecurity) or whether additional dimensions are needed. This debate raises the question of whether the present concept of "technostress" is still up to date and accounts for the prevailing circumstances, given the unprecedented variety, pervasiveness, and usage intensity of digital technologies in all domains of life.

Contemporary research in the field of technostress deals with topics such as stress appraisal (e.g., Benlian 2020; Califf et al. 2020), stress coping (Pirkkalainen et al. 2019; Tarafdar et al. 2019b), stress outcomes (e.g., Chen et al. 2019; La Torre et al. 2020), and the design of stress-sensitive systems (e.g., Adam et al. 2017; Jimenez and Bregenzer 2018). These research foci are valuable and essential since it is the appraisal of technostress creators and the application of coping measures that determine the extent to which employees experience technostress and its negative consequences. At the same time, however, it is also crucial to examine how working life has changed and how this change affects technostress creators, their perception by employees, and appropriate prevention and coping measures. Only an up-to-date understanding of digital work demands that create stress will allow researchers to study the appraisal, coping, outcomes, and system design concerning these demands.

Therefore, a conceptualization of stress caused by digital technology use that fits the new sociotechnical context of digital work is important for understanding the resulting psychological strain and its organizational and personal consequences (e.g., low productivity, dissatisfaction at work, health issues) and to allow researchers and practitioners to design and analyze measures to counter this dark side of digital transformation. We do not suggest that an entirely new theory of technostress is needed. However, context matters for theories (Hong et al. 2014), and the digital transformation (Vial 2019) has changed the technological, organizational, and social context of work for many individuals. We believe the time has come to update technostress theory. Toward this end, we adopt a cumulative knowledge perspective, and pose the following research questions:

> *RQ1: What demands from contemporary work practices relating to digital technologies cause stress for employees?*
>
> *RQ2: How do these different demands relate to each other?*

To answer these research questions, we applied a sequential qualitative-quantitative mixed-methods research design, following the guidelines proposed by Venkatesh et al. (2013) and Venkatesh et al. (2016). Our research is divided into a qualitative phase that relies on expert interviews and focus group discussions and grounds our research in a general conceptual framework, followed by a quantitative phase analyzing survey data from a total of 5,005 employees.

Key contributions are as follows: First, we present a holistic framework of twelve contemporary digital work demands, summarizing demands spread across different studies and adding new demands. Second, based on theoretical and empirical evidence, we model the hierarchical structure of these demands. Third, given the magnitude of change related to the considered stress creators and the context of digitalization, we propose the concept of "digital stress" as an update to and extension of technostress. Fourth, we present and validate a survey-based measurement model for the complete set of demands.

In the following section, we describe the conceptual foundation and current state of knowledge. Our mixed-methods research process and related design decisions are explained in Section 3.3.3. Section 3.3.4 presents the qualitative phase of our research and focuses on the conceptual development of stress induced by digital technologies. Section 3.3.5 introduces the quantitative phase and presents the survey results. Section 3.3.6 discusses the results and the meta-inferences, and Section 3.3.7 concludes the paper.

3.3.2 Conceptual Foundation

Brod (1984, p. 16) describes technostress as "a modern disease of adaptation caused by an inability to cope with the new computer technologies in a healthy manner," illuminating the phenomenon from an early perspective. The scholarly concept presented in Tarafdar et al. (2007, p. 304) specifically focuses on the workplace, stating that "in the organizational context, technostress is caused by individuals' attempts and struggles to deal with constantly evolving [information and communication technologies] and the changing physical, social, and cognitive requirements related to their use." These definitions stem from different decades and contexts but, importantly, they are both based on the transactional theory of stress. According to this theory, stress is more than a threatening, potentially harmful event and entails more than the individual's response to a stressor. Stress is anchored neither solely in the environment nor in the person; it is created in a transactional process (Lazarus and Folkman 1984). Demands are transmitted from the environment to a person through appraisal, which signifies the validation of situational facets "with respect to the significance for well-being" (Lazarus and Folkman 1984, p. 31) along with one's resources and ability to handle this situation.

Following Lazarus and Folkman (1984), technostress arises when negative consequences resulting from digital technology use are anticipated and an imbalance occurs between these demands, and the user's personal or organizational resources to meet the demands (Tarafdar et al. 2007). Digital technologies exist in various forms and refer to a "combinations of information, computing, communication, and connectivity technologies" (Bharadwaj et al. 2013, p. 471). By using these new technologies in a working context, work becomes more digital. We define digital work as the "effort to create digital goods or that makes substantial use of digital tools" (Durward et al. 2016, p. 283). While further definitions propose a broad perspective in which current work practices always entail digital aspects (Orlikowski and Scott 2017), we view digital work as essentially knowledge work in the framework of this study (Nash et al. 2018).

In their recent literature analysis of existing work on technostress, Tarafdar et al. (2019a) structured existing research on technostress along with a framework that builds on the transactional process. This framework includes technology environmental conditions, technostress creators, consequences, and moderators of the technostress creators and outcomes relationship. Our focus here is on technostress creators, which are specific demanding conditions that occur during digital technology use and must be met using personal resources. Techno-invasion, techno-overload, techno-complexity, techno-uncertainty, and techno-insecurity are well-known technostress creators (Ragu-Nathan et al. 2008; Tarafdar et al. 2007). Techno-invasion refers to situations that require being constantly available and connected, which may cause the boundary between work and private life to blur. Techno-overload is associated with situations in which digital technologies induce a greater workload and higher speed of work. Techno-complexity describes situations where digital technologies make users feel that they lack the skills and experiences necessary to deal with the complexities of digital technologies and are forced to spend time and effort learning about them. Techno-uncertainty refers to situations in which digital technologies are frequently changed and upgraded, requiring users to continually develop their abilities and knowledge. Techno-insecurity describes situations where users perceive the threat of losing their job due to automation or the lack of skills needed to deal with digital technologies.

The five well-established technostress creators introduced by Tarafdar et al. (2007) and Ragu-Nathan et al. (2008) have attracted much attention in the research on technostress and are still considered to be state-of-the-art conceptualizations of technostress. Califf et al. (2020, p. 812) state that “in IS research, technostress is composed of five dimensions” and Benlian (2020, p. 1264) refers to them as “classical technostress creators.” Many other recent studies also refer to these technostress creators (e.g., Güğerçin 2020; Korzynski et al. 2021; Molino et al. 2020; Pflügner et al. 2020; Pflügner et al. 2021). However, other aspects discussed in the literature are also capable of creating technostress and can cause negative consequences for individuals using technologies at the workplace.

Fischer and Riedl (2015) and Adam et al. (2017), for example, discuss techno-unreliability. This technology-related stressor comprises system malfunctions as well as IT hassles. Galluch et al. (2015) focus on interruptions enabled by digital technology, such as emails and instant messages. Ayyagari et al. (2011) consider role ambiguity and the invasion of privacy to be part of the technostress concept. Role ambiguity describes the unpredictable consequences emerging from the conflict between the need to perform a role and the lack of information to adequately do so. This might occur, for example, when an employee is unsure whether to prioritize dealing with technical problems or work activities. Invasion of privacy involves the perceived impairment of one’s privacy. Invasion of privacy is not to be confused with techno-invasion. While techno-invasion focuses on the blurring of boundaries between work and private life, invasion of privacy refers to the perception that the private and occupational use of digital technologies during work time can easily be traced, potentially allowing the employer or coworkers to invade one's privacy.

3.3.3 Research Process

We followed a mixed-methods design. Mixed-methods research designs "contain elements of both quantitative and qualitative approaches" (Tashakkori and Teddlie 1998, p. 5). Within the IS discipline, mixed-methods designs are beneficial since context changes frequently and researchers may have difficulty drawing significant insights from existing theories and perspectives (Venkatesh et al. 2013). Mixed-methods designs offer three specific benefits: the ability to "address confirmatory and explanatory research questions," to "provide stronger inferences than a single method or worldview," and to "produce a greater assortment of divergent and/or complementary views" (Venkatesh et al. 2016, p. 437). Given the general multiplicity of studies on technostress and the changed context, a mixed-methods design is well suited to our work.

Our study's mixed-methods design began with the articulation of two research questions. We followed a developmental purpose, first conducting a qualitative study and then using the results from this study to develop the research model tested in the second quantitative phase of research (Tashakkori and Teddlie 1998; Venkatesh et al. 2013; Venkatesh et al. 2016). We adopted multiple paradigms as an epistemological stance. During the qualitative phase (Phase 1), we take an interpretive perspective. During the quantitative phase (Phase 2), we adopted a positivist approach. This methodology can be classified as "mixed-methods multistrand" approach (Venkatesh et al. 2016, p. 443), with both strands of research being equally important. We used a sequential sampling strategy with parallel samples and performed data analysis sequentially to help build the research model for the quantitative study based on the results of the qualitative study (Venkatesh et al. 2016).

Overall, the mixed-methods design is divided into two phases (see Figure 3.3-1). In the qualitative phase, we accomplished the following: We grounded our research in a general conceptual framework and compiled known demands of digital work discussed in this literature to provide a holistic view of stress and technostress (Phase 1a). Subsequently, we revealed new digital work demands through interviews with experts from various fields and through focus group discussions. By identifying the currently most important/significant stressful aspects of the interaction with digital technologies, we were able to understand the conditions that may give rise to technostress (Phase 1b). We concluded this phase with qualitative inferences by analyzing the interview data and iteratively reviewing the literature base. We thus defined the demands and evaluated the concept of technostress to understand whether it complies in its current form with the (newly) defined technostress creators (Phase 1c). Phase 1 was influenced by contextual research studies (see Hong et al. 2014). While the first three steps of the guideline by Hong et al. (2014) can be mapped to Phases 1a-c, Steps 4-6 of the guideline are not reflected in our research process because Phase 2 of our study goes beyond contextualizing. The overarching goal of this research is the extension of theory.

In our quantitative study, we accomplished the following: We operationalized the constructs and pre-tested our measurement model (Phase 2a). We used validated scales from literature where possible and developed items for newly identified demands that emerged from the qualitative study. We examined the associated measurement models, and then drew on survey data to validate our measurement model and thereby the findings from the qualitative study. Further, we revealed higher-order structures to understand the multilevel structure of the demands (Phase 2b). We then selected the best structure for the demands based on another survey and embedded the model in a nomological net to test its validity (Phase 2c). We concluded our mixed-methods study by integrating the findings from the qualitative and quantitative phases of our research and deriving meta-inferences.

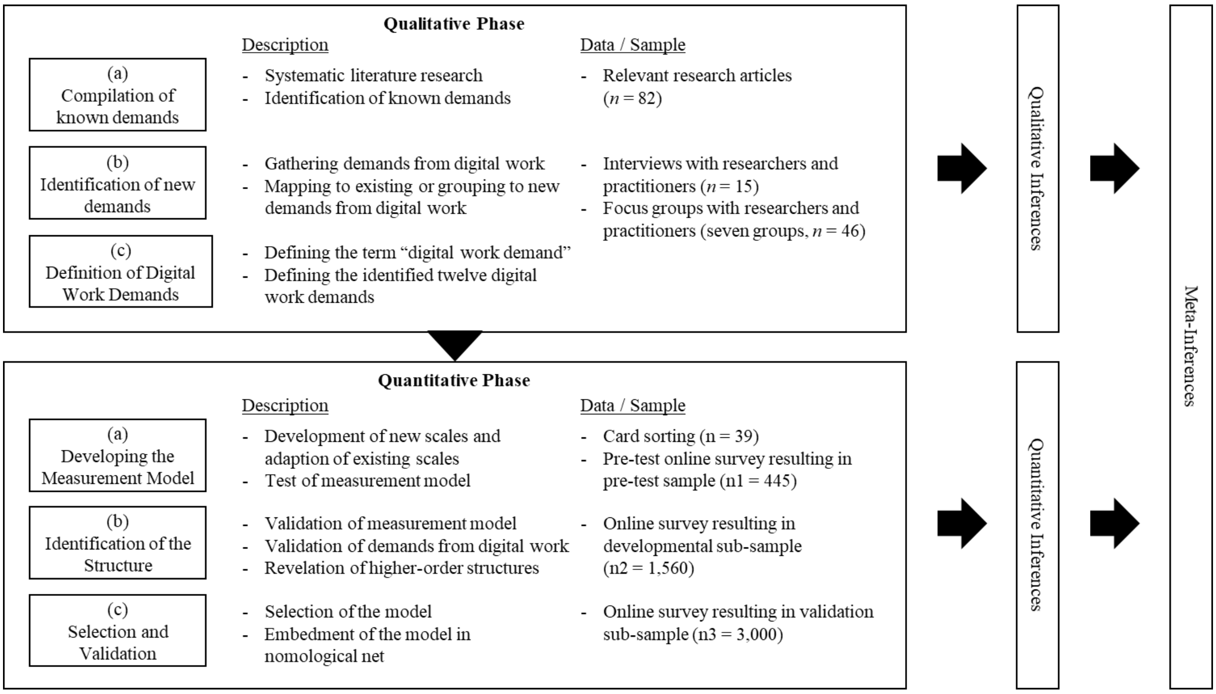

Figure 3.3-1: Research Process of the Mixed-Methods Research Paradigm

3.3.4 Qualitative Phase

3.3.4.1 Compilation of Known Demands

In the literature building our research foundation, we aimed to identify phenomena classified as technostress creators. We searched the following databases: EBSCO Business Source Premier, EBSCO Academic Search Premier, EBSCO Psych, Web of Science, and PubMed. Because the seminal paper on this topic by Tarafdar et al. was published in 2007, we included only publications from this year onward. Types of publications that we considered included academic journals, proceedings, books, book chapters, and dissertations. First, we developed several search strings for aspects, potentially linked to technostress. These included technologies, the occupational context, as well as different possible outcomes such as stress and strain, detachment, monitoring, cognition, acceptance, and job performance. We then combined the search strings for technologies and the context, including only one specific outcome at a time. Additionally, we defined exclusion criteria around, for example, chemistry, physics, animals, and some specific human health issues not directly related to stress.

Overall, 82 articles were identified as relevant because their title and/or abstract are directly linked to technologically induced stress at work. The final list covered a broad range of literature from several disciplines—most importantly, from information systems, psychology, and media science. From this corpus, we extracted the constructs capturing technologically induced stress and analyzed their definitions and operationalizations. This process led to the identification of the nine technostress creators covered in the Conceptual Foundation Section above: techno-invasion, techno-overload, techno-complexity, techno-uncertainty, techno-insecurity, techno-unreliability, interruptions, role ambiguity, and invasion of privacy.

3.3.4.2 Identification of New Demands

We collected qualitative data from expert interviews and focus groups to gather information about potential new technostress creators not yet covered in the technostress literature. Both interviews and focus groups are commonly used for in-depth analysis of a phenomenon. While interviews are often conducted with the goal of obtaining individual expertise on a specific topic, focus groups are more appropriate for research questions investigating how certain issues are talked about or debated (Secor 2010). Therefore, we conducted expert interviews and one expert focus group to gain insights from a broader and more general practical perspective. Employee focus groups were held to receive information from employees affected by technostress in their everyday working lives.

The interview participants came from both science and practice to cover a variety of perspectives. We conducted 15 semi-structured interviews with experts having backgrounds ranging from employer and employee representation, corporate health management, occupational science, computer science, human resources, and moral ethics. Table 3.3-1 shows a list of all interviewed experts. All interviews were recorded and transcribed.

Code	Role
Exp1	Chairman of the works council working for a manufacturer of entertainment and communication technology with over 2,000 employees
Exp2	Employee of the human resources department working for a manufacturer of entertainment and communication technology with over 2,000 employees
Exp3	Head of human resources department in a SME focusing on customer acquisition and retention
Exp4	Person in charge of occupational reintegration management in a SME focusing on customer acquisition and retention
Exp5	Chairman of the works council working in a SME focusing on customer acquisition and retention
Exp6	Scientific director of a federal institute focusing on occupational safety and health
Exp7	Researcher with a focus on work life and work organization at a federal institute focusing on occupational safety and health
Exp8	University professor for moral ethics
Exp9	Work health and safety expert from a major employer association
Exp10	Former vice chairman of the works council and lecturer at a training institute for works councils
Exp11	University professor for sociology
Exp12	Software developer at a university IT department
Exp13	Head of competence field occupational safety working for an occupational health management service provider responsible for over one million employees
Exp14	Regional director working for an occupational health management service provider responsible for over one million employees
Exp15	Regional director working for an occupational health management service provider responsible for over one million employees

Table 3.3-1: List of Experts and their Function

The expert focus group consisted of researchers from computer science, information systems, and psychology. The employee focus groups consisted of different occupational groups, with separate groups for executive staff and employees. In total, we conducted seven practitioner focus groups and two researcher focus groups with five to eight participants per group. An overview of all focus groups can be found in Table 3.3-2. In total, 61 individuals took part in the qualitative data collection, 15 in individual interviews and 46 in focus groups. There were 27 male and 19 female participants who took part in the focus group workshops, with ages ranging from 25 to 64 years. Two facilitators conducted the focus groups; they took field notes and recorded the results from the discussions.

Focus Group	Number of Participants	Level of Hierarchy	Occupational Group
1	6	Staff	Controlling, human resource, marketing, product manager
2	8	Staff	IT support, account manager, media designer/production, business development, tourism
3	7	Staff	Counseling, psychologist, doctors, distribution
4	5	Executive staff	Distribution, IT
5	6	Department managers	IT, marketing, quality management, finance, supply chain management
6	6	Postdoctoral and doctoral researchers	Researchers in information systems
7	8	Professors	Researchers in information systems, computer science, and psychology

Table 3.3-2: Overview of the Participants from the Focus Groups

The basic structure of both the expert interviews and focus groups was similar: first, the participants were asked to list the technologies they currently use for work. In the focus groups, we asked the participants to rate how much the use of each single technology stresses them out on a scale ranging from *not at all* to *completely*. This step was omitted in the expert interviews. The purpose was to narrow down the list of relevant technologies having a high potential for stress. Afterward, we asked participants to name the potential aspects (characteristics and use cases) of these technologies that cause stress. Here, we deliberately avoided the term technostress to retrieve general experiences in handling digital technologies, which we expanded using a question about the resulting consequences of the encountered stress for employees. To complete the picture, attendees elaborated on how they might successfully overcome (i.e., cope with) the stress.

We used a qualitative deductive approach to analyze transcripts and field notes (Pearse 2019). At first, we developed a codebook based on our previously conducted literature review. For the nine technostress creators derived from the literature, we created codes for sources of the respective technostress creators, consequences resulting from these sources, coping behaviors, and resources that might be used to prevent technostress caused by the specific technostress creator. Furthermore, we subdivided the codes for sources and resources into technological, organizational, and individual types of origin. Subcodes for consequences were divided into physiological, cognitive, and behavioral consequences, whereas coping strategies were coded separately as problem-oriented and emotion-oriented strategies. Beyond this, a general code with the same subcodes mentioned above was created for topics not related to one of the technostress creators identified in the literature. The codebook was then applied to the analysis of the collected data to identify themes. Themes can be described as patterns within the data

(Braun and Clarke 2006), and may derive from codes that either existed in the original codebook or were added afterward through the analysis process (Pearse 2019). Our primary focus was on those themes that could not be linked to one of the technostress creators named in the literature so that we could identify potentially new/understudied technostress creators.

Overall, the interviews and focus groups revealed three recurring themes not linked to established technostress creators. The first theme emphasizes the potential monitoring of employees enabled by newly arising digital technologies. Concerning this theme, one member of a work council (Exp1) stated:[4]

> *"To some degree, our production line is close to industry 4.0. For almost 20 years now, we record and process data. That´s why we can assign which employee produced a device on any given day in the past, in case, for example, a client complains about a defective one. For us, this is absolute monitoring of employees. In this regard, employees have to be protected so that the new possibilities won´t lead to surveillance. This is a common topic for us. Once employers have the ability to monitor employees even a little bit, we try to prevent them from doing so. And most of the new technologies can easily be used for monitoring employees."*

However, monitoring not only allows employees to be blamed for possible mistakes made in the past, new technologies also allow for performance comparisons among employees. As one employee representative (Exp10) explained:

> *"Regarding digital stress, one common question is related to new possibilities of monitoring. A lot of new technologies and forms of work, like, for example, working in a cloud or crowd, offer new possibilities of usability, interpretability, and comparability. A one-sided transparency, as I call it. This doesn´t even have to be strict efficiency control. However, one does become more visible. This is an important point."*

The second theme, which was reoccurring and not related to the technostress creators identified in previous literature, emphasizes a certain nonavailability of modern technologies. In this regard, a leading scientist at a federal institute focusing on occupational safety and health (Exp6), mentioned:

[4] All quotes have been translated into English by the authors.

> *"... one can name a restrictive use of access rights as well as a more general access to technologies. That you cannot work like you want to or as the situation requires because of organizational regulations."*

The knowledge that technologies exist to make one's work easier but are not available for use can lead to perceived stress. A professor for moral ethics (Exp8) summarized these situations as follows:

> *"I notice a tendency toward anachronism. From my perspective as a professor, I have to correct exams and write handwritten comments. You ask yourself: 'What year are we living in?' So much additional effort just because you are not allowed to work with digital technologies. This definitely leads to stress. This is ridiculous. As a workaround, I write everything with my computer, print my comments and then glue them into the exams. No one has complained about it yet. In some domains, especially if regulated by the state, you have to work in ways that do not fit into our modern times. This waste of time causes stress."*

Participants in focus groups also mentioned this theme. When asked about potential stress creators, most participants mentioned inadequate software design, insufficient personal competence, or the unreliability of the technologies they use as the most frequently occurring stress creators caused by technology. These themes are common within technostress literature. However, some participants in different focus groups mentioned a lack of access rights as well as the nonavailability of necessary technologies as a source of stress.

The third theme that presented was that employees often lack a sense of achievement when working with digital technologies. This phenomenon was mentioned in the seventh focus group when discussing potential creators of stress. In the discussion, one of the attendees, a computer science professor, mentioned the difficulty of feeling a sense of progress or achievement when working with digital technologies, describing it as a sense of not seeing the results of one's work – contrasted, for example, with the clear physical results craftspeople see in their work. The attendee cited this as a problem that he personally experienced. Indeed, his research focuses on designing technologies to address this problem. After some discussion about this, the focus group concluded by suggesting that lacking a sense of achievement could be described as another digital work demand in addition to the ones already mentioned in the literature.

3.3.4.3 Definition of Digital Work Demands

Technostress literature refers to multiple technostress creators or technostressors (Tarafdar et al. 2007; Tarafdar et al. 2019a). Strictly speaking, these are potential technostress creators or potential technostressors because whether these circumstances (like techno-invasion) lead to stress depends on the individual and the individual's appraisal in a specific situation. For example, whether an unreliable technology is seen as a technostress creator results in part from the individual analysis of the work situation. Benlian (2020) already diverges from the established terminology of technostress creators or technostressors and "calls for contextualizing general theories in IS research" (Benlian 2020, p. 1263). He uses the term "technology-driven work stressors" to emphasize "the socio-technical nature of ICT that essentially and distinctly shapes the frequency, valence, and intensity of the stress experienced at work" (Benlian 2020, p. 1263). However, he uses this term without explicitly defining it. The term is focused on the technology itself, as is the contemporary term technostress creator. Therefore, like Benlian (2020), we borrow from general psychology (Lazarus and Folkman 1984), work psychology (Bakker and Demerouti 2007), and management literature (Kirmeyer 1988) and use the word "demand," which also appears in Tarafdar et al. (2007), Ragu-Nathan et al. (2008), Ayyagari et al. (2011), and Bakker and Demerouti (2007). Specifically, we use the term "digital work demands," which we define as job demands caused by working with digital technologies. According to Demerouti et al. (2001, p. 501), "job demands refer to those physical, social, or organizational aspects of the job that require sustained physical or mental effort and are therefore associated with certain physiological and psychological costs."

Combining the results of the literature review, expert interviews, and the focus groups, we define twelve digital work demands. These include uncertainty, insecurity, complexity, invasion, and overload from the technostress concept elucidated by Tarafdar et al. (2007) and Ragu-Nathan et al. (2008), supplemented by the demands of unreliability from Fischer and Riedl (2015) and Adam et al. (2017), role ambiguity and invasion of privacy from Ayyagari et al. (2011), and interruptions from Galluch et al. (2015). These latter demands are already used sporadically and separately in technostress literature but have not yet been included in an overall construct of technostress. Through our expert interviews and focus groups, we identified three new digital work demands not yet identified by the existing literature on technostress: performance control, nonavailability, and lacking a sense of achievement. Performance control is the perception of being constantly monitored and assessed. This is mainly caused by the increasing ability of modern technology to collect data and compare performance data among individuals.

Nonavailability is the perceived conflict between knowing how to fix problems or facilitate work processes by using new technology and not being able to do so because of organizational restrictions. Lacking a sense of achievement is the perception of not having made significant progress during one's work. This is mainly caused by perceived difficulty in assessing work already completed because of its digital and nonphysical nature. Table 3.3-3 summarizes all twelve digital work demands.

Demand	**Definition**
Invasion	Invasion "describes the invasive effect of [digital technologies] in terms of creating situations where users can potentially be reached anytime, employees feel the need to be constantly 'connected,' and there is a blurring between work-related and personal contexts" (Tarafdar et al. 2007, p. 311).
Overload	Overload "describes situations where [digital technologies] force users to work faster and longer" (Tarafdar et al. 2007, p. 311).
Complexity	Complexity "describes situations where the complexity associated with [digital technologies] makes users feel inadequate as far as their skills are concerned and force them to spend time and effort in learning and understanding various aspects of" digital technologies (Tarafdar et al. 2007, p. 311).
Insecurity	Insecurity "is associated with situations where users feel threatened about losing their jobs as a result of new [digital technologies] replacing them, or to other people who have a better understanding of" digital technologies (Tarafdar et al. 2007, p. 311).
Uncertainty	Uncertainty "refers to contexts where continuing changes and upgrades in an [digital technology] unsettle users and create uncertainty for them, in that they have to constantly learn and educate themselves about the new" digital technologies (Tarafdar et al. 2007, p. 311).
Unreliability	Unreliability describes situations in which individuals "face system malfunctions and other … hassles" with digital technologies (Fischer and Riedl 2015, p. 1462).
Role Ambiguity	Role ambiguity is associated with situations where "there is uncertainty as to whether an individual should expend his or her resources to perform the task requirements at work or to acquire new skills" (Ayyagari et al. 2011, p. 842).
Invasion of Privacy	Invasion of privacy refers to situations in which individuals "are becoming increasingly concerned that their privacy could be invaded by" digital technologies (Ayyagari et al. 2011, p. 841, based on Best et al. 2006).
Interruptions	Interruptions describe situations where individuals attention is shifted away from a current task by an external, digital-technology-based source (Galluch et al. 2015).
Performance Control	Performance control describes situations where individuals feel that digital technologies are used to monitor and assess their performance.
Nonavailability	Nonavailability refers to situations where individuals are impaired in their activities because digital technologies, which might facilitate or ease work processes, are unavailable due to organizational restrictions, safety, or monetary reasons.
Lacking a Sense of Achievement	Lacking a sense of achievement refers to situations where individuals feel that they hardly make work progress as completed tasks with digital technologies can be assessed poorly due to their digital, nonphysical nature.

Table 3.3-3: Definition of the Twelve Digital Work Demands

3.3.5 Quantitative Phase

The quantitative research phase assessed the identified twelve digital work demands from a positivist perspective. Specifically, we used cross-sectional survey data to test convergent, discriminant, and nomological validity. Along the way, we developed and validated a measurement instrument for digital work demands, demonstrated their prevalence, and identified a higher-order structure among these demands. The nomological net is a fundamental tool for understanding constructs and building theory. Cronbach and Meehl (1955, p. 294) state that "scientifically speaking, to make clear what something is means to set forth the laws in which it occurs. We shall refer to the interlocking system of laws that constitute a theory as a nomological network." This is done by embedding the construct of interest – in our case, the identified twelve digital work demands – in a nomological net with theoretically related entities and empirically testing these relationships.

3.3.5.1 Developing the Measurement Model

The measurement instrument used to assess the latent digital work demands is essential for quantitative investigation. For most of the digital work demands, validated survey scales exist. However, measurement instruments had to be developed from scratch for the newly revealed demands (i.e., nonavailability, performance control, and lacking a sense of achievement). Therefore, we followed the guidelines for developing and evaluating measurement instruments by Hinkin (1998) and MacKenzie et al. (2011). We give an overview of the steps suggested by MacKenzie et al. (2011) here and provide the details, including additional numbers for each step in Appendix 3.3.A.

Step 1: *Develop a conceptual definition of the construct*. This step was covered in Phase 1c of our mixed-methods study (see Table 3.3-3).

Step 2: *Generate items to represent the construct*. We used the validated measurement instruments from Ragu-Nathan et al. (2008) for overload, invasion, complexity, insecurity, and uncertainty, from Ayyagari et al. (2011) for role ambiguity, invasion of privacy, and unreliability, and Galluch et al. (2015) for interruptions. For the newly identified demands – nonavailability, performance control, and lacking a sense of achievement – we developed six items for each demand, based on the definitions of these constructs (Table 3.3-3) and considering standard guidelines (Hinkin 1998; MacKenzie et al. 2011; Podsakoff et al. 2003).

Step 3: *Assess the content validity of the items*. We performed a card-sorting exercise with 39 participants and revised the wording of the newly developed items where necessary.

Step 4: *Formally specify the measurement model*. We specified the measurement model as first-order reflective for each of the established scales as suggested by Ragu-Nathan et al. (2008) and for the newly developed scales. We allowed for correlation among the twelve demands. In a later step, we investigated whether there are higher-order structures among the demands.

Steps 5 & 6: *Collect data to conduct pre-test & scale purification and refinement*. We ran a pre-test with n_1 = 445 participants in an online survey (pre-test sample). For this sample and the two following samples (developmental, validation), participants were German workers recruited via an external panel provider. We performed an exploratory factor analysis (EFA) on data from the pre-test sample. For nonavailability and lacking a sense of achievement, the EFA revealed a lack of convergent validity triggering a rewording of some items.

Steps 7 & 8: *Gather data from new sample and reexamine scale properties*. Using the revised scales, we collected a new data set from a large-scale study with 4,560 respondents participating in an online survey. The sample was recruited via the same external research panel as the pre-test. Respondents were paid 3.70 USD / 3.10 EUR for their participation. We randomly split our study population into a subset for developmental purposes (developmental sample; n_2 = 1,560) and a subset for validation purposes (validation sample; n_3 = 3,000). Steps 7 and 8 were performed on the developmental sample to reassess scale properties, while all consecutive steps were performed on the validation sample. A confirmatory factor analysis (CFA) showed a good fit. Likewise, standard thresholds for discriminant and convergent validity were met. Further, Cronbach's alpha showed satisfactory values for the twelve demands from digital work. Details on the numbers are presented in Appendix 3.3.A.

MacKenzie et al. (2011) mention that Step 8 should also examine the extent to which a multidimensional structure is present, as we already pointed out in our fourth step. We thus move discussion of Steps 8 and 9 to the following subsections, where we describe how we used the developmental sample (n_2 = 1,560) to investigate the structure of the twelve demands. Next, we employed the new data from the validation sample (n_3 = 3,000) to reassess scale validity, select among the potential structures of the demands, and embed the final structure in a nomological net. We omitted Step 10 (norm development), as it is not relevant for our research questions.

Overall, these steps suggested by MacKenzie et al. (2011) led us to a validated measurement instrument for all twelve digital work demands. Details on these steps are provided in Appendix 3.3.A. The final scales are given in Appendix 3.3.B.

3.3.5.2 Identification of the Structure

The definitions and the high number of digital work demands suggest that they may not all be completely unrelated. For example, acute demands such as interruptions and unreliability might be grouped, as might more chronic demands such as insecurity and uncertainty. Similarly, invasion of privacy and performance control both involve collecting or accessing personal data by third parties – the first focuses on the private life and the second focuses on the working life.

Thus, on theoretical grounds, there is no reason to believe that the demands are unrelated (we therefore used oblique rotation in the EFA for developing the measurement model, Step 6). Furthermore, the above reasoning also suggests that there might be a higher-order structure at play. Understanding the underlying structure is desirable because it leads to stronger theory. Weber (2012) discusses a trade-off between parsimony and a theory's predictive and/or explanatory power and recommends, referring to the work of Miller (1956), that there should be no more than seven constructs, in order to reduce complexity to a manageable level. Accordingly, we sought to condense our twelve digital work demands into a few higher-order factors in order to highlight their interrelations.

The four different possible models identified by Rindskopf and Rose (1988) for such structures are illustrated in Figure 3.3-2 using three factors and five items rather than the twelve factors and three to five items that we have. From prior literature (e.g., Ayyagari et al. 2011; Ragu-Nathan et al. 2008; Tarafdar et al. 2007) and our parallel and MAP analyses in the development of the measurement model (Step 6), we know that the structure of digital work demands does not correspond to the one-factor model. Prior research such as Tarafdar et al. (2007) and Ragu-Nathan et al. (2008) assume a model with one reflective second-order factor while Ayyagari et al. (2011) assume a model of correlated group factors. Given that we are dealing with a rather high number of twelve digital work demands, the question arises whether the model of correlated group factors is most appropriate or whether a second-order model or a bi-factor model might be a better fit. The factor analysis presented so far provides us with an understanding of the structure of the twelve correlated group factors. Thus, we empirically explored the second-order model and bi-factor model on the developmental sample (n_2 = 1,560) and then used the validation sample (n_3 = 3,000) to select the best model for the new data.

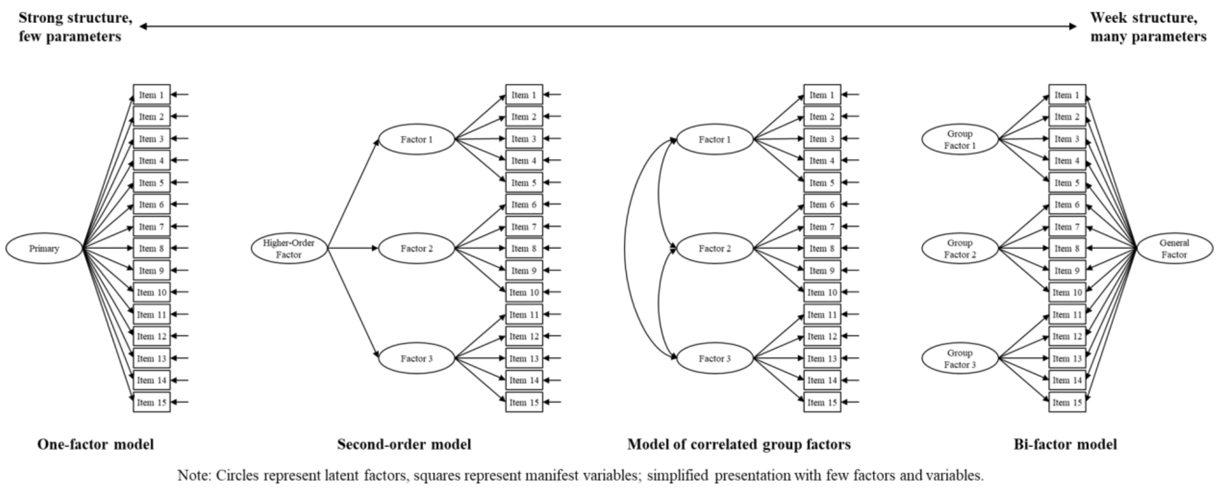

Figure 3.3-2: Possible Models Based on Rindskopf and Rose (1988)

Extracting the twelve demands in an EFA with oblique rotation on the data from the developmental sample yielded high correlations between 0.27 and 0.75 (see Appendix 3.3.A), suggesting a potential second-order structure, and a multilevel exploratory factor analysis run on the developmental sample revealed a possible higher-order structure (Navruz et al. 2015). We first applied an EFA with twelve predefined factors. The correlations of the factor score estimates were extracted and used as input to run another EFA (principal axis factoring with oblique rotation). Parallel analysis suggested four or five factors; for the fifth factor, the eigenvalue comparison between actual and simulated data showed only a marginal difference. Thus, we extracted five factors in an EFA similar to that run previously and inspected the loadings. For the fifth factor, the maximum loading of any of the first-order factors was 0.37, below the conventional threshold of 0.4 necessary to consider it a major loading. Hence, we decided to drop the fifth factor and extracted four factors in an EFA with oblique rotation (Table 3.3-4).

Construct	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**
Complexity	0.51			
Invasion	0.41			
Nonavailability	0.51			
Lacking a Sense of Achievement	0.79			
Role ambiguity	0.75			
Interruptions		0.41		
Overload		0.56		
Unreliability		0.46		
Insecurity			0.83	
Uncertainty			0.56	
Invasion of Privacy				0.88
Performance control				0.69

Note: Loadings < 0.4 are not displayed.

Table 3.3-4: Factor Loadings for Four Second-Order Factors

This resulted in a desirable loading matrix with each first-order factor loading highly on exactly one second-order factor (loadings ranging from 0.413 to 0.884 all exceeding the 0.4 threshold). The matrix revealed no major cross-loading (maximum is 0.36 and no cross-loading greater than half of the loading on the respective other factor). Moreover, each second-order factor was relevant in the sense that at least one first-order factor loaded high on it. Table 3.3-5 presents definitions, and explanations for the four higher-order digital work demands we identified: impediment, interference, constant change, and exposure.

Higher-Order Digital Work Demand	Definition	Explanation
Impediment	Impediment describes the digital work demands from complexity, invasion, nonavailability, lack of sense of achievement, and role ambiguity.	During a workday, different activities must be carried out to achieve the objectives associated with the work role. However, the (steady) presence or absence of digital technologies may contribute to the perception that making progress in achieving the objectives is more complicated in digital work than nondigital work.
Interference	Interference describes the digital work demands arising from interruptions, overload, and unreliability.	Digital technologies aim to support the handling of tasks in everyday work by facilitating communication and collaboration with others and accomplishing activities. However, digital technologies can also foster the perception that task execution is prolonged due to incidents occurring during the direct interaction with the technologies or interferences caused by third parties using technologies.
Constant Change	Constant change describes the digital work demands arising from insecurity and uncertainty.	New digital technologies and technology-related work routines lead to higher demands of building up the necessary skills and abilities to carry out work-related tasks or cause job requirements not to be fulfilled due to incorrect or inefficient use of digital technologies.
Exposure	Exposure describes the digital work demands from invasion of privacy and performance control.	The use of digital technologies leaves digital trace data with varying visibility. The increasing use of connected digital technologies enables easier access and simplified processing of these data and may foster the perception that information about persons from different contexts and sources is provided to third parties.

Table 3.3-5: Explanation, Definition, and Interpretation of Higher-Order Factors

Although the bi-factor model might best describe the interrelation of digital work demands, the bi-factor model has the weakest structure of the models considered here, consisting of one general factor (shown on the far right side of Figure 3.3-2) and multiple group factors. In a bi-factor model, each item loads onto a general factor that represents the individual differences in the target dimension in which the researcher is most interested (in our case technostress). The bi-factor model also specifies two or more group factors that are orthogonal to the general factor (Dunn and McCray 2020), which are common factors measured by multiple items that explain variance not reflected in the general factor. We ran an EFA using the bi-factor approach suggested by Jennrich and Bentler (2011) to extract a general factor and twelve group factors. All items loaded highly on the general factor. For each of the group factors, at least half of the items related to the respective first-order demand loaded on the group factor.

3.3.5.3 Selection and Validation

We used the second subsample (validation sample, n_3 = 3,000) and covariance-based structural equation modeling to determine which structure of digital work demands fit best and then embedded it in a nomological net. Table 3.3-6 characterizes the sample with respect to demographics and work-related factors. Appendix 3.3.C lists the psychometric properties of our scales for digital work demands. We added two outcome-related constructs to the survey to assess nomological validity: exhaustion and job satisfaction, defined as the extent to which an employee likes his or her work. Exhaustion was measured with nine items (Maslach and Jackson 1986) and job satisfaction was measured with six items (Agho et al. 1992).

Gender	**N**	**%**	**Employment**	**N**	**%**
Male	1,623	54	Full-Time (> 20 h)	2,886	96
Female	1,377	46	Half-Time (< 20 h)	114	4
Age	**N**	**%**	**Technology Use**	**N**	**%**
< 25	108	4	Never	0	0
25-34	704	23	Seldom	0	0
35-44	815	27	Weekly	192	6
45-54	766	26	Daily	330	11
55-64	593	20	Several times a day	2,478	83
> 65	14	< 1			
Education				**N**	**%**
Primary / lower secondary school graduation certificate				49	2
Intermediate school graduation certificate				360	12
Higher education entrance qualification				310	10
Apprenticeship				985	33
University degree (bachelor’s)				491	16
University degree (master’s)				694	23
Doctorate				111	4

Table 3.3-6: Demographic Properties of the Validation Sample (n_3 = 3,000)

We conducted Harman’s single factor test and applied a correlational marker technique as a post hoc test for common-method bias (CMB) (Richardson et al. 2009). Both analyses suggest that CMB is not a serious threat for our data (details in Appendix 3.3.C).

We evaluated the model fit according to standard fit measures like RMSEA and SRMR for global measures, CFI, TLI, and NFI for incremental measures, and AGFI to assess model parsimony (Gefen et al. 2000; Lei and Wu 2007). We do not report χ^2 or χ^2/df, as these are not considered meaningful for samples of our size. The results are displayed in Table 3.3-7.

Fit Measures		**Threshold**	**Source of Threshold**	**Second-Order Model**	**Model of Correlated Group Factors**	**Bi-Factor Model**
Global measures	RMSEA	< 0.06	Lei and Wu (2007)	0.050 ✓	0.048 ✓	0.063 X
	SRMR	< 0.05	Gefen et al. (2000)	0.049 ✓	0.044 ✓	0.126 X
Incremental measures	NFI	> 0.90	Gefen et al. (2000)	0.926 ✓	0.932 ✓	0.889 X
	TLI	> 0.90	Gefen et al. (2000)	0.930 ✓	0.934 ✓	0.888 X
	CFI	> 0.90	Gefen et al. (2000)	0.934 ✓	0.940 ✓	0.897 X
Parsimony	AGFI	> 0.80	Gefen et al. (2000)	0.866 ✓	0.872 ✓	0.830 ✓

Note: ✓ indicates that a threshold is met, X indicates that it is not met.

Table 3.3-7: Fit Measures for the Different Model from a CFA on the Validation Sample (n_3 = 3,000)

Our results reveal that the data do not adequately fit the bi-factor model but fit both the second-order and the correlated group factors model reasonably well. Despite marginally better fit values for the model of correlated group factors, we adopted the second-order model of digital work demands because it has a stronger structure with fewer parameters and is parsimonious. Parsimony is generally considered to be a beneficial characteristic of theoretical models (Popper 2005). Further, such second-order conceptualization is in line with the seminal contributions by Tarafdar et al. (2007) and Ragu-Nathan et al. (2008). However, in contrast to Tarafdar et al. (2007) and Ragu-Nathan et al. (2008), given our broader set of digital work demands, we identified four rather than one second-order factor: namely, *impediment*, *interference*, *constant change*, and *exposure*.

Next, we embedded the second-order model in a nomological net. Based on prior literature, we decided to investigate job satisfaction and exhaustion as consequences of digital work demands (Gaudioso et al. 2015; Tarafdar et al. 2010). Like Tarafdar et al. (2007) and Ragu-Nathan et al. (2008) we assumed that they are affected not by first-order demands but by second-order demands. We embedded sex, age, and frequency of technology use for the execution of work tasks as relevant control variables in the model.

We hypothesize that the steady presence or absence of digital technologies might lead to less satisfying work results and frustration – for example, when a task could be easily completed with technology not available at work. For this reason, we expect the second-order factor of impediment to have a negative effect on job satisfaction (H1a) and a positive effect on exhaustion (H1b). Feeling hampered in completing one's own tasks by digital technologies is mentally draining and prolongs the completion of tasks. Thus, we hypothesize a negative relationship between the second-order factor of interference and job satisfaction (H2a) and a positive effect between interference and exhaustion (H2b). We also expect that a decreasing reliance on existing skills coupled with the constant need to keep skills up to date may be exhausting. Thus, we hypothesize that the second-order factor of constant change negatively affects job satisfaction (H3a) and positively affects exhaustion (H3b). Finally, we assume that feeling constantly monitored or fearing that information could be provided to third parties makes for an unpleasant work environment. Thus, we hypothesize a negative relationship between the second-order factor of exposure and job satisfaction (H4a) and a positive effect between exposure and exhaustion (H4b).

These hypothesized negative effects of technostress on job satisfaction and exhaustion are in line with prior theorizing and empirical evidence (e.g., Boonjing and Chanvarasuth 2017; Fieseler et al. 2014; Gaudioso et al. 2015; Tarafdar et al. 2010; Tu et al. 2008). Regarding the three control variables, we assume that age is positively related to job satisfaction and negatively related to exhaustion because of higher coping skills and more accumulated work experience among older workers compared to younger ones (Fritzsche and Parrish 2005; Hsu 2018). While prior research suggests almost no gender difference in job satisfaction (Fritzsche and Parrish 2005), women are more likely to experience exhaustion than men (Rubino et al. 2013). Given the highly ambivalent characteristics of technology and its use, ranging from higher levels of flexibility to dilution of the boundaries between work and private life, we assume no effect of technology use on either job satisfaction or exhaustion (Sandoval-Reyes et al. 2019).

We used covariance-based structural equation modeling (CB-SEM) to test the resulting model. The model fit the data from the validation sample well. NFI, TLI, and CFI (NFI = 0.91, TLI = 0.92, CFI = 0.92) showed good values, as did RMSEA and SRMR (RMSEA = 0.05, SRMR = 0.05) for the incremental fit and AGFI for the parsimony of the model (AGFI = 0.88). The analysis showed that all first-order factors loaded on their assumed second-order factor with loadings ranging between 0.65 and 0.94 (Figure 3.3-3). Out of the three control variables, we observed a significant effect of age on job satisfaction ($\beta = 0.14$, $z = 7.38$, $p < .001$) and of gender on exhaustion ($\beta = -0.06$, $z = -3.90$, $p < .001$). There were no statistically significant effects (at the 5 % level) of technology use on either of the dependent variables.

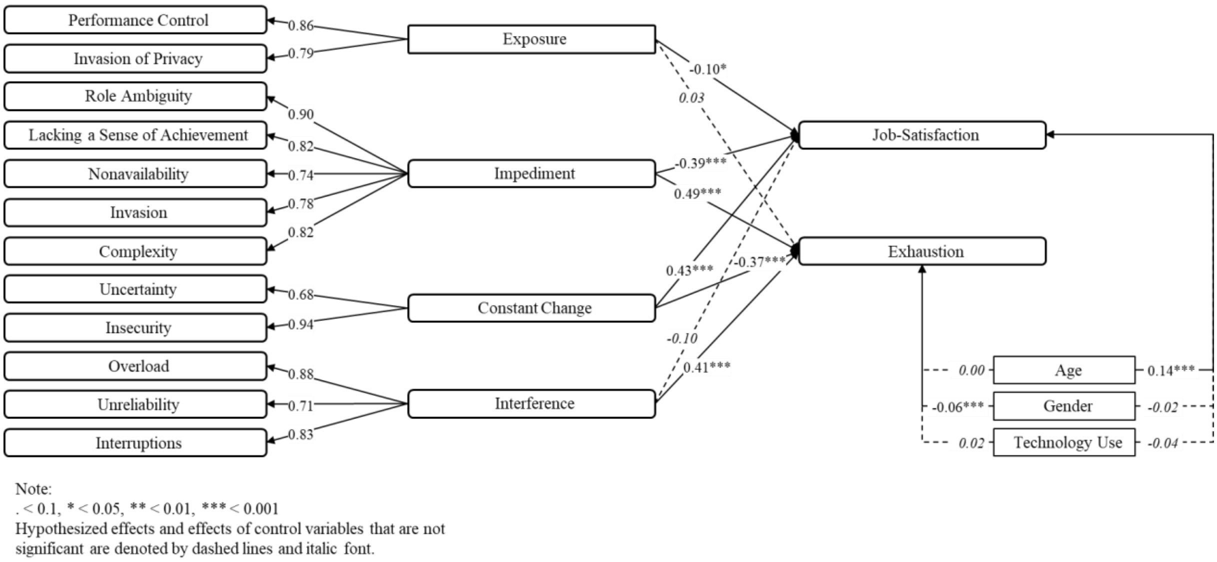

Figure 3.3-3: Nomological Net of Digital Work Demands and their Consequences

Regarding the hypothesized effects of the second-order demands from digital work, our results show that impediment ($\beta = -0.39$, $z = -4.78$, $p < .001$) and exposure ($\beta = -0.10$, $z = -2.29$, $p = .020$) negatively relate to job satisfaction whereas constant change is positively associated with job satisfaction ($\beta = 0.43$, $z = 6.90$, $p < .001$). The relationship between interference and job satisfaction is not significant. Thus, H1a and H4a are supported by the data, while H2a and H3a are not supported. Impediment is also positively associated with exhaustion ($\beta = 0.49$, $z = -7.06$, $p < .001$), as is interference ($\beta = 0.41$, $z = 4.55$, $p < .001$). Further, constant change ($\beta = -0.37$, $z = -7.14$, $p < .001$) is negatively related to exhaustion, and the relationship between exposure and exhaustion is not significant. Therefore, H1b and H2b are supported by the data, while H3b and H4b are not supported. Overall, this analysis shows that the newly identified digital work demands and their structure of four second-order demands are well-integrated with relevant and well-known consequences of stress at work.

3.3.6 Discussion

This paper seeks to provide a contemporary perspective to the established research stream of psychological stress caused by working with digital technologies. The context of work has changed substantially under the umbrella term of digital transformation (Vial 2019). We follow recent calls to update the understanding of digital work demands that cause stress (Fischer et al. 2019; Tarafdar et al. 2019a) and address broader calls for contextualizing theories in IS research (Hong et al. 2014). We united nine different digital work demands found in prior research in a single model. Based on qualitative interviews and focus groups, we identified three novel digital work demands and added them to the model: nonavailability, performance control, and lacking a sense of achievement. In a series of quantitative survey-based studies, we discerned four higher-order digital work demands (exposure, impediment, constant change, interference).

Although stress is individual and situational, with demands differing over time and between individuals, the ranking of average digital work demands based on intensity reported by the 3,000 employees from the validation sample is informative (Table 3.3-17). In terms of aggregate values, employees perceive the strongest demands from the two first-order constructs related to exposure: performance control and invasion of privacy. This indicates that employees are deeply concerned about how their data are handled within the company. The high intensity of perceived performance control shows the relevance of the addition of this new factor to the repertoire of digital work demands. While the second and third strongest demands, invasion of privacy (Ayyagari et al. 2011) and unreliability (Adam et al. 2017; Fischer and Riedl 2015), have been previously discussed as technostress creators, they had not yet been integrated in an overarching framework along with the five classical technostress creators identified by Tarafdar et al. (2007) and Ragu-Nathan et al. (2008). The strong perception of these demands highlights the need for an integrated consideration of all the different digital work demands. Overall, our ranking shows that the newly identified and integrated digital work demands do not lag behind the classical ones. Thus, extending the set of demands to a contemporary work context reduces parsimony but adds important facets needed to understand the psychological demands currently caused by digital work.

Considering specifically the nomological validity of the higher-order factors, four of eight hypotheses were in line with our expectations: higher impediment correlates with less job satisfaction and more emotional exhaustion. Thus, the steady presence or absence of digital technologies plays a significant role in assessing important aspects of occupational and health outcomes. Further, interference is positively associated with exhaustion; therefore, being hampered by digital technologies in completing tasks can be assumed to be mentally draining. Finally, exposure is negatively associated with job satisfaction, and the awareness of potentially being monitored during work contributes to an unpleasant work environment.

Beyond these expected findings, some of our results seem counterintuitive. Contrary to our expectations, the second-order factor of constant change correlates with higher job satisfaction and less employee exhaustion. A motivational effect may serve as a possible explanatory mechanism. In the transactional stress model (Lazarus and Folkman 1984), the third kind of stress appraisal is "challenge." It has much in common with threat appraisal, as it also activates coping resources, but it also has a motivational aspect. This form of appraisal focuses "on the potential for gain or growth inherent in an encounter and …[is] characterized by pleasurable emotions such as eagerness, excitement, and exhilaration" (Lazarus and Folkman 1984, p. 33). This aspect of technostress was also acknowledged by Tarafdar et al. (2019a), who invoked the question of "how and why individuals appraise IS as challenging or thrilling, experience consequent 'good' stress, and are faced with positive outcomes" (Tarafdar et al. 2019a, p. 14). Benlian (2020) also found technology-driven challenges along with technology-driven hindrance demands. The factor constant change comprises uncertainty and insecurity. If employees feel that they lack the competence to handle digital technologies, it could motivate them to learn. If one invests time and effort to learn and is successful in that endeavor, it could lead to satisfaction and, consequentially, reduce exhaustion.

Inferences from the qualitative strand of our mixed-methods approach led us to a broad set of digital work demands that could be combined into a unified model. Inferences from the quantitative study show that all twelve digital work demands exist, are distinct, and interpretable. Following the developmental purpose of our mixed-methods approach, the meta-inference is that there are twelve demands from digital work. This answers our first research question. Based on this result, a further inference from the quantitative strand is the second-order structure, which answers our second research question.

3.3.6.1 Advancing the Concept of Technostress to Digital Stress

Arguably, the last fifteen years brought about a substantive change in the nature, pervasiveness, and use of technologies at work. Contemporary digital work is different from former IT-based work (Colbert et al. 2016). This created a new work context. Given the substantial transformation of work and the novel perspective of digital work demands, one may reconsider the concept of technostress itself. As mentioned above, the term "technostress" was introduced in 1982 when the internet was still in its infancy. Since then, the definition has been revised and expanded over time (see Table 3.3-8). All of these definitions focus on the user's inability to deal with technology adequately, and some of them even seem to "throw the burden of technostress onto the users" (Sellberg and Susi 2014, p. 200). However, some dimensions of technostress do not concern the user's (in)capability to use technology adequately. For example, technology-induced stress can occur because of system malfunctions or a lack of appropriate technologies available to accomplish a task. The latter demand is caused not by using digital technologies but by not using them. Likewise, job insecurity is not linked to technology use by the stressed person but to the concern of losing one's job and not being asked to use technology. To account for these dimensions of technology-related stress, a broader definition of technostress is needed. Furthermore, even though the definition of technostress has been revised and expanded over time, the terminological and theoretical framework is closely related to its period of origin. Since this period, technology, its use, and perception have changed drastically. While the internet has become a universal source of information, new additional digital technologies like mobile computing, social media (Chiappetta 2017), cloud computing, advanced analytics, artificial intelligence, and the internet of things have found their way into digital work. Therefore, because of its constricting definition, as well as a changing perceptions about and interactions with technologies, "the term of technostress acquires a new meaning" (Chiappetta 2017, p. 359). There are good reasons to go beyond Chiappetta's (2017) redefinition of technostress and use the term "digital stress" instead.

Technostress	
Source	**Definition**
Brod 1984, p. 16	Technostress is a "modern disease of adaptation caused by an inability to cope with new computer technologies in a healthy manner."
Arnetz and Wiholm 1997, p. 36	Technostress is a "state of mental and physiological arousal observed in certain employees who are heavily dependent on computers in their work."
Weil and Rosen 1997, p. 5	Technostress is "any negative impact on attitudes, thoughts, behaviors, or body physiology that is caused either directly or indirectly by technology."
Tarafdar et al. 2007, p. 304	"Technostress, therefore, is one of the fallouts of an individual's attempts and struggles to deal with constantly evolving [digital technologies] and the changing cognitive and social requirements related to their use."
Ragu-Nathan et al. 2008, p. 418	Technostress "is stress experienced by individuals due to the use of ICTs."
Wang et al. 2008, p. 3004	"In summary, we define technostress as a reflection of one's discomposure, fear, tenseness and anxiety when one is learning and using computer technology directly or indirectly that ultimately ends in psychological and emotional repulsion and prevents one from further learning or using computer technology."
Salanova et al. 2013, p. 423	Technostress is a "negative psychological state associated with the use or threat of digital technology use in the future."
Tarafdar et al. 2019a, p. 7	Technostress is "stress that individuals experience due to their use of Information Systems."
Califf et al. 2020, p. 812	"Technostress is conceptually defined as 'a modern disease of adaptation caused by an inability to cope with new computer technologies in a healthy manner' (Brod 1984, p. 16). In IS research, technostress is composed of five dimensions. These dimensions are collectively known as technostressors, which are considered harmful stressors that induce deleterious individual and workplace outcomes (Tarafdar et al. 2007; Tarafdar et al. 2017). [...] The five technostressors are techno-overload, techno-invasion, techno-complexity, techno- insecurity, and techno-uncertainty (Ragu-Nathan et al. 2008)."

Digital Stress	
Source	**Definition**
Hefner and Vorderer 2016, p. 237	Digital stress has been defined as the "stress resulting from a strong and perhaps almost permanent use of information and communication technology… that is triggered by permanent access to an inconceivable amount and diversity of (social) content."
Weinstein and Selman 2016, p. 392	Digital stress is "stress related to [...] digital social lives."
Reinecke and Oliver 2016, p. 6	Digital stress is defined as "stress reactions elicited by environmental demands originating from digital technology use."
Fischer and Riedl 2020, p. 219	"Digital stress is a form of stress, which is caused by interaction with information and communication technologies and by their omnipresence in economy and society."

Table 3.3-8: Exemplary Definitions of Technostress and Digital Stress

Even though these terms may seem interchangeable, we believe they differ from each other in important ways. As mentioned above, technostress is often defined rather narrowly by focusing on the use of digital technologies, oftentimes in a work context. Instead, digital stress has a broader general meaning. Fischer and Riedl (2020) emphasize the use of digital stress beyond the workplace context by defining digital stress as "a form of stress caused by interaction with information and communication technologies and by their omnipresence in economy and society." The term digital stress is broader because it terminologically includes digitalization at large as a source of stress rather than focusing only on technologies. In this, we consider digitalization to be a sociotechnical phenomenon and view the processes of adopting and using digital technologies in broader individual, organizational, and societal contexts (Legner et al. 2017). Further, by being less technology-centric than the term technostress, digital stress better represents the fact that it is not the technology alone that creates stress but rather our individual and collective use of and perspectives on technology. In addition, several definitions of technostress (e.g., Salanova et al. 2013; Tarafdar et al. 2007) focus on use, yet use is not required for stress to emerge when considering the nonavailability of needed technologies or the threat of losing one's job to new technologies (techno-insecurity, Ragu-Nathan et al. 2008; Tarafdar et al. 2007).

In summary, digital stress contains all aspects of the technostress concept while also including further aspects of technologically induced stress that have arisen in the course of digitalization. Interactions with information and communication technologies, for example, comprise both the role of the user and the role of (unreliable or nonavailable) technology. In addition, Steele et al. (2020) attribute an essential role to digital stress when trying to understand how digital media, in general, and social media, in particular, affect adolescents and young adults. Against this background, Weinstein and Selman (2016) identify several digital demands, such as the pressure to comply or public shaming and humiliation, by investigating the private use of digital media by adolescents.

Furthermore, by adopting the broader digital stress concept, we see an opportunity to terminologically unite the multidisciplinary research field of technology-induced stress. Currently, “the use of numerous terminologies for similar or identical constructs complicates the literature” (Steele et al. 2020, p. 18). Focusing on a single term that includes the research aspects of both private and work life spanning user ages ranging from the very young to the elderly would prevent obscuring results among studies and therefore make it easier to bring together the results of different disciplines and to understand the phenomenon of digital stress in its entirety (Steele et al. 2020). The nomenclature of digital stress could unify different terminologies used in the literature and integrate new phenomena and contemporary work practices relating to digital technologies that cause stress.

Considering prior definitions of technostress and digital stress along with general definitions of stress (Lazarus and Folkman 1984; Selye 1973), we define digital stress as the physiological, emotional, and/or cognitive reaction of an individual to an imbalance between the demands directly or indirectly imposed on the individual through interactions with digital technologies and the available resources and coping measures available to meet these demands. These demands result either directly from the use of digital technologies by the individual, indirectly through the digital technologies themselves, or from the use of digital technologies by third parties. For digital technologies, we adapt the definition from Bharadwaj et al. (2013, p. 471), who define them as “combinations of information, computing, communication, and connectivity technologies.” While the given definition comprises digital stress within both private and work contexts, our empirical analysis focuses solely on digital stress encountered in the work context.

3.3.6.2 Implications for Theory and Research

Our research evaluates the current concept of technostress and its creating factors in the context of contemporary digital work practices. The capabilities, availability, and use of digital technologies at work have considerably expanded and changed over the last ten to fifteen years. The interdependence of communication and information channels and the availability of new technologies have given rise to novel use cases and interaction forms through and with technologies. Our research aligns with Tarafdar et al. (2019a, p. 7) who suggested that stress induced by digital technologies is a continually evolving phenomenon with ongoing digitalization.

Further, we answer Fischer et al.'s (2019) question of whether the measurement instrument of technostress is still up to date. Against this background, our research makes the following four contributions.

First, we present a holistic set of the most important digital work demands. Nine of these twelve demands have been previously considered in technostress literature, e.g., Tarafdar et al. (2007), Ragu-Nathan et al. (2008), Ayyagari et al. (2011), and Galluch et al. (2015). Further, we added three additional digital work demands that tax or potentially exceed workers' resources, creating stress: nonavailability, performance control, and lacking a sense of achievement. We combined all twelve of these demands in a single unified model. A large body of research in IS and related disciplines is currently focused on stress appraisal (e.g., Benlian 2020; Califf et al. 2020), stress coping (e.g., Pirkkalainen et al. 2019; Tarafdar et al. 2019b), stress outcomes (e.g., Chen et al. 2019; La Torre et al. 2020), and the design of stress-sensitive systems (e.g., Adam et al. 2017; Jimenez and Bregenzer 2018). When stress from digital work is of concern, such endeavors should consider using our unified and updated conceptualization.

Second, empirical evidence and theoretical reasoning bring to light a higher-order structure with four second-order demands from digital work. Prior research has already considered higher-order models (e.g., Tarafdar et al. 2007; Ragu-Nathan et al. 2008; and research building on these articles), suggesting a single unitary second-order factor. In contrast, given the context of contemporary work practices, our substantially broader conceptualization of digital work demands and our large empirical samples identify the structure as multifaceted. Hence, we introduce the new second-order demands of impediment, interference, constant change, and exposure. By adding much needed further dimensions and expanding the concept of technostress from five to twelve dimensions, this hierarchical structure adds depth to the understanding of the increasing complexity of digital stress and identifies links between its dimensions. We encourage fellow researchers to not only solely investigate the twelve dimensions of technostress, but also consider these higher-order demands to understanding technostress on a larger scale and develop preventive and reactive measures against it.

Third, we suggest evolving the concept of technostress to digital stress. We expect that this suggestion is controversial. One of the manifold potential objections could be that terming anything as "digital" is a fad that will fade. It might be considered meaningless transient wording. Second and more concerning, some might fear a discontinuity in the well-established (IS) research stream on technostress. We partially share these concerns. Yet, because of its broader definition, a theory of digital stress as an extension of technostress can consider more aspects of modern private and professional use of technology by individuals over the complete human lifespan. Thus, this theory of digital stress may contribute to terminologically uniting the multidisciplinary research field of technology-induced stress. Future research should engage with the concept of digital stress, to challenge and evolve the definition provided here and develop the nomological net surrounding it in various contexts.

Fourth, we created and validated survey-based measurement scales for newly identified constructs. Further, we validated the compatibility and delineation of these scales with established digital work demands. These scales could be used in future research to measure digital work demands.

3.3.6.3 Implications for Practice

Our findings contribute to managerial practice in two ways. First, we raise awareness of the broader categories of stress that arise from the individual and collective use of digital technologies and go beyond the established concept of technostress. Especially given that companies, politics, and the public, are trying to keep up with the increasing digitalization and all its expected benefits, it is important to emphasize potential negative effects associated with digitalization because these effects can only be inhibited or prevented if they are known.

Second, we go beyond raising awareness and offer a psychological risk assessment tool for the workplace context. With the help of our measurement instrument for digital stress exposure, companies can determine which of the twelve digital work demands are most relevant for their employees. Based on company-specific assessment, specific measurements for prevention or counteraction could be developed and implemented either for the entire company or for specific employee groups experiencing high levels of digital stress.

3.3.6.4 Evaluation and Limitations

According to the classification of Gregor (2006), our conceptualization of demands and digital stress constitutes a type IV theory for explaining and predicting. We propose that digital stress is a physiological, emotional, and/or cognitive reaction of an individual to an imbalance between the demands directly or indirectly imposed on the individual through interaction with digital technologies and the available resources and coping measures. Digital stress in the work domain arises primarily from twelve demands of digital work combined in a hierarchical structure of four second-order demands: impediment, interference, constant change, and exposure. Each of these constructs is associated with job satisfaction and exhaustion. According to Weber (2012), we suggest evaluating our theoretical contribution, as shown in Table 3.3-9.

Criterion	Summary Evaluation
Parts	
Constructs	We deduced the constructs from literature, qualitative interviews, focus groups, and quantitative survey data according to our mixed-methods approach. We provided definitions for all constructs: digital technologies, digital work (Section 3.3.2), digital work demands (Section 3.3.4.3), twelve specific first-order digital work demands (Table 3.3-3), four specific second-order digital work demands (Table 3.3-5), job satisfaction and exhaustion (Section 3.3.5.3), digital stress, and digital work stress (Section 3.3.6.1). The boundary condition for the demands and their consequences is digital work. The demands and their consequences apply to the individual worker level.
Associations	We show and empirically tested the associations of all constructs. The demands originate from digital work and affect job satisfaction and exhaustion. The first-order demands are consolidated to second-order demands as shown in Figure 3.3-3.
States	Digital work demands, job satisfaction, and exhaustion each have a continuous state space. While typically there will be correlations (or nonlinear associations) of the state, theoretically, any combination of individual states is possible.
Whole	
Importance	Excessive digital stress leads to negative humanistic (e.g., reduced satisfaction, well-being, health) and instrumental outcomes (e.g., increased exhaustion, increased job turnover). Since not only the sheer number and functionalities of digital technologies have enormously increased in the last ten to fifteen years but also the interaction with these technologies has considerably changed due to availability, a changed individual and social view of technologies, and expectations regarding digitalization, the concept of technostress needed a review.
Novelty	While technostress is already an extensively researched concept, we unite disparate perspectives on demands, add three new digital work demands, and reveal their higher-order structure. Further, we suggest adopting the concept of digital stress.
Parsimony	The empirical studies show that the reduction of parsimony compared to prior conceptualizations of technostress brings the benefit of capturing the important demands from contemporary work practices. The second-order structure provides parsimony.
Level	Our contribution resides on the mesolevel.
Falsifiability	As we clearly defined the constructs and associations and provide measurement instruments for all constructs, our model can be subjected to further empirical tests. Thus, it can be falsified.

Table 3.3-9: Evaluation of our Contribution to Digital Stress Theory according to Weber's (2012) Guidelines

Our research has a few limitations. First, our sample in the qualitative study is not representative of all employees. We collected qualitative data from 61 individuals in expert interviews and focus groups but did not select the individuals based on representativeness. Second, in our conclusions drawn from the qualitative data, we did not consider whether participants represented a larger industry or employee group in the working world but took all of their statements equally into account. However, following a mixed-methods approach and combining qualitative and quantitative research strands likely mitigated any potential problems related to these issues because our qualitative results were tested in a large-scale quantitative analysis. Third, we collected the quantitative data with the help of online surveys providing financial incentives. Typical weaknesses of this method, such as self-selection of the population, nonresponse, and questionable reliability of expressed opinions (Nayak and Narayan 2019), should be considered when interpreting our results. Fourth, our three newly identified digital work demands –

nonavailability, lacking a sense of achievement, and performance control – were tested using multiple large data sets based on employees in Germany. Future work should seek to validate our results in other economic and cultural backgrounds. Finally, we embedded the digital work demands in a nomological net with job satisfaction and exhaustion. Some hypotheses were not supported and, in two cases, a significant effect of demands on outcomes was observed in the direction opposite from that hypothesized. Future research should delve deeper into these surprising relationships and consider the second-order demands with regard to further consequences (e.g., appraisal, coping behavior) and moderators of the demand-outcome relationship (e.g., resources such as individual characteristics).

3.3.7 Conclusion

Digitalization is one of the most significant sociotechnical challenges of modern humankind; it has tremendously transformed work practices and altered the demands placed on employees. Our research contributes to understanding these new demands in the age of digital work and thus lays the foundation for further research regarding antecedents, appraisal, coping, outcomes of digital stress, and the design of social, technical, and sociotechnical systems seeking to limit excessive stress and its negative consequences.

3.3.8 References

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3.3.9 Appendix

Appendix 3.3.A. Development and Validation of Measures

For the development and validation of measures, we followed two different processes depending on the prerequisites. If possible, the use of existing measures is recommended (Urbach and Ahlemann 2010). In the case of new constructs without existing measures, we followed the guidelines formulated by Hinkin (1998) and MacKenzie et al. (2011). Therefore, the following passages are structured according to the steps recommended by MacKenzie et al. (2011).

Step 1: *Develop a conceptual definition of the construct*

The first step is to define the constructs conceptually and to discuss “how the construct differs from other related constructs” (MacKenzie et al. 2011, p. 298). This step has been covered in Phase 1 of our mixed-methods study. The qualitative investigations concluded with a definition of twelve digital work demands, as presented in Table 3.3-3 within the research article.

Step 2: *Generate items to represent the construct*

For existing scales, we collected the items from Ragu-Nathan et al. (2008) (i.e., invasion, overload, complexity, insecurity, and uncertainty), Ayyagari et al. (2011) (i.e., unreliability, role ambiguity, and invasion of privacy), and Galluch et al. (2015) (i.e., interruptions). The items were slightly adapted. For example, instead of the wording “technology” or “ICT”, we consistently used the term “digital technology and media”. The items were collected in English and then translated into German since the survey’s final sample consisted of German employees. Therefore, two bilingual speakers translated the questions in parallel. They met afterward to discuss discrepancies with a third bilingual speaker and agree on the most suitable translation. A fourth bilingual speaker back-translated the items into English again and checked the semantic equivalence.

For the newly identified demands, nonavailability, performance control, and lacking a sense of achievement, we developed items based on the definitions of these constructs (cf. Table 3.3-3) considering standard guidelines (Hinkin 1998; MacKenzie et al. 2011; Podsakoff et al. 2003). We created the items to be short, simple, and precise and used appropriate language for employees (Hinkin 1998; MacKenzie et al. 2011). During the development, we carefully made sure that the items only address a single aspect (i.e., no connection of different statements in one item) to prevent the respondent’s confusion (Hinkin 1998). High quality of items and careful construction of the statements used are necessary procedural remedies to avoid common method bias (CMB) (Podsakoff et al. 2003). Since it is likely in a scale development process that approximately half of the items may be dropped due to reliability and validity issues (Hinkin 1998), we generated six items for each creator of digital stress so that at least three items would remain after the validation process. Because the questionnaire was rather long, reverse-coded items were included to reduce response patterns in the first draft of the survey. The items of the three new scales were generated in German. We translated the final versions of the items into English for further reusability according to the same procedure as we translated the existing English item scales into German.

We used a five-point Likert-type rating scale from 0 = "*I do not agree at all*" to 4 = "*I totally agree*" to measure all twelve demands.

Step 3: *Assess the content validity of the items*

To evaluate the newly developed item scales' content and face validity, we conducted a card-sorting experiment via an online matching task with fellow researchers (Moore and Benbasat 1991; Thatcher et al. 2018). Thirty-nine participants completed the task. Items that were correctly matched by less than 85 % of participants were subject to refinement. Thus, we changed the wording of these items to fit the corresponding digital work demands better and finished this step of item generation with the revised scales.

Step 4: *Formally specify the measurement model*

We specified the measurement model as first-order reflective for each of the established scales as suggested by Ragu-Nathan et al. (2008, p. 428), who "… have conceptualized technostress creators … as reflective or superordinate (Edwards 2001; Law and Wong 1999) constructs. This implies that (1) each of the first-order constructs represents a facet or manifestation and can be viewed as one of its dimensions and the direction of causality is from the second-order construct to its facets, the first-order constructs, (2) the first-order constructs are interchangeable, (3) covariation among the first-order constructs is not unexpected, and (4) the nomological networks associated with them are expected to be similar (Jarvis et al. 2003)". For the newly developed scales, we followed the suggestion from Ragu-Nathan et al. (2008, p. 428) and are "consistent with previous literature on stress that models stress as a reflective construct (Law et al. 1998)". Furthermore, we allowed for correlation among the twelve demands. In a later step, we investigated whether there are higher-order structures among the twelve demands.

Step 5: *Collect data to conduct pre-test*

Next, we collected data for evaluating our measures' factor structure and validity (Hinkin 1998; MacKenzie et al. 2011). First, we acquired respondents for a pre-test via an external research panel focusing on the German workforce. Respondents were paid 3.70 USD / 3.10 EUR for participation in the study. Four hundred forty-five respondents took part in the study providing data (pre-test sample; n_1 = 445) in sufficiently good quality (e.g., consistency checks between individual items, meaningful answers to free-text questions).

Step 6: *Scale purification and refinement*

On the pre-test data set, we performed an exploratory factor analysis (EFA) to assess the quality of our questionnaire carefully and did a preliminary analysis of all scales (Hinkin 1998). Parallel analysis (Horn 1965) suggested extracting nine factors but also showed a strong first factor, which suggests that a minimum average partial (MAP) test (Beauducel 2001) is more adequate to determine the number of factors to extract (Velicer 1976). The MAP test suggested 13 factors.

We used principle axis factoring and oblique rotation to identify the factors. As can be seen in Table 3.3-11, the items for overload as well as for interruptions loaded on one joint factor. Further, the items for nonavailability and for lacking a sense of achievement loaded on two separate factors each. These “sub-factors” were compounded of items that were formulated in the same direction. Thus, we decided to reformulate all reversely coded items. Furthermore, we removed the first item of invasion of privacy due to its cross-loading on performance control. As both, the overload and interruptions scales were validated in prior research (even if not used jointly), we for now refrained from adaptations.

Step 7: *Gather data from new sample and reexamine scale properties*

Using the revised scales, we collect a new data set from a large scale-study with 4,560 respondents participating in an online survey through the same external research panel as in the pre-test. We randomly split our study population into a subset for developmental purposes (developmental sample; n_2 = 1,560) and a subset for validation purposes (validation sample; n_3 = 3,000). Step seven and eight is performed on the developmental sample to re-assess scale properties, while all consecutive steps are performed on the validation sample. Table 3.3-10 presents the demographic properties of the participants in the developmental sample.

Gender	**N**	**%**	**Employment**	**N**	**%**
Male	834	53	Full-Time (> 20 h)	1,488	95
Female	726	47	Half-Time (< 20 h)	72	5
Age	**N**	**%**	**Technology Use**	**N**	**%**
< 25	53	3	Never	0	0
25-34	341	22	Seldom	0	0
35-44	427	27	Weekly	80	5
45-54	406	26	Daily	203	13
55-64	328	21	Several times a day	1,277	82
> 65	5	<1			
Education				**N**	**%**
Primary / lower secondary school graduation certificate				23	1
Intermediate school graduation certificate				205	13
Higher education entrance qualification				170	11
Apprenticeship				485	31
University degree (bachelor's)				286	18
University degree (master's)				346	22
Doctorate				45	3

Table 3.3-10: Demographic Properties of the Developmental Sample (n_2 = 1,560)

Item	F01	F02	F03	F04	F05	F06	F07	F08	F09	F10	F11	F12	F13
INV01	0.753												
INV02	0.667												
INV03	0.483												
OVE01		0.367											
OVE02		0.529											
OVE03		0.526											
OVE04		0.565											
COM01			0.582										
COM02			0.817										
COM03			0.627										
COM04			0.688										
COM05			0.805										
INS01				0.309									
INS02				0.419									
INS03				0.420									
INS04				0.387									
UNC01					0.650								
UNC02					0.719								
UNC03					0.860								
UNC04					0.917								
UNR01						0.886							
UNR02						0.943							
UNR03						0.764							
ROL01							0.564						
ROL02							0.675						
ROL03							0.781						
ROL04							0.525						
IOP01								0.416	0.439				
IOP02								0.877					
IOP03								0.892					
IOP04								0.834					
INT01		0.318											
INT02		0.330											
INT03		0.328											
PER01									0.571				
PER02									0.668				
PER03									0.798				
PER04									0.702				
PER05									0.758				
PER06									0.675				
NON01										0.901			
NON02										0.909			
NON03											0.676		
NON04											0.778		
NON05											0.766		
NON06										0.476			
LSA01												0.761	
LSA02												0.852	
LSA03												0.850	
LSA04													0.832
LSA05												0.782	
LSA06													0.866

Note: Loadings < 0.4 are not displayed; INV = Invasion, OVE = Overload, COM = Complexity, INS = Insecurity, UNC = Uncertainty, UNR = Unreliability, ROL = Role Ambiguity, IOP = Invasion of Privacy, INT = Interruptions, PER = Performance Control, NON = Nonavailability, LSA = Lacking a Sense of Achievement

Table 3.3-11: Item loadings from EFA on Data from the Pre-Test Sample (n_1 = 445)

Using the revised scales, we conducted a confirmatory factor analysis (CFA) to measure the models' fit according to standard fit measures likes the root mean square error of approximation (RMSEA) and the square root mean residual (SRMR) for global measures, the comparative fit index (CFI), Tucker-Lewis index (TLI), and the Normed Fit Index (NFI) for incremental measures, and the Adjusted Goodness of Fit Index (AGFI) for the assessment of the parsimony. We applied the thresholds suggested by Lei and Wu (2007) and Gefen et al. (2000). We do not report χ^2 or χ^2/df as these are not considered meaningful for samples of our size. Results are displayed in Table 3.3-12.

Fit Measures		**Thresholds**	**Source of Threshold**	**Twelve Digital Work Demands**
Global Measures	RMSEA	< 0.06	Lei and Wu (2007)	0.050
	SRMR	< 0.05	Gefen et al. (2000)	0.049
Incremental Measures	NFI	> 0.90	Gefen et al. (2000)	0.920
	TLI	> 0.90	Gefen et al. (2000)	0.929
	CFI	> 0.90	Gefen et al. (2000)	0.935
Parsimony	AGFI	> 0.80	Gefen et al. (2000)	0.826

Table 3.3-12: Fit Measures from a CFA Using the Developmental Sample (n_2 = 1,560)

The data from the developmental sample showed a good fit. Furthermore, we evaluated reliability using Cronbach's alpha and convergent validity using the item loadings and average variance extracted (AVE) from the confirmatory factor analysis. The descriptive statistics, loadings, Cronbach's alpha values, and AVE are presented in Table 3.3-13. Cronbach's alpha showed values of at least 0.82 for all scales indicating internal consistency. Almost all loadings of the items on their respective latent factors in the CFA were above the value of 0.70, which indicates that the underlying construct explains more than 50 % of the variance of this item. Also, the AVE (i.e., assessing whether, on average, over all items, the underlying latent construct explains more than 50 % of the variation in its indicators in sum) of all constructs was above 0.50. Thus, convergent validity was satisfactory.

Construct	# Items	M	SD	Loadings	Cronbach's α	AVE
Invasion	3	1.14	1.33	0.64-0.89	0.82	0.60
Overload	4	1.52	1.31	0.71-0.85	0.88	0.66
Complexity	5	1.21	1.21	0.76-0.87	0.91	0.67
Insecurity	4	1.18	1.26	0.69-0.84	0.83	0.57
Uncertainty	4	1.69	1.24	0.76-0.86	0.88	0.65
Unreliability	3	1.75	1.22	0.85-0.94	0.92	0.79
Role Ambiguity	4	1.22	1.23	0.79-0.89	0.91	0.72
Invasion of Privacy	3	1.95	1.38	0.90-0.94	0.93	0.85
Interruptions	3	1.49	1.26	0.85-0.90	0.91	0.76
Performance Control	6	1.95	1.36	0.77-0.88	0.92	0.67
Nonavailability	6	1.19	1.27	0.79-0.88	0.93	0.68
Lacking a Sense of Achievement	6	1.04	1.22	0.79-0.94	0.96	0.81

Table 3.3-13: Descriptive Statistics, Internal Consistency, AVE, and Factor Loadings from the Developmental Sample (n_2 = 1,560)

Additionally, we assessed the discriminant validity of our twelve constructs amongst themselves based on the Fornell-Larcker criterion (Fornell and Larcker 1981) as Cronbach's alpha does not account for the dimensionality of constructs. The Fornell-Larcker criterion compares the size of the intercorrelations of the latent constructs to the AVE. The square root of the AVE printed in the diagonal of Table 3.3-14 was higher than the intercorrelations of each construct with the other latent factors. Therefore, we considered construct validity as given.

Construct	INV	OVE	CO	INS	UNC	UNR	ROL	IOP	INT	PER	NON	LSA
INV	0.78											
OVE	0.65	0.82										
CO	0.63	0.66	0.82									
INS	0.73	0.72	0.66	0.76								
UNC	0.48	0.56	0.43	0.64	0.81							
UNR	0.48	0.62	0.51	0.51	0.43	0.89						
ROL	0.65	0.69	0.75	0.68	0.44	0.58	0.85					
IOP	0.42	0.49	0.43	0.41	0.27	0.44	0.54	0.92				
INT	0.57	0.71	0.61	0.57	0.42	0.62	0.70	0.54	0.87			
PER	0.40	0.59	0.45	0.50	0.38	0.45	0.55	0.67	0.55	0.82		
NON	0.59	0.54	0.59	0.55	0.34	0.52	0.66	0.44	0.58	0.42	0.82	
LSA	0.64	0.62	0.67	0.64	0.41	0.48	0.75	0.47	0.65	0.43	0.64	0.90

Note: Diagonal elements are square root AVE; off-diagonal elements are correlations; INV = Invasion, OVE = Overload, COM = Complexity, INS = Insecurity, UNR = Unreliability, ROL = Role Ambiguity, IOP = Invasion of Privacy, INT = Interruptions, PER = Performance Control, NON = Nonavailability, LSA = Lacking a Sense of Achievement

Table 3.3-14: Discriminant Validity According to Fornell-Larcker for the Developmental Sample (n_2 = 1,560)

The accomplished analyses show that the scales to assess the digital work demands perform well, and there is evidence for twelve underlying factors in the data. The translated scales worked well, just as did the three scales for the newly developed constructs from scratch.

Especially as we initially intended to potentially reduce the number of items for nonavailability, performance control, and lacking a sense of achievement. However, all newly generated items' psychometric properties were good enough for retaining them in the final scales. The final scales from this process are presented in Appendix 3.3.B.

Appendix 3.3.B. Final Scale for Digital Work Demands and Scales for Outcomes

Construct	Item	Loadings
Invasion (Adapted from Tarafdar et al. 2007)	INV01: I have to sacrifice my vacation and weekend time to keep current on digital technologies.	0.817
	INV02: I have to be in touch with my work even during my vacation due to digital technologies.	0.876
	INV03: I feel my personal life is being invaded by digital technologies.	0.650
Overload (Adapted from Tarafdar et al. 2007)	OVE01: I am forced by digital technologies to do more work than I can handle.	0.848
	OVE02: I am forced to work with very tight time schedules by digital technologies.	0.850
	OVE03: I am forced to change my work habits to adapt to new technologies.	0.721
	OVE04: I have a higher workload because of increased technology complexity.	0.864
Complexity (Adapted from Tarafdar et al. 2007)	COM01: I do not know enough about digital technologies to handle my job satisfactorily.	0.772
	COM02: I need a long time to understand and use new technologies.	0.867
	COM03: I do not find enough time to study and upgrade my technology skills.	0.803
	COM04: I find new recruits to this organization know more about computer technologies than I do.	0.769
	COM05: I often find it too complex for me to understand and use new technologies.	0.861
Insecurity (Adapted from Tarafdar et al. 2007)	INS01: I feel constant threat to my job security due to new digital technologies.	0.708
	INS02: I have to constantly update my skills with regard to digital technologies to avoid being replaced.	0.779
	INS03: I am threatened by coworkers with newer technology skills.	0.833
	INS04: I feel there is less sharing of knowledge about digital technologies among coworkers.	0.695
Uncertainty (Adapted from Tarafdar et al. 2007)	UNC01: There are constant changes in computer software in our organization.	0.755
	UNC02: There are constant changes in computer hardware in our organization.	0.791
	UNC03: There are frequent upgrades in computer networks in our organization.	0.806
	UNC04: There are always new developments in the technologies we use in our organization.	0.853
Unreliability (Adapted from Ayyagari et al. 2011)	UNR01: I often experience that features provided by digital technologies are not dependable.	0.863
	UNR02: I often experience that the capabilities provided by digital technologies are not reliable.	0.924
	UNR03: I often experience that digital technologies do not behave in a highly consistent way.	0.870
Role Ambiguity (Adapted from Ayyagari et al. 2011)	ROL01: I am not sure whether I have to deal with problems with digital technologies or with my work activities.	0.869
	ROL02: I am not sure what to prioritize: problems with digital technologies or my work activities.	0.878
	ROL03: I cannot allocate time properly for my work activities because the time spent on solving problems with digital technologies varies.	0.869
	ROL04: Time spent resolving digital technology problems takes time away from fulfilling my work responsibilities.	0.753

Invasion of Privacy (Adapted from Ayyagari et al. 2011)	IOP02: I feel my privacy can be compromised because my activities using digital technologies can be traced.	0.917
	IOP03: I feel my employer could violate my privacy by tracking my activities using digital technologies.	0.945
	IOP04: I feel that my use of digital technologies makes it easier to invade my privacy.	0.895
Interruptions (Adapted from Galluch et al. 2015)	INT01: I received too many interruptions during the task through digital technologies.	0.869
	INT02: I experienced many distractions during the task due to digital technologies.	0.843
	INT03: The interruptions caused by digital technologies are frequent.	0.903
Performance Control (Self-Developed)	PER01: I feel that my professional performance is monitored using digital technologies.	0.788
	PER02: I feel that professional achievements can be better monitored because of digital technologies.	0.818
	PER03: Due to digital technologies other people can easily monitor my performance.	0.878
	PER04: I feel that my professional achievements can be compared with the achievements of my <colleagues/competitors> due to digital technologies.	0.845
	PER05: My performance can be continually assessed through digital technologies.	0.880
	PER06: I have the feeling that more of the mistakes I make during work can be discovered through digital technologies.	0.782
Nonavailabiliy (Self-Developed)	NON01: I do not have the necessary digital technologies at hand that I need to carry out my activities.	0.834
	NON02: The digital technologies available to me are not sufficient to execute my work tasks.	0.846
	NON03: I could do better work if I had more digital technologies available.	0.816
	NON04: I am restricted in the execution of my work tasks because I am lacking essential technologies.	0.896
	NON05: I could handle my work tasks better if I had more rights to the relevant digital technologies.	0.822
	NON06: I do not have the right to use the digital technologies which I need to do my job.	0.801
Lacking a Sense of Achievement (Self-Developed)	LSA01: I feel that I do not know what I have accomplished at the end of a working day when using digital technologies.	0.882
	LSA02: When working with digital technologies, I lack the feeling of knowing what I have personally achieved.	0.915
	LSA03: It is hard for me to recognize the results of my work while using digital technologies.	0.928
	LSA04: I can’t tell what progress I’ve made at the end of the day when working with digital technologies.	0.926
	LSA05: It is very difficult for me to recognize my work success and I have to think carefully about what I have actually achieved when using digital technologies.	0.922
	LSA06: Digital technologies do not help me to assess the progress I made at work.	0.810

Table 3.3-15: Items of the Final Scale to Assess Digital Work Demands

Construct	Item
Job Satisfaction (Adapted from Agho et al. 1992)	SAT01: I find real enjoyment in my job. SAT02: I like my job better than the average person. SAT03: I am seldom bored with my job. SAT04: I would not consider taking another kind of job. SAT05: Most days I am enthusiastic about my job. SAT06: I feel fairly well satisfied with my job.
Exhaustion (Adapted from Maslach and Jackson 1986)	EMO01: I feel emotionally drained by my work. EMO02: Working at my job all day long requires a great deal of effort. EMO03: I feel like my work is breaking me down. EMO04: I feel frustrated with my work. EMO05: I feel I work too hard on my job. EMO06: It stresses me too much to work on my job. EMO07: I feel like I am at the end of my rope. EMO08: I feel burned out from my work. EMO09: I feel used up at the end of the workday.

Table 3.3-16: Scales and Items Used to Measure the Outcomes in the Nomological Net

Appendix 3.3.C. Psychometric Properties for the Final Scale on the Validation Sample

Construct	# Items	M	SD	Loadings	Cronbach's α	AVE
Invasion	3	1.15	1.32	0.40-0.86	0.82	0.60
Overload	4	1.54	1.31	0.55-0.71	0.89	0.67
Complexity	5	1.16	1.22	0.55-0.87	0.91	0.66
Insecurity	4	1.16	1.27	0.45-0.79	0.83	0.57
Uncertainty	4	1.70	1.25	0.72-0.83	0.88	0.64
Unreliability	3	1.75	1.21	0.78-0.94	0.92	0.78
Role Ambiguity	4	1.20	1.24	0.40-0.61	0.91	0.70
Invasion of Privacy	3	1.81	1.39	0.85-0.98	0.94	0.84
Interruptions	3	1.48	1.27	0.74-0.83	0.90	0.76
Performance Control	6	1.90	1.38	0.65-0.89	0.93	0.69
Nonavailability	6	1.18	1.27	0.66-0.91	0.93	0.70
Lacking a Sense of Achievement	6	1.02	1.27	0.70-0.94	0.96	0.80

Table 3.3-17: Descriptive Statistics, Internal Consistency, AVE, and Factor Loadings for the Validation Sample (n_3 = 3,000)

We conducted Harman's single factor test to derive whether CMB seems a problem in our data. All items were subject to principal components analysis (Podsakoff et al. 2003). More than one factor was extracted, the largest one accounting for about 13 % of the variance, so CMB is considered as uncritical. Second, we employed the correlational marker technique (Richardson et al. 2009). Therefore, we partialled out the smallest and the second-smallest shared variance in bivariate correlations among substantive exogenous latent variables (i.e., digital work demands). Since we found only minor changes in the significance of the bivariate correlation among these variables, we assume that CMB is not a concern in this study.

Construct	INV	OVE	CO	INS	UNC	UNR	ROL	IOP	INT	PER	NON	LSA
INV	0.78											
OVE	0.65	0.82										
CO	0.63	0.66	0.81									
INS	0.73	0.72	0.66	0.76								
UNC	0.48	0.56	0.43	0.64	0.80							
UNR	0.48	0.62	0.51	0.51	0.43	0.89						
ROL	0.65	0.72	0.76	0.68	0.45	0.58	0.84					
IOP	0.42	0.49	0.43	0.41	0.27	0.44	0.51	0.92				
INT	0.57	0.71	0.61	0.57	0.42	0.62	0.74	0.54	0.87			
PER	0.40	0.59	0.45	0.50	0.38	0.45	0.57	0.67	0.55	0.83		
NON	0.59	0.54	0.59	0.55	0.34	0.52	0.67	0.44	0.58	0.42	0.84	
LSA	0.64	0.62	0.67	0.64	0.41	0.48	0.75	0.47	0.65	0.43	0.64	0.90

Note: Diagonal elements are square root AVE; off-diagonal elements are correlations; INV = Invasion, OVE = Overload, COM = Complexity, INS = Insecurity, UNR = Unreliability, ROL = Role Ambiguity, IOP = Invasion of Privacy, INT = Interruptions, PER = Performance Control, NON = Nonavailability, LSA = Lacking a Sense of Achievement

Table 3.3-18: Discriminant Validity According to Fornell-Larcker for the Validation Sample (n_3 = 3,000)

4 Organizational and Social Mechanisms as Technostress Inhibitors

4.1 Technostress and Digitalization: Evidence from German Employees

Abstract

Technostress at work is well established. Nevertheless, the influence of the degree of workplace digitalization on technostress has not yet been investigated extensively. Based on theoretical models on technostress and a large-scale survey (n = 2,640), this study analyzes the relationship between the degree of workplace digitalization and technostress, including the moderating effect of the three inhibitors literacy facilitation, involvement facilitation, and technical support provision. The results reveal that a higher degree of workplace digitalization is positively associated with technostress and the three inhibitors. However, the effect on technostress varies when considering single technostress creators instead of technostress in general. For the inhibitors, the effects are also multifaceted. While literacy facilitation and technical support provision negatively affect technostress, literacy facilitation also decreases the effect of the degree of workplace digitalization on technostress. Involvement facilitation is positively associated with technostress. The results are important for organizations willing to take advantage of the benefits of digital technologies at the workplace and at the same time prevent them from causing adverse effects such as technostress for their employees.

Keywords: Technostress, Technostress Creators, Technostress Inhibitors, Digitalization, Survey Research

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4.1.1 Introduction

Digitalization has changed the business world. Organizations keep on digitalizing their businesses or even their business models in order to achieve competitive advantages like increases in operational efficiency, performance, productivity, and sales as well as savings in cost and time, and innovations in value creation (Fitzgerald et al. 2013; Neumeier et al. 2017; Vial 2019). Additionally, the COVID-19 pandemic and the associated social distancing measures have further accelerated workplace digitalization since many employees were forced to work from home using digital technologies. This continuing digitalization of the business world also has a major impact on the employees facing the proliferation of digital technologies at their workplace and the consequent changes of, for example, communication, working routines, and organizational structures (Colbert et al. 2016). Today, employees gain high flexibility in collaborating worldwide and at any time due to mobile internet, ubiquitous digital devices, and access to a vast amount of information on their tasks. However, they also are confronted with challenges like work overload due to high amounts of incoming emails and a blurring of work and non-work life (Barley et al. 2011; Colbert et al. 2016; Stanko and Beckman 2014; van Knippenberg et al. 2015).

The imbalance between the demands due to digital technologies and an individual's resources to meet these demands leads to stress. In information systems (IS) literature, this increased stress for employees due to digital technologies is known as technostress (Tarafdar et al. 2019). Technostress was described by Brod (1984, p. 16) as an individual's "inability to cope with new computer technologies in a healthy manner." Research on technostress has identified different technostress creators (Adam et al. 2017; Ayyagari et al. 2011; Ragu-Nathan et al. 2008; Tarafdar et al. 2007): techno-invasion, techno-overload, techno-complexity, techno-uncertainty, techno-insecurity, and techno-unreliability. Further, many studies have investigated the impact of technostress on different outcomes in the business context (Tarafdar et al. 2019). Examples are job-related adverse outcomes such as reduced job satisfaction and organizational commitment (Gimpel et al. 2018; Ragu-Nathan et al. 2008; Tarafdar et al. 2007), IS-use related adverse outcomes such as lower end-user satisfaction (Tarafdar et al. 2010; Tarafdar et al. 2015) and non-adherence to IS use requirements (D'Arcy et al. 2014) as well as well-being related adverse outcomes such as exhaustion and burnout (Day et al. 2012; Galluch et al. 2015; Maier et al. 2015b).

Prior literature has studied organizational measures to inhibit technostress, especially literacy facilitation, involvement facilitation, and technical support provision (Ragu-Nathan et al.

2008). Concerning the antecedents of technostress, Ayyagari et al. (2011) and Becker et al. (2020) find that technology usage and technology characteristics influence technostress. In several studies, selected digital technologies, including smartphones (Lee et al. 2014) and enterprise resource planning (ERP) systems (Maier et al. 2015a), have been investigated for their effects on technostress. However, to date, we lack understanding of the interplay of the degree of workplace digitalization and technostress.

The degree of workplace digitalization is the extent to which a workplace is equipped with digital technologies. For employees, the degree of workplace digitalization is primarily determined by their employers, who decide on IT strategies and procurement, deployment, and use of digital technologies. High levels of digitalization shall foster the positive effects of digitalization and support the efficiency and effectiveness of work (Colbert et al. 2016). However, increasing degrees of digitalization might lead to rising levels of technostress, which is associated with adverse effects on employees' productivity, satisfaction, well-being, and health. Nevertheless, since not digitalizing work is hardly an option for companies due to the constant competition with other organizations, we need to understand the exact relationship between the degree of workplace digitalization, possible inhibiting measures, and different technostress factors. Thus, we formulate the following two research questions:

> *RQ1: How is the degree of workplace digitalization linked to technostress?*
>
> *RQ2: How do the technostress inhibitors literacy facilitation, involvement facilitation, and technical support provision moderate the relationship of the degree of workplace digitalization and technostress?*

To answer these research questions, we build research models to assess the effect of the degree of workplace digitalization on technostress and the effects of three different inhibitors (literacy facilitation, involvement facilitation, and technical support provision) on this relationship. We chose these three inhibitors as they are the most established in prior technostress literature (e.g., Ragu-Nathan et al. 2008; Tarafdar et al. 2011). We test the models empirically with survey data of 2,640 German employees. We find that a higher degree of workplace digitalization increases technostress and is associated with higher inhibitors, but it shows different effects on individual technostress creators. The effects also differ between the three inhibitors. Literacy facilitation and technical support provision negatively affect technostress. Further, literacy facilitation moderates the effect of the degree of workplace digitalization on technostress. Surprisingly, involvement facilitation increases technostress. Our results give evidence for the fact that high degrees of workplace digitalization cause high levels of technostress. Further, we can draw recommendations regarding possible measures to inhibit this effect.

The remainder of this paper is structured as follows: Section 4.1.2 sets up the theoretical foundation on the digitalization of workplaces and technostress. Section 4.1.3 introduces our research models and hypotheses. Section 4.1.4 describes the design and operationalization of the survey as well as its results. Section 4.1.5 discusses the findings. Section 4.1.6 illustrates the theoretical contributions and practical implications for individuals, organizations, and IT designers and provides an outlook for future research.

4.1.2 Theoretical Background

4.1.2.1 Digitalization of Workplaces

Employees today face major changes and ever more digital technologies at their workplaces through organizations' ongoing digitalization (Colbert et al. 2016). Digital technologies are all "combinations of information, computing, communication, and connectivity technologies" (Bharadwaj et al. 2013 according to Vial 2019, p. 118). There is no particular research stream on workplace digitalization in IS literature (Köffer 2015), and different definitions exist in practice. According to Williams and Schubert (2018, p. 480), "the digital workplace is an integrated platform that provides all the tools and services to enable employees to effectively undertake their work, both alone and with others, regardless of location and is strategically coordinated and managed through digital workplace designs that are agile and capable of being adapted to meet future organizational requirements and technologies."

The degree of digitalization of workplaces differs between jobs, organizations, and different sectors (Fitzgerald et al. 2013; Reimann et al. 2020). For example, many jobs are highly digital in the information and communication sector, with employees using laptops, smartphones, and various communication and collaboration applications. In other sectors, such as healthcare, many activities are still person-centered and non-digital, with employees using only a few different digital technologies.

Digitalization of workplaces brings chances for individuals (e.g., automation, enhanced decision making, access to information, increased performance, collaboration, flexibility) (Barley et al. 2011; Colbert et al. 2016; Neumeier et al. 2017; van Knippenberg et al. 2015). At the same time, working at a digital workplace requires employees to bring or build a specific set of skills like analytical skills, leadership skills, self-awareness, and digital fluency (Colbert et al. 2016; Hess et al. 2016; Vial 2019). Further, Colbert et al. (2016) name challenging effects on individuals like excessive amounts of emails that have to be answered, the blurring of boundaries between work and private life, and decreased productivity due to constant interruptions via digital technologies.

4.1.2.2 Technostress

In IS literature, a whole research stream addresses the consequence of workplace digitalization for individuals, namely technostress (i.e., stress caused by the use of digital technologies) (e.g., Adam et al. 2017; Lee et al. 2014; Maier et al. 2015a; Ragu-Nathan et al. 2008; Riedl 2013; Tarafdar et al. 2011; Tarafdar et al. 2019). Tarafdar et al. (2015, p. 103) define technostress as "stress that users experience as a result of their use of IS in the organizational context." Recent literature on technostress can be categorized by three questions: Which technostress creators exist? Which consequences are caused by technostress? Which factors inhibit technostress?

Concerning technostress creators, research has identified six relevant factors: techno-invasion, techno-overload, techno-complexity, techno-uncertainty, techno-insecurity (Ragu-Nathan et al. 2008; Tarafdar et al. 2007), and techno-unreliability (Adam et al. 2017; Ayyagari et al. 2011). They are defined in Appendix 4.1.A. The technostress creators refer to the use of digital technologies. Tarafdar et al. (2019) see the "technology environment conditions" as an antecedent of technostress but also show that the stream of "future of work" is understudied in technostress literature. Concerning the relationship between the degree of workplace digitalization and technostress, several studies have been conducted to investigate the effect of digital technologies on technostress (e.g., Ayyagari et al. 2011; Lee et al. 2014; Maier et al. 2015a). However, there is even less evidence when considering the overall degree of workplace digitalization instead of single technologies, groups of technologies, or specific characteristics and features of technologies, and we do not find prior research investigating the relationship of the whole portfolio of digital technologies with technostress.

Concerning the consequences of technostress, many different studies have already been conducted. On the side of the organizational outcomes, reduced end-user satisfaction has been found, followed by reduced job satisfaction, performance, productivity, and organizational commitment (Ragu-Nathan et al. 2008; Srivastava et al. 2015; Tarafdar et al. 2007; Tu et al. 2005). Further, technostress harms individuals' well-being and is associated with increased exhaustion and burnout (Day et al. 2012; Galluch et al. 2015).

The adverse effects of technostress can be counteracted by establishing appropriate technostress inhibitors. Concerning these factors, research primarily concentrates on three inhibitors:

literacy facilitation, involvement facilitation, and technical support provision (Ragu-Nathan et al. 2008). Literacy facilitation refers to measures taken by the employer to promote the sharing of knowledge on the use of digital technologies within the organization. Involvement facilitation refers to the employer's involvement of employees in the process of introducing new digital technologies. Technical support by the employer (e.g., a helpdesk) assists employees in solving problems related using digital technologies. See Appendix 4.1.A for definitions of these three inhibitors. Ragu-Nathan et al. (2008) identify literacy facilitation, involvement facilitation, and technical support provision as fact that positively affect job satisfaction, organization, and continuance commitment. Hence, these inhibitors counteract some effects of technostress.

All studies contribute to acquiring knowledge about technostress, its antecedents, inhibitors, and possible outcomes. However, no research endeavor has yet put a holistic view on workplace digitalization and its effect on technostress. Nevertheless, we believe that such a view is required for being able to mitigate technostress. Thus, we aim to close this gap and investigate the effect of the degree of workplace digitalization (i.e., the number of digital technologies at a workplace) on technostress. We also aim to understand the inhibiting effects of organizational mechanisms like literacy facilitation, involvement facilitation, and technical support provision.

4.1.3 Hypotheses Linking the Degree of Workplace Digitalization, Technostress Creators, and Technostress Inhibitors

To answer our research questions, we build three models to investigate the relationship of the focused constructs. Our models' central paradigm is that the degree of workplace digitalization influences the level of technostress and that certain inhibiting factors can counteract this effect.

There is little evidence on the effect of technology usage on technostress. Ayyagari et al. (2011) include "technology usage" as a control variable for technostress. Further, some studies analyze different single technologies and their effect on technostress. Lee et al. (2014) show that compulsive smartphone usage increases technostress. Maier et al. (2015a) find that different characteristics of ERP systems like usefulness and reliability can affect technostress. However, there is only little evidence on the effect of the degree to which digital technologies are used. Stich et al. (2019) investigate the extent to which an individual uses email on technostress. Further, Galluch et al. (2015) find that a higher quantitative demand (i.e., the number of interruptions caused by digital technologies) increases the perceived stress.

According to Lazarus and Folkman (1984), stress occurs when environmental demands exceed an individual's resources to deal with the demands. At the digital workplace, the environmental demands are the technology environment conditions (Tarafdar et al. 2019). Thus, the different digital technologies an individual works with.

The ongoing digitalization of workplaces and the corresponding increase in the number of digital technologies at the workplace leads to a required increase in the individuals' skills and resources to deal with technologies. In many cases, this may happen due to increased media competence of individuals in general, rising experience with the digital technologies on the job, selection by the employer when recruiting employees for the respective workplace, or self-selection by the individual when applying for suitable jobs. However, as digitalization progresses rapidly, the change in resources does not always meet the changed technology environment conditions. Thus, we believe that a higher degree of workplace digitalization is associated with higher levels of technostress creators and hypothesize:

H1: A higher degree of workplace digitalization is associated with higher technostress.

To detail the understanding of the relationship of the degree of workplace digitalization with the second-order construct technostress, we also aim to analyze the effect on the underlying first-order constructs of technostress: techno-invasion, techno-overload, techno-complexity, techno-insecurity, techno-uncertainty, and techno-unreliability. As we hypothesize that the combined construct is positively affected by a higher degree of workplace digitalization, we consider the same effect for the detailed technostress creators. Thus, we propose the hypotheses H2a to H2f as follows.

H2a: A higher degree of workplace digitalization is associated with higher techno-invasion.

H2b: A higher degree of workplace digitalization is associated with higher techno-overload.

H2c: A higher degree of workplace digitalization is associated with higher techno-complexity.

H2d: A higher degree of workplace digitalization is associated with higher techno-insecurity.

H2e: A higher degree of workplace digitalization is associated with higher techno-uncertainty.

H2f: A higher degree of workplace digitalization is associated with higher techno-unreliability.

Technostress inhibitors are possible measures to counteract the emergence of technostress creators. Ragu-Nathan et al. (2008) analyzed the effect of all three inhibitors as a second-order construct on the consequences of technostress. They found that the inhibitors are associated with increased job satisfaction, organizational commitment, and continuance commitment. In the same direction, Fuglseth and Sørebø (2014) found increased satisfaction with ICT use associated with the inhibitors. Additionally, Day et al. (2012) found that technical support provision moderated the effect between technostress creators and its consequences. Higher technical support provision decreased the effect of ICT hassles on strain. Further studies analyzed the direct effect on the arising of technostress rather than on its consequences. Tarafdar et al. (2010) found a decreasing effect of involvement facilitation on technostress creators. In line with that, Tarafdar et al. (2015) found technostress inhibitors to be associated with lower levels of technostress creators.

However, none of these research contributions has investigated to what extent the degree of workplace digitalization is associated with technostress inhibitors. As Vial (2019) states, digital transformation of workplaces requires structural changes such as new employee skills for the digital work – which refers to literacy facilitation. Further, according to Vial's (2019) extensive literature review on digital transformation, involvement facilitation can be one mechanism to overcome employees' resistance to digital transformation. For technical support provision, we believe that in organizations with higher digitalization, key processes depend on digital technologies, making it essential to have adequate technical support to sustain the ability to work at any time. In line with these notions, we suggest that organizations take such measures when the degree of workplace digitalization is high. Thus, we hypothesize:

> *H3a: A higher degree of workplace digitalization is associated with higher literacy facilitation.*
>
> *H3b: A higher degree of workplace digitalization is associated with higher involvement facilitation.*
>
> *H3c: A higher degree of workplace digitalization is associated with higher technical support provision.*

Literacy facilitation is an organizational measure to help employees enhance their personal resources and skills to deal with digital technologies. That is why it helps individuals to better deal with the increased demands of a higher number of digital technologies at the workplace. Thus, we hypothesize that literacy facilitation helps to decrease the increasing effect of digitalization on technostress creators.

H4a: Literacy facilitation moderates the effect of digitalization of the workplace on technostress creators in the sense that higher literacy facilitation attenuates the increasing effect of digitalization of the workplace on technostress creators.

Involvement facilitation means involving employees before launching new digital technologies at their workplace. Thereby, employees can influence the type of technology and, thus, the technology environment conditions at the workplace. According to the person-environment fit theory, a misfit between the environmental supplies and the personal values to what extent supplies are desired is associated with stress creators (Stich et al. 2019). Thus, if individuals can influence their environment, they can create it according to their values, leading to a decreased level of technostress creators. Further, involving individuals in launching new digital technologies makes them learn about the advantages and disadvantages of different technologies. This learning opportunity leads to an increased understanding of the digital technology in general and how it can be used for different tasks. Also, involvement facilitation gives the employees a feeling of having something to say, which increases the employees' self-efficacy to affect their workplace conditions and gives them a higher internal locus of control (Anderson 1977). Control has already been found to reduce strain from technostress (Pirkkalainen et al. 2017). We believe that these involvement processes take action when the degree of workplace digitalization increases and suppose that involvement facilitation thus decreases the increasing effect of workplace digitalization on technostress creators.

H4b: Involvement facilitation moderates the effect of digitalization of the workplace on technostress creators in the sense that higher literacy facilitation attenuates the increasing effect of digitalization of the workplace on technostress creators.

Technical support provision helps individuals to deal with problems that occur when working with digital technologies. With an increasing number of digital technologies at the workplace, there are more issues with the technologies (e.g., due to updates or incompatibilities between different digital technologies) that individuals have to deal with. Here, helpdesk experts may help. Also, knowing that if they need help, individuals can reach out to the helpdesk increases the perceived internal locus of control. Thus, technical support provision also should decrease the effect of degree of workplace digitalization on technostress creators.

H4c: Technical support provision moderates the effect of digitalization of the workplace on technostress creators in the sense that higher literacy facilitation attenuates the increasing effect of digitalization of the workplace on technostress creators.

Figure 4.1-1 summarizes the hypotheses in three research models. Furthermore, we included several control variables into the models to identify the effect of the degree of workplace digitalization and the technostress inhibitors. The control variables are age, gender, occupational activity, school qualification, and professional qualification.

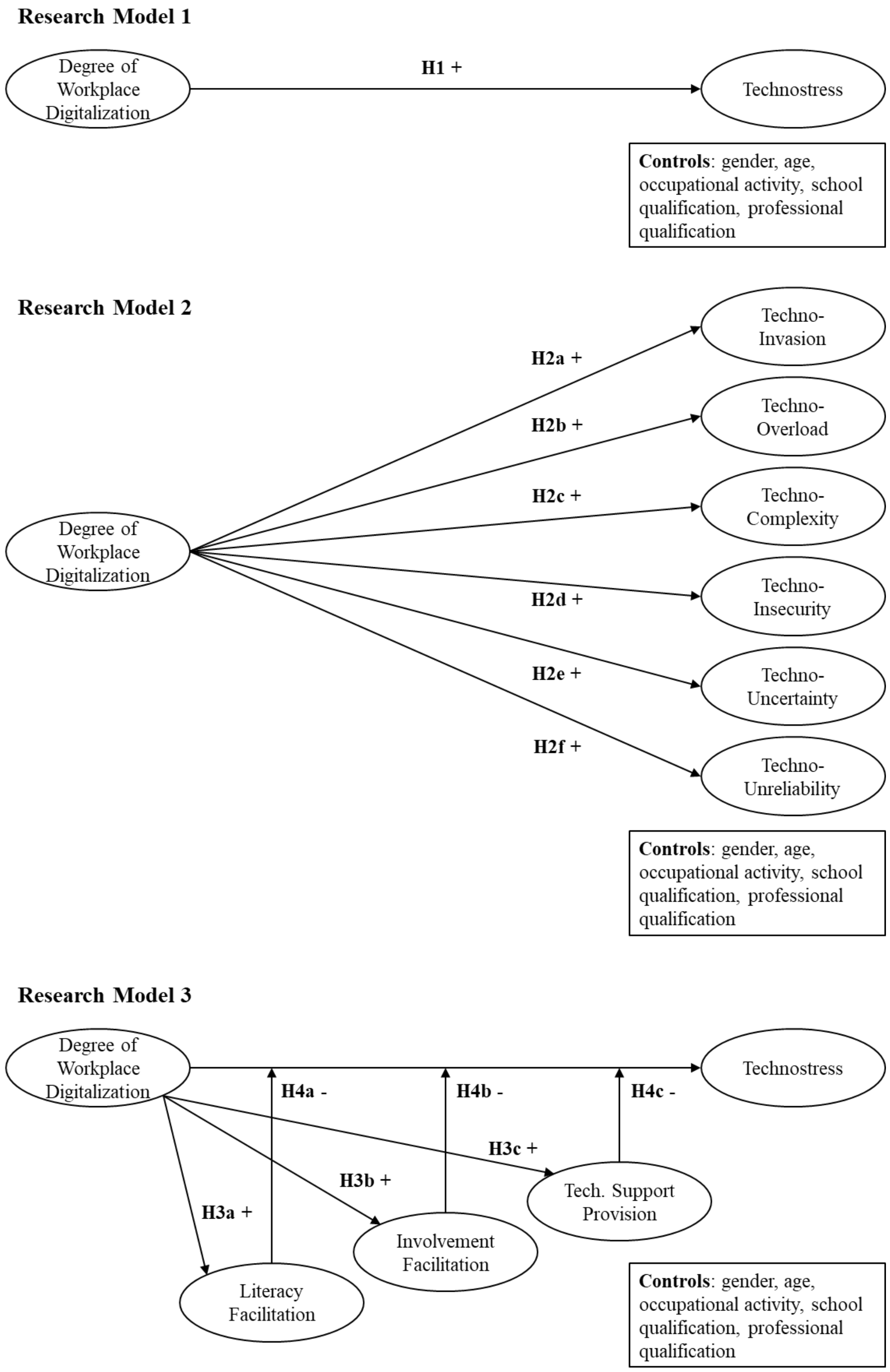

Figure 4.1-1: Research Model

4.1.4 Research Methodology, Analysis, and Results

We designed an online survey to measure all constructs from the research model and control variables to empirically test the hypotheses.

4.1.4.1 Questionnaire Development

The first part of the survey was to measure respondents' workplace equipment with digital technologies, that is, the degree of workplace digitalization. For this purpose, participants were shown a list of 40 technologies, like smartphones, laptops, or text, spreadsheet, and presentation software. The list of technologies was generated based on the ACM Computing Classification System, the job information of the German Federal Employment Agency, and several job advertisements. The development process is described in detail in (disguised for review). The complete list of technologies is provided in Appendix 4.1.B. The survey participants were asked to select all technologies they use actively or passively in their daily work.

Following this section, the survey dealt with the six dimensions of technostress (invasion, overload, complexity, insecurity, uncertainty, and unreliability) and its inhibiting factors (literacy facilitation, involvement facilitation, and technical support provision). Therefore, we used the item scales from Ayyagari et al. (2011) for techno-unreliability and Ragu-Nathan et al. (2008) for all other constructs. Following Tarafdar et al. (2007) and Ragu-Nathan et al. (2008), we model technostress as a reflective second-order construct comprised of the individual dimensions of technostress.

Furthermore, we asked the participants for their gender (female, male, or other), year of birth, German federal state, industry, type of occupational activity according to the German Federal Employment Agency as well as the school qualification and professional qualification according to the German Federal Statistical Office.

As ex-ante precautions against common method bias (CMB), we assured the respondents of anonymity of their answers and stated that there were no right or wrong answers to the questions (Podsakoff et al. 2003). We translated all items into German for the questionnaire and measured them on a five-point Likert scale ("fully disagree," "rather disagree," "undecided," "rather agree," "fully agree"). Appendix 4.1.C provides an overview of all items.

4.1.4.2 Sample Characteristics

Participants were recruited via a professional panel provider, were compensated for their participation, and completed the survey online. The inclusion criterion was that they are active members of the German workforce. To ensure data quality, we implemented an attention check ("If you are answering this survey cautiously, tick the second box from the left.").

2,640 participants completed the survey and passed the attention check. Table 4.1-1 gives an overview of several demographics of our diverse sample. The average age was just under 48 years, with a range between 19 and 88 years. The average contracted weekly working time of the participants was 34.4 hours. The average actual weekly working time of 36.9 was slightly higher, resulting in average overtime of 2.5 hours.

Gender	**Absolute Frequency**	**Relative Frequency**
Female	1,417	53.7%
Male	1,219	46.2%
Other	4	0.2%
Total	2,640	100.0%
Age in Years	**Absolute Frequency**	**Relative Frequency**
Below 25	40	1.5%
25 to 34	387	14.7%
35 to 44	558	21.1%
45 to 54	835	31.6%
55 to 64	735	27.8%
65 and above	85	3.2%
Total	2,640	100.0%
Type of Occupational Activity according to the German Federal Employment Agency	**Absolute Frequency**	**Relative Frequency**
Unskilled or semi-skilled activities	153	5.8%
Specialist activities	1,248	47.3%
Complex specialist activities	595	22.5%
Highly complex activities	207	7.8%
Supervisory activities	124	4.7%
Leadership activities	313	11.9%
Total	2,640	100.0%
School Qualification according to the German Federal Statistical Office	**Absolute Frequency**	**Relative Frequency**
Without or primary / lower secondary school leaving certificate	221	8.4%
intermediate school leaving certificate	1,003	38.0%
Entrance qualification for studies at University of Applied Sciences	345	13.1%
higher education entrance qualification	1,071	40.6%
Total	2,640	100.0%

Professional Qualification according to the German Federal Statistical Office	**Absolute Frequency**	**Relative Frequency**
No professional qualification	96	3.6%
Apprenticeship	1,090	41.3%
Specialized Technical College	487	18.4%
Specialized Academy	138	5.2%
University of Applied Sciences	318	12.0%
University	471	17.8%
Doctorate	40	1.5%
Total	2,640	100.0%

Table 4.1-1: Demographics of the Sample

We define the degree of workplace digitalization as the number of digital technologies used at a respondent's workplace. As respondents were able to select from a list of 40 different digital technologies, the degree of workplace digitalization ranges from 0 to 40, the mean is 13.08. Figure 4.1-2 shows the histogram. email, printers/scanners/fax machines, world wide web, stationary personal computers, and text/spreadsheet/presentation software were the most frequently selected digital technologies. Medical software, augmented/virtual/mixed reality, and modeling/simulation software were the least frequently chosen ones.

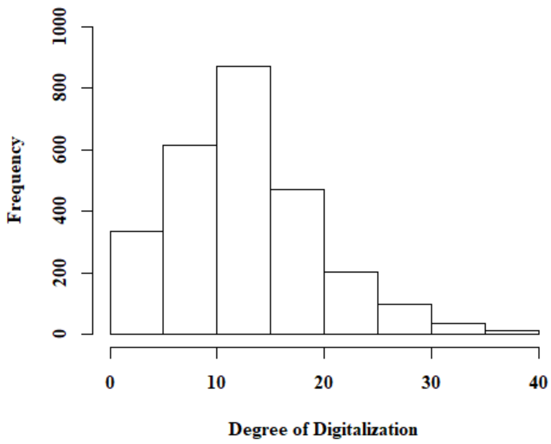

Figure 4.1-2: Histogram of the Degree of Workplace Digitalization

4.1.4.3 Assessment of the Measurement Model

We tested the measurement model using confirmatory factor analysis (CFA). Therefore, we built a model containing all latent constructs and associated manifest survey items without any relationship among the latent constructs. Table 4.1-2 shows means (on a scale from 1 to 5), standard deviations (SD), loadings, Cronbach's Alpha, and the average variance extracted

(AVE) for all constructs. Appendix 4.1.C further shows the means, standard deviations, and factor loadings for each item. As the results show, all factor loadings are greater than 0.6, and Cronbach's Alpha values are greater than 0.7 and, thus, meet the respective thresholds (Nunnally and Bernstein 1994). These values indicate good construct reliability. Also, each construct's AVE is higher than 0.5, indicating convergent validity (Bagozzi and Yi 1988; Hair et al. 2012).

Construct	# Items	Mean	SD	Loadings	Cronbach's α	AVE
Techno-Invasion	3	1.961	1.161	0.693-0.812	0.783	0.547
Techno-Overload	4	2.348	1.231	0.850-0.891	0.861	0.759
Techno-Complexity	5	2.085	1.109	0.708-0.850	0.884	0.611
Techno-Insecurity	4	1.869	1.050	0.644-0.798	0.758	0.512
Techno-Uncertainty	4	2.786	1.217	0.719-0.897	0.904	0.712
Techno-Unreliability	3	2.378	0.961	0.899-0.935	0.936	0.832
Literacy Facilitation	4	3.052	1.262	0.785-0.863	0.895	0.682
Involvement Facilitation	3	2.281	1.305	0.678-0.909	0.866	0.714
Technical Support Provision	3	3.460	1.226	0.835-0.932	0.923	0.807

Table 4.1-2: Mean, SD, Loadings, Cronbach's α and AVE of each Construct after CFA

Further, each construct's square root of the AVE is higher than the highest correlation with other constructs (Fornell-Larcker criterion, see Table 4.1-3), indicating discriminant validity.

Construct	TIV	TO	TC	TIS	TUC	TUR	LF	IF	TSP
Techno-Invasion	0.740								
Techno-Overload	0.699	0.871							
Techno-Complexity	0.356	0.439	0.782						
Techno-Insecurity	0.572	0.626	0.700	0.716					
Techno-Uncertainty	0.367	0.422	0.134	0.376	0.844				
Techno-Unreliability	0.047	0.064	0.243	0.174	-0.121	0.912			
Literacy Facilitation	0.089	0.045	-0.186	-0.068	0.357	-0.451	0.826		
Involvement Facilitation	0.281	0.164	-0.130	0.085	0.308	-0.357	0.580	0.845	
Technical Support Provision	0.017	0.018	-0.185	-0.100	0.229	-0.452	0.711	0.379	0.898

Table 4.1-3: Inter-Factor-Correlations (square root of the AVE in the diagonal)

We tested for common method variance (CMV) by applying the correlational marker technique without and with a theoretically unrelated marker variable as post-hoc detection method (Lindell and Whitney 2001; Richardson et al. 2009). Both procedures suggest that CMV is not a major concern in our data. Overall, we conclude that the measurement model has satisfactory properties, and we can proceed with testing the theoretical hypotheses.

4.1.4.4 Hypotheses Testing

We apply covariance-based structural equation modeling (CB-SEM) to estimate the three research models. The models' fit was judged according to various fit indices, as shown in Table 4.1-4. We present χ^2 values and degrees of freedom in Table 4.1-4 but did not consider them for model fit evaluation because this indicator has shown to be sensible to sample size in simulation studies (Boomsma 1982). All indices comply with the respective thresholds indicating satisfactory model fit of all three models.

Fit Measures	Threshold	Source of Threshold	Model 1		Model 2		Model 3	
χ^2			3,135		1,596		8,175	
Degrees of Freedom			278		239		938	
RMSEA	< 0.06	Lei and Wu (2007)	0.062	X	0.046	✓	0.054	✓
SRMR	< 0.08	Gefen et al. (2000)	0.085	X	0.033	✓	0.116	X
NFI	> 0.90	Gefen et al. (2000)	0.914	✓	0.956	✓	0.904	✓
TLI	> 0.90	Gefen et al. (2000)	0.908	✓	0.949	✓	0.905	✓
CFI	> 0.90	Gefen et al. (2000)	0.921	✓	0.962	✓	0.914	✓
AGFI	> 0.80	Gefen et al. (2000)	0.880	✓	0.930	✓	0.846	✓

Note: ✓ indicates that a threshold is met, X indicates that it is not met.
Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Normed Fit Index (NFI), Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Adjusted Goodness of Fit Index (AGFI)

Table 4.1-4: Fit Indices for the Three Research Models

Figure 4.1-3 shows the estimated models. The results for the control variables and the loadings of the first-order technostress creators on the second-order technostress construct in model 1 and model 3 are in Appendix 4.1.D.

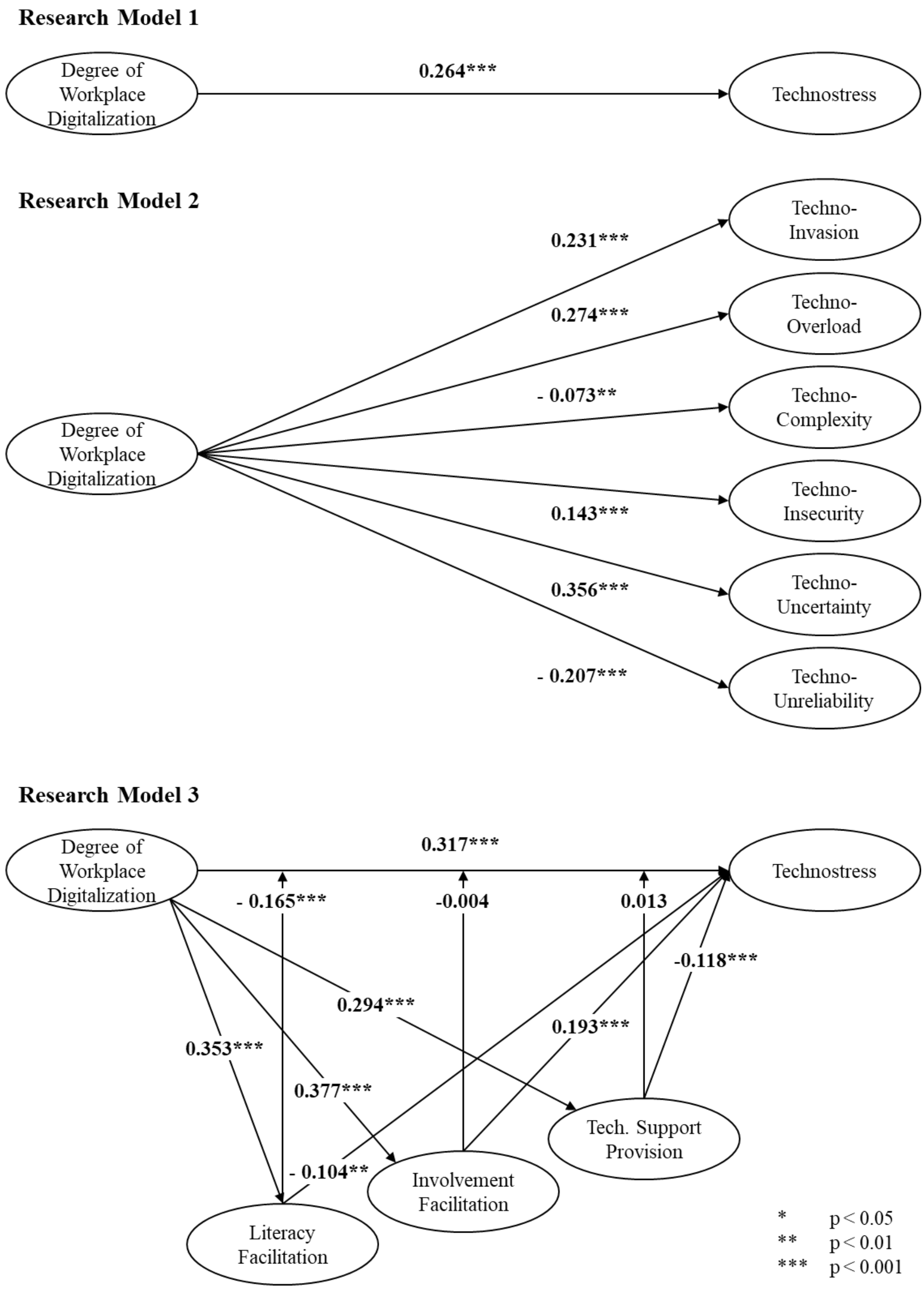

Figure 4.1-3: Results of Research Models

In model 1, the effect of a higher degree of workplace digitalization on technostress is significant and positive. This finding supports H1. In model 2, the effect of a higher degree of workplace digitalization on each single technostress creator is significant. However, only the effect on techno-invasion, techno-overload, techno-insecurity, and techno-uncertainty, is positive as expected in H2a, H2b, H2d, and H2e. Regarding techno-complexity and techno-unreliability, the effect is negative. Hence, H2c and H2f are not supported by the data.

Figure 4.1-4 plots the estimated linear effects of the degree of workplace digitalization on technostress and its dimensions. Since we restricted participation in the study to participants who use at least one digital technology at their workplace, the degree of digitalization starts at one on the scale. Due to the low number of respondents with a degree of workplace digitalization above 30, we exclude those 49 data points. The figure illustrates the data from model 1 and model 2 (see Figure 4.1-4): Among the technostress creators, techno-uncertainty is perceived as the strongest and is most affected by an increasing degree of workplace digitalization. Techno-complexity and techno-unreliability are lower with high levels of workplace digitalization as compared to low levels of workplace digitalization. The effect of the degree of workplace digitalization on technostress is a composite of the effects shown for the individual technostress creators. As such, the effect is positive with a moderate slope.

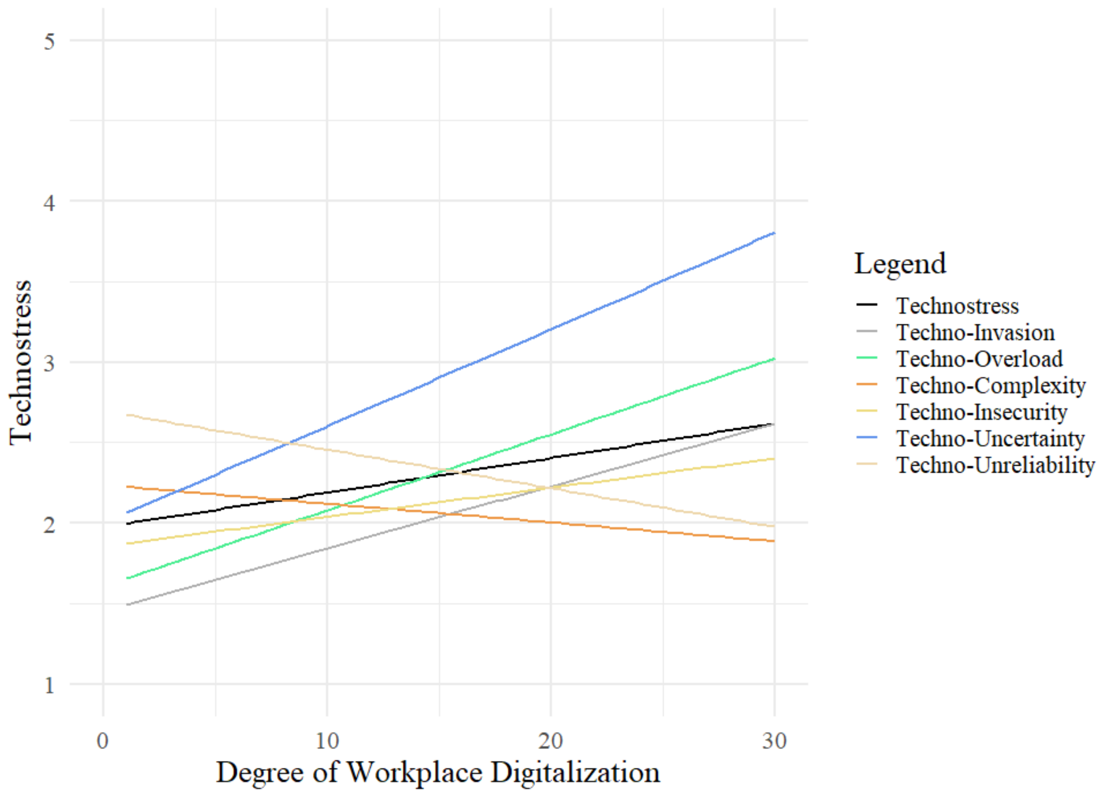

Figure 4.1-4: Linear Effects of the Degree of Digitalization on Technostress and its Dimensions

For model 3, we find significant effects of degree of workplace digitalization on the three inhibitors (see Figure 4.1-3). This finding supports H3a-H3c. Concerning the moderating effects of the inhibitors, the effects differ between the three inhibitors. For literacy facilitation, the results show a significant and negative direct effect on technostress. Also, literacy facilitation's moderating effect on the relationship between the degree of workplace digitalization on technostress is significant and negative, supporting H4a. Literacy facilitation attenuates the increasing effect of a higher degree of workplace digitalization on technostress. There is also a significant direct effect on technostress creators for involvement facilitation, but it is positive, meaning that involvement facilitation increases technostress. Further, no moderating effect as expected in H4b can be found. For technical support provision, the effect on technostress is found to be significant and negative. However, the moderating effect of technical support provision on the relationship of degree of workplace digitalization on technostress is not significant. Thus, H4c does not find support. Table 4.1-5 summarizes the hypotheses and their empirical support.

Theoretical Hypotheses				Empirical Results	Support for Hypotheses
Model 1	H1	pos.	Degree of Workplace Digitalization → Technostress Creators	+	✓
Model 2	H2a	pos.	Degree of Workplace Digitalization → Techno-Invasion	+	✓
	H2b	pos.	Degree of Workplace Digitalization → Techno-Overload	+	✓
	H2c	pos.	Degree of Workplace Digitalization → Techno-Complexity	-	X
	H2d	pos.	Degree of Workplace Digitalization → Techno-Insecurity	+	✓
	H2e	pos.	Degree of Workplace Digitalization → Techno-Uncertainty	+	✓
	H2f	pos.	Degree of Workplace Digitalization → Techno-Unreliability	-	X
Model 3	H3a	pos.	Degree of Workplace Digitalization → Literacy Facilitation	+	✓
	H3b	pos.	Degree of Workplace Digitalization → Involvement Facilitation	+	✓
	H3c	pos.	Degree of Workplace Digitalization → Technical Support Provision	+	✓
	H4a	neg.	Degree of Workplace Digitalization x Literacy Facilitation → Technostress Creators	-	✓
	H4b	neg.	Degree of Workplace Digitalization x Involvement Facilitation → Technostress Creators	n.s.	X
	H4c	neg.	Degree of Workplace Digitalization x Technical Support Provision→ Technostress Creators	n.s.	X

Note: plus signs indicate a significant and positive effect, minus signs a significant and negative effect, n.s. a non-significant effect at the 5 % level.

Table 4.1-5: Overview of Hypotheses and Empirical Results

The heterogeneity of the technostress creators observed in model 2 suggests that the focus of H4a to H4c on technostress in general rather than individual technostress creators, and the corresponding estimation of model 3 might mask more nuanced effects of the technostress inhibitors. Thus, we estimated a fourth model containing the three inhibitors and their moderating effect on the relationship between workplace digitalization and the six technostress creators. In a way, this model 4 is a blend of models 2 and 3. The key results are presented in Table 4.1-6. We present it as a table rather than a figure for the model's complexity. The satisfactory fit indices and an extended version of the table, including the control variables, are displayed in Appendix 4.1.E.

Relationship	Estimate	Sig.
Degree of Workplace Digitalization → Techno-Invasion	0.226	***
Degree of Workplace Digitalization → Techno-Overload	0.336	***
Degree of Workplace Digitalization → Techno-Complexity	0.010	
Degree of Workplace Digitalization → Techno-Insecurity	0.202	***
Degree of Workplace Digitalization → Techno-Uncertainty	0.291	***
Degree of Workplace Digitalization → Techno-Unreliability	-0.003	
Literacy Facilitation → Techno-Invasion	-0.085	*
Literacy Facilitation → Techno-Overload	-0.124	**
Literacy Facilitation → Techno-Complexity	-0.095	*
Literacy Facilitation → Techno-Insecurity	-0.129	**
Literacy Facilitation → Techno-Uncertainty	0.266	***
Literacy Facilitation → Techno-Unreliability	-0.162	***
Involvement Facilitation → Techno-Invasion	0.250	***
Involvement Facilitation → Techno-Overload	0.132	***
Involvement Facilitation → Techno-Complexity	-0.008	
Involvement Facilitation → Techno-Insecurity	0.185	***
Involvement Facilitation → Techno-Uncertainty	0.074	**
Involvement Facilitation → Techno-Unreliability	-0.156	***
Technical Support Provision → Techno-Invasion	-0.096	**
Technical Support Provision → Techno-Overload	-0.044	
Technical Support Provision → Techno-Complexity	-0.112	***
Technical Support Provision → Techno-Insecurity	-0.121	***
Technical Support Provision → Techno-Uncertainty	-0.074	*
Technical Support Provision → Techno-Unreliability	-0.275	***
Degree of Workplace Digi. x Literacy Facilitation → Techno-Invasion	-0.107	*
Degree of Workplace Digi. x Literacy Facilitation → Techno-Overload	-0.196	***
Degree of Workplace Digi. x Literacy Facilitation → Techno-Complexity	-0.069	
Degree of Workplace Digi. x Literacy Facilitation → Techno-Insecurity	-0.092	
Degree of Workplace Digi. x Literacy Facilitation → Techno-Uncertainty	-0.038	
Degree of Workplace Digi. x Literacy Facilitation → Techno-Unreliability	-0.065	
Degree of Workplace Digi. x Involvement Facilitation → Techno-Invasion	0.054	
Degree of Workplace Digi. x Involvement Facilitation → Techno-Overload	-0.012	
Degree of Workplace Digi. x Involvement Facilitation → Techno-Complexity	0.007	
Degree of Workplace Digi. x Involvement Facilitation → Techno-Insecurity	-0.034	
Degree of Workplace Digi. x Involvement Facilitation → Techno-Uncertainty	-0.041	
Degree of Workplace Digi. x Involvement Facilitation → Techno-Unreliability	-0.020	

Degree of Workplace Digi. x Technical Support Provision → Techno-Invasion	-0.023
Degree of Workplace Digi. x Technical Support Provision → Techno-Overload	0.047
Degree of Workplace Digi. x Technical Support Provision → Techno-Complexity	-0.001
Degree of Workplace Digi. x Technical Support Provision → Techno-Insecurity	-0.006
Degree of Workplace Digi. x Technical Support Provision → Techno-Uncertainty	0.002
Degree of Workplace Digi. x Technical Support Provision → Techno-Unreliability	0.017

Note: *** p < 0.001, ** p < 0.01, * p < 0.05; full results including the control variables are in 0.

Table 4.1-6: Estimates for Model 4

Model 4 suggests three key results: First, when including the technostress inhibitors, the significant and negative effect of degree of workplace digitalization on techno-complexity and techno-unreliability that surprisingly occurred in model 2 vanishes. In model 4, the degree of workplace digitalization is not significantly related to techno-complexity or techno-unreliability. The effects of the degree of workplace digitalization on the other four technostress creators are basically unaffected. Second, literacy facilitation and technical support provision have significant and negative direct effects on most technostress creators. Involvement facilitation has varying direct effects on the technostress creators. Third, the technostress inhibitors hardly moderate the effect of the degree of workplace digitalization on technostress creators. Only literacy facilitation attenuates the effect of the degree of workplace digitalization on techno-invasion and techno-overload.

4.1.5 Discussion

Digitalization of work leads to more digital technologies being part of employees' workplaces (Barley et al. 2011). At the same time, there is substantial heterogeneity among workplaces. Some workplaces might only have very few digital technologies. For example, employees filling the shelves in supermarkets might only have a radio with a headset. Other workplaces might have many digital technologies. For example, stockbrokers having multiple computers and phones, a printer, standard software like a web browser, advanced modeling and analysis software, security systems like a virtual private network, a smart card, and the like. In short, the degree of workplace digitalization differs between workplaces. One aim of our research was to understand the effect of this degree of workplace digitalization on technostress.

Further, like any other type of stress, technostress is highly individual. Nevertheless, there are technostress inhibitors an organization can put in place to prevent technostress (Ragu-Nathan et al. 2008; Tarafdar et al. 2010). Hence, a second aim was to study how these technostress inhibitors affect the relationship between the degree of workplace digitalization and workers' technostress. Thus, we derived theoretical hypotheses and conducted a large-scale online survey.

Our results suggest that a higher degree of workplace digitalization increases technostress, but the relationship differs among the six technostress creators. While most technostress creators are more pronounced with a high rather than low degree of workplace digitalization, the opposite is the case for techno-complexity and techno-unreliability.

The complexity associated with digital technologies can force users to learn how to handle them (Ragu-Nathan et al. 2008). One might think (as in fact, we did in our hypothesis H2c) that an increasing degree of workplace digitalization leads to more complexity and more effort for learning. However, the data suggest otherwise. Hypotheses to explore in future research are that the selection of digitally savvy employees (either self-selection or selection by the supervisor or employer) is responsible for the surprising effect or that learning how to deal with a specific technology has positive side-effects for dealing with other technologies. In other words, competencies in handling digital technologies might not be fully technology-specific and, thus, exposure to a highly digital workplace may eventually lead to reduced perceived complexity.

The perception of techno-unreliability might be lower for a high degree of workplace digitalization, as some technologies might be substitutes. Take the example of an employee equipped with a landline phone, a smartphone, and a computer mainly used to browse the internet, access documents in cloud storage, and email. When one of the three devices is temporarily not operational, the other two in combination afford to perform basically the same work (likely with less convenience and lower productivity than the complete set of three devices). Testing whether such substitutability explains the surprising result regarding H2f is a matter for future research.

Despite these two counterintuitive effects, the overall picture is that a higher degree of workplace digitalization goes along with higher levels of technostress.

The degree of workplace digitalization is also positively associated with the three investigated technostress inhibitors. However, the effect of technostress inhibitors on technostress is not always as expected previously. Literacy facilitation behaves as expected as it decreases technostress and the positive relationship between the degree of workplace digitalization and technostress. This effect is in line with prior research suggesting that individual resources that are enhanced by literacy facilitation are of great importance in terms of technostress (Tarafdar et al. 2019). Involvement facilitation has no moderating effect and increases instead of decreases technostress. This results contrasts with Tarafdar et al. (2010) finding a negative effect. Thus, further examination of this relationship is required. When looking at model 4, involvement facilitation has a significantly negative effect on techno-unreliability and a significantly positive effect on techno-invasion, techno-overload, techno-insecurity, and techno-uncertainty. This finding calls for further research to understand these relationships better. Technical support provision does not moderate the relationship between the degree of workplace digitalization and technostress but has a significantly negative direct effect on technostress and most individual technostress creators.

The results also highlight the double-edged effect of workplace digitalization on technostress. While the direct effect on technostress creators is positive – referring to an adverse outcome for individuals – the indirect effect over literacy facilitation and technical support provision is associated with a beneficial effect for the individuals since inhibitors are higher when workplace digitalization is high, and thus their inhibiting effect is stronger.

4.1.5.1 Theoretical Contribution

We contribute to theory in three ways. First, we focus on the degree of overall workplace digitalization rather than analyzing specific digital technologies and their effect on technostress. This focus complements prior work of, for example, Maier et al. (2015a) or Stich et al. (2019). It establishes the degree of workplace digitalization as an important characteristic of the working and technological environment.

Second, we find evidence for the link of the degree of workplace digitalization with technostress. Thereby, we find a significant effect on technostress overall and find significant effects on each of the six individual technostress creators. Prior research mostly builds a second-order factor of technostress based on the technostress creators. We contribute a more detailed understanding. We further show the importance of the individual consideration of technostress creators as we find that only four of the six technostress creators (techno-invasion, techno-overload, techno-insecurity, and techno-uncertainty) are positively affected by a higher degree of workplace digitalization as expected. Techno-complexity and techno-unreliability, however, have a negative relationship with the degree of workplace digitalization. This surprising result should inspire future research to consider different technostress creators individually rather than as one combined construct.

Third, we find evidence for the three-way relationship between the degree of workplace digitalization, technostress inhibitors, and technostress. Thereby, we find an effect of the degree of workplace digitalization on technostress inhibitors, of technostress inhibitors on the emergence of technostress creators, and the moderating effect of literacy facilitation on the relationship between the degree of workplace digitalization and technostress. Since the effects differ between the three technostress inhibitors and the affected technostress creators, we further strengthen the need to consider them separately.

4.1.5.2 Practical Implications

Our results also bring practical implications for organizations. With our large-scale study among German employees, we provide input on the existence and strength of the effect of the degree of workplace digitalization and technostress inhibitors on different technostress creators. Especially literacy facilitation can be an effective measure for organizations to mitigate the adverse effects of increasing workplace digitalization. This finding gives inspiration for mitigating the adverse effects of digitalization without slowing digitalization down. Our specific results for the six technostress creators and the three technostress inhibitors can impact IT and HR departments' decisions to design digital workplaces and leverage inhibitors better.

4.1.6 Limitations and Conclusion

Our study has several limitations that leave room for future research. First, our study was conducted in Germany and thus limited to the German workforce. Future research can analyze the robustness of the findings across other nationalities. Second, we collected cross-sectional data. Future work should also consider the effect of an increasingly digitalized workplace on technostress over time. Third, we measured the degree of workplace digitalization by providing participants with a list of 40 technologies to choose from. Even though we believe that these technologies cover the digital technologies present at today's workplaces, we cannot control for completeness of the list as it may change over time.

In conclusion, our research makes an important contribution to knowledge on inhibiting the adverse effects of the ongoing digitalization of workplaces. While organizations will keep on adopting digital technologies and establishing work routines based on digital technologies to achieve the associated benefits, they also have to consider possible adverse outcomes for their employees, such as technostress. Our work shows that inhibitors like literacy facilitation, involvement facilitation, and technical support provision can be effective.

4.1.7 References

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4.1.8 Appendix

Appendix 4.1.A. Definitions of Latent Variables

Construct	Definition	Source
Techno-Invasion	"Techno-invasion describes the invasive effect of [digital technologies] in situations where employees can be reached anytime and feel the need to be constantly connected, thus blurring work-related and personal contexts."	Ragu-Nathan et al. 2008, p. 427
Techno-Overload	"Techno-overload describes situations where [digital technologies] force users to work faster and longer."	Ragu-Nathan et al. 2008, p. 427
Techno-Complexity	"Techno-complexity describes situations where the complexity associated with [digital technologies] leads users to feel inadequate with regard to their computer skills and forces them to spend time and effort in learning and understanding [digital technologies]."	Ragu-Nathan et al. 2008, p. 427
Techno-Uncertainty	"Techno-uncertainty refers to contexts where continuing [digital technology] changes and upgrades unsettle users and create uncertainty so that they must constantly learn and educate themselves about new [digital technologies]."	Ragu-Nathan et al. 2008, p. 427
Techno-Insecurity	"Techno-insecurity is associated with situations where users feel threatened about losing their jobs, either because of automation from [digital technologies] or to other people who have a better understanding of [digital technologies]."	Ragu-Nathan et al. 2008, p. 427
Techno-Unreliability	Techno-unreliability refers to the "degree to which features and capabilities provided by the [digital] technology are [not] dependable".	Ayyagari et al. 2011, p. 837
Literacy Facilitation	"Literacy facilitation describes mechanisms that encourage and foster the sharing of [digital technologies]-related knowledge within the organization."	Ragu-Nathan et al. 2008, p. 427
Involvement Facilitation	"Involvement facilitation helps alleviate technostress by keeping users informed about the rationale for introducing new [digital technologies], by letting them know about the effects of such introduction, and by encouraging them to use and experiment with new [digital technologies]."	Ragu-Nathan et al. 2008, p. 427
Technical Support Provision	"Technical support provision describes activities related to end-user support that reduce the effects of technostress by solving users' [digital technology] problems relating."	Ragu-Nathan et al. 2008, p. 427

Appendix 4.1.B. List of Digital Technologies for Operationalization of Degree of Workplace Digitalization

(Groups of) Technologies	Examples
Laptops	
Stationary PCs	
Tablets	
Smartphones	
Mobile phones (no smartphones)	

Printers, scanners, and fax machines	
Headsets	
Stationary phones	
Text, spreadsheet, and presentation software	Microsoft Office applications
Document and knowledge management systems	Intranets, blogs, wikis
Visualization systems	Smartboards, digital positioning tables
Real-time communication systems	Web-conferencing, chats
Systems for social interaction and collaboration	Social networks, social collaboration
Email	
Background security systems without user interaction	Firewalls, encryption, VPN
Security systems involving user interaction	Password entry, authentication
Network hardware	Network systems, fieldbus systems
Wireless connections	Mobile networks, WiFi, radio devices
Cloud computing and virtual machines	Access to infrastructure for computing power or software via internet
World wide web	Access to information via browser or web applications
Data bases and data warehouses	Data storage and data management systems accessible locally or via internet
Medical software	Control systems for diagnostic and therapy devices
Modeling and simulation software	Mathematical modeling, physical simulations
Software for creativity and design	Software for editing images, videos, or audio for the entertainment industry
Software for product and software development	CAD/CAM systems, programming environments
Software for statistics and analysis	Software for the application of statistical methods for data mining
Content management systems	Software for website creation and website management
Cash register systems	Card readers, electronic cash register systems
Digital cash flow systems	Digital cash, online transactions
E-commerce systems	Software for web-shops or online auctions
Management information software	Project management software, business process modeling
Organizational administration software	Systems for financial controlling, ERP systems, administrative software
Decision support software	Decision support systems
Systems for production planning and production management	Software for purchasing and warehousing, production control units
Logistics systems	Systems for storage and transportation management
Automatic manufacturing systems	3D printers, CNC machines, robotics
Localization and distance measurement systems	Radar devices, devices for distance determination, navigation devices, GPS
Sensor systems	Sensor networks, mobile data acquisition devices
Artificial intelligence	Machine learning
Augmented, virtual, and mixed reality	Smart glasses
Speech interaction	Voice control, software for speech-to-text conversion

Appendix 4.1.C. Measurement Items of Latent Constructs

Items		Mean	SD	Loadings
Techno-Invasion (source: Ragu-Nathan et al. 2008)		**1.961**	**1.161**	
TIV01	I have to be in touch with my work even during my vacation due to this technology.	2.222	1.296	0.693
TIV02	I have to sacrifice my vacation and weekend time to keep current on new technologies.	1.643	0.971	0.812
TIV03	I feel my personal life is being invaded by this technology.	2.019	1.118	0.745
Techno-Overload (source: Ragu-Nathan et al. 2008)		**2.348**	**1.231**	
TO01	I am forced to change my work habits to adapt to new technologies.	2.317	1.211	0.850
TO02	I have a higher workload because of increased technology complexity.	2.378	1.250	0.891
Techno-Complexity (source: Ragu-Nathan et al. 2008)		**2.085**	**1.109**	
TC01	I do not know enough about this technology to handle my job satisfactorily.	1.789	0.960	0.763
TC02	I need a long time to understand and use new technologies.	1.984	1.063	0.845
TC03	I do not find enough time to study and upgrade my technology skills.	2.131	1.111	0.746
TC04	I find new recruits to this organization know more about computer technology than I do.	2.366	1.206	0.708
TC05	I often find it too complex for me to understand and use new technologies.	2.155	1.109	0.850
Techno-Insecurity (source: Ragu-Nathan et al. 2008)		**1.869**	**1.050**	
TIS01	I feel constant threat to my job security due to new technologies.	1.988	1.094	0.704
TIS02	I am threatened by coworkers with newer technology skills.	1.804	0.998	0.798
TIS03	I feel there is less sharing of knowledge among coworkers for fear of being replaced.	1.815	1.044	0.644
Techno-Uncertainty (source: Ragu-Nathan et al. 2008)		**2.786**	**1.217**	
TUC01	There are always new developments in the technologies we use in our organization.	3.157	1.166	0.719
TUC02	There are constant changes in computer software in our organization.	2.921	1.228	0.863
TUC03	There are constant changes in computer hardware in our organization.	2.544	1.167	0.897
TUC04	There are frequent upgrades in computer networks in our organization.	2.522	1.189	0.880
Techno-Unreliability (source: Ayyagari et al. 2011)		**2.378**	**0.961**	
TUR01	The features provided by the digital technologies I use are dependable.*	2.361	0.957	0.899
TUR02	The capabilities provided by the digital technologies I use are reliable.*	2.388	0.981	0.935
TUR03	The digital technologies I use behave in a highly consistent way.*	2.385	0.943	0.900

Literacy Facilitation (source: Ragu-Nathan et al. 2008)		**3.052**	**1.262**	
LF01	Our organization emphasizes teamwork in dealing with new technology-related problems.	3.187	1.212	0.785
LF02	Our organization provides end-user training before the introduction of new technology.	2.973	1.322	0.795
LF03	Our organization fosters a good relationship between IT department and end-users.	3.020	1.260	0.863
LF04	Our organization provides clear documentation to end-users on using new technologies.	3.027	1.242	0.857
Involvement Facilitation (source: Ragu-Nathan et al. 2008)		**2.281**	**1.305**	
IF01	Our end-users are rewarded for using new technologies.	2.089	1.224	0.678
IF02	Our end-users are consulted before introduction of new technology.	2.270	1.318	0.904
IF03	Our end-users are involved in technology change and/or implementation.	2.482	1.340	0.909
Technical Support Provision (source: Ragu-Nathan et al. 2008)		**3.460**	**1.226**	
TSP01	Our end-user help desk is well staffed by knowledgeable individuals.	3.445	1.216	0.835
TSP02	Our end-user help desk is easily accessible.	3.496	1.243	0.924
TSP03	Our end-user help desk is responsive to end-user requests.	3.440	1.218	0.932

*reverse coded

Appendix 4.1.D. Results for Research Models 1 to 3 including Control Variables

Model	Relationship	Estimate	Sig.
Model 1	Technostress → Techno-Invasion	0.787	***
	Technostress → Techno-Overload	0.848	***
	Technostress → Techno-Complexity	0.553	***
	Technostress → Techno-Insecurity	0.791	***
	Technostress → Techno-Uncertainty	0.476	***
	Technostress → Techno-Unreliability	0.101	***
	Degree of Workplace Digitalization → Technostress	0.264	***
	Gender → Technostress	-0.059	**
	Age → Technostress	-0.100	***
	Occupational Activity → Technostress	-0.010	
	School Qualification → Technostress	0.007	
	Occupational Qualification → Technostress	0.071	**
Model 2	Degree of Workplace Digitalization → Techno-Invasion	0.231	***
	Degree of Workplace Digitalization → Techno-Overload	0.274	***
	Degree of Workplace Digitalization → Techno-Complexity	-0.073	**
	Degree of Workplace Digitalization → Techno-Insecurity	0.143	***
	Degree of Workplace Digitalization → Techno-Uncertainty	0.356	***
	Degree of Workplace Digitalization → Techno-Unreliability	-0.207	***
	Gender → Techno-Invasion	-0.069	**
	Gender → Techno-Overload	-0.050	*
	Gender → Techno-Complexity	-0.007	
	Gender → Techno-Insecurity	-0.032	
	Gender → Techno-Uncertainty	-0.038	*
	Gender → Techno-Unreliability	0.014	

	Age → Techno-Invasion	-0.227	***
	Age → Techno-Overload	-0.040	
	Age → Techno-Complexity	0.077	***
	Age → Techno-Insecurity	-0.066	**
	Age → Techno-Uncertainty	-0.045	*
	Age → Techno-Unreliability	-0.105	***
	Occupational Activity → Techno-Invasion	0.043	
	Occupational Activity → Techno-Overload	0.024	
	Occupational Activity → Techno-Complexity	-0.078	***
	Occupational Activity → Techno-Insecurity	-0.102	***
	Occupational Activity → Techno-Uncertainty	0.057	**
	Occupational Activity → Techno-Unreliability	-0.046	*
	School Qualification → Techno-Invasion	0.005	
	School Qualification → Techno-Overload	0.017	
	School Qualification → Techno-Complexity	-0.010	
	School Qualification → Techno-Insecurity	-0.003	
	School Qualification → Techno-Uncertainty	0.007	
	School Qualification → Techno-Unreliability	-0.018	
	Occupational Qualification → Techno-Invasion	0.114	***
	Occupational Qualification → Techno-Overload	0.070	**
	Occupational Qualification → Techno-Complexity	0.041	
	Occupational Qualification → Techno-Insecurity	-0.003	
	Occupational Qualification → Techno-Uncertainty	-0.018	
	Occupational Qualification → Techno-Unreliability	0.066	**
Model 3	Technostress → Techno-Invasion	0.790	***
	Technostress → Techno-Overload	0.848	***
	Technostress → Techno-Complexity	0.554	***
	Technostress → Techno-Insecurity	0.796	***
	Technostress → Techno-Uncertainty	0.473	***
	Technostress → Techno-Unreliability	0.110	***
	Degree of Workplace Digitalization → Technostress	0.314	***
	Degree of Workplace Digitalization → Literacy Facilitation	0.353	***
	Degree of Workplace Digitalization → Involvement Facilitation	0.377	***
	Degree of Workplace Digitalization → Technical Support Provision	0.294	***
	Literacy Facilitation → Technostress	-0.083	***
	Involvement Facilitation → Technostress	0.177	***
	Technical Support Provision → Technostress	-0.126	***
	Degree of Workplace Digitalization x Literacy Facilitation → Technostress	-0.159	***
	Degree of Workplace Digitalization x Involvement Facilitation → Technostress	-0.006	
	Degree of Workplace Digitalization x Technical Support Provision→ Technostress	0.013	
	Gender → Technostress	-0.048	*
	Age → Technostress	-0.085	***
	Occupational Activity → Technostress	-0.023	
	School Qualification → Technostress	0.007	
	Occupational Qualification → Technostress	0.049	

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Appendix 4.1.E. Results for Model 4

Fit Measures	Threshold	Source of Threshold	Model 4	
χ^2			5,757	
Degrees of Freedom			869	
RMSEA	< 0.06	Lei and Wu (2007)	0.046	✓
SRMR	< 0.08	Gefen et al. (2000)	0.079	✓
NFI	> 0.90	Gefen et al. (2000)	0.932	✓
TLI	> 0.90	Gefen et al. (2000)	0.931	✓
CFI	> 0.90	Gefen et al. (2000)	0.942	✓
AGFI	> 0.80	Gefen et al. (2000)	0.891	✓

Note: ✓ indicates that a threshold is met, X indicates that it is not met.
Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Normed Fit Index (NFI), Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Adjusted Goodness of Fit Index (AGFI)

Relationship	Estimate	Sig.
Degree of Workplace Digitalization → Techno-Invasion	0.223	***
Degree of Workplace Digitalization → Techno-Overload	0.335	***
Degree of Workplace Digitalization → Techno-Complexity	0.013	
Degree of Workplace Digitalization → Techno-Insecurity	0.201	***
Degree of Workplace Digitalization → Techno-Uncertainty	0.284	***
Degree of Workplace Digitalization → Techno-Unreliability	0.007	
Degree of Workplace Digitalization → Literacy Facilitation	0.353	***
Degree of Workplace Digitalization → Involvement Facilitation	0.377	***
Degree of Workplace Digitalization → Technical Support Provision	0.294	***
Literacy Facilitation → Techno-Invasion	-0.063	**
Literacy Facilitation → Techno-Overload	-0.096	***
Literacy Facilitation → Techno-Complexity	-0.093	***
Literacy Facilitation → Techno-Insecurity	-0.109	***
Literacy Facilitation → Techno-Uncertainty	0.236	***
Literacy Facilitation → Techno-Unreliability	-0.184	***
Involvement Facilitation → Techno-Invasion	0.234	***
Involvement Facilitation → Techno-Overload	0.116	***
Involvement Facilitation → Techno-Complexity	-0.012	
Involvement Facilitation → Techno-Insecurity	0.168	***
Involvement Facilitation → Techno-Uncertainty	0.091	***
Involvement Facilitation → Techno-Unreliability	-0.170	***
Technical Support Provision → Techno-Invasion	-0.100	***
Technical Support Provision → Techno-Overload	-0.061	**
Technical Support Provision → Techno-Complexity	-0.120	***
Technical Support Provision → Techno-Insecurity	-0.130	***
Technical Support Provision → Techno-Uncertainty	-0.038	
Technical Support Provision → Techno-Unreliability	-0.296	***

Degree of Workplace Digitalization x Literacy Facilitation → Techno-Invasion	-0.102	*
Degree of Workplace Digitalization x Literacy Facilitation → Techno-Overload	-0.188	***
Degree of Workplace Digitalization x Literacy Facilitation → Techno-Complexity	-0.067	
Degree of Workplace Digitalization x Literacy Facilitation → Techno-Insecurity	-0.086	
Degree of Workplace Digitalization x Literacy Facilitation → Techno-Uncertainty	-0.050	
Degree of Workplace Digitalization x Literacy Facilitation → Techno-Unreliability	-0.066	
Degree of Workplace Digitalization x Involvement Facilitation → Techno-Invasion	0.053	
Degree of Workplace Digitalization x Involvement Facilitation → Techno-Overload	-0.015	
Degree of Workplace Digitalization x Involvement Facilitation → Techno-Complexity	0.005	
Degree of Workplace Digitalization x Involvement Facilitation → Techno-Insecurity	-0.036	
Degree of Workplace Digitalization x Involvement Facilitation → Techno-Uncertainty	-0.036	
Degree of Workplace Digitalization x Involvement Facilitation → Techno-Unreliability	-0.024	
Degree of Workplace Digitalization x Technical Support Provision→ Techno-Invasion	-0.022	
Degree of Workplace Digitalization x Technical Support Provision→ Techno-Overload	0.045	
Degree of Workplace Digitalization x Technical Support Provision→ Techno-Complexity	0.000	
Degree of Workplace Digitalization x Technical Support Provision→ Techno-Insecurity	-0.006	
Degree of Workplace Digitalization x Technical Support Provision→ Techno-Uncertainty	0.010	
Degree of Workplace Digitalization x Technical Support Provision→ Techno-Unreliability	0.022	
Gender → Techno-Invasion	-0.051	*
Gender → Techno-Overload	-0.044	*
Gender → Techno-Complexity	-0.010	
Gender → Techno-Insecurity	-0.022	
Gender → Techno-Uncertainty	-0.031	
Gender → Techno-Unreliability	-0.001	
Age → Techno-Invasion	-0.208	***
Age → Techno-Overload	-0.029	
Age → Techno-Complexity	0.084	***
Age → Techno-Insecurity	-0.051	*
Age → Techno-Uncertainty	-0.046	*
Age → Techno-Unreliability	-0.104	***
Occupational Activity → Techno-Invasion	0.015	
Occupational Activity → Techno-Overload	0.020	
Occupational Activity → Techno-Complexity	-0.061	**
Occupational Activity → Techno-Insecurity	-0.109	***
Occupational Activity → Techno-Uncertainty	0.025	
Occupational Activity → Techno-Unreliability	0.015	
School Qualification → Techno-Invasion	0.010	
School Qualification → Techno-Overload	0.015	
School Qualification → Techno-Complexity	-0.016	
School Qualification → Techno-Insecurity	-0.003	
School Qualification → Techno-Uncertainty	0.012	
School Qualification → Techno-Unreliability	-0.035	

Occupational Qualification → Techno-Invasion	0.100	***
Occupational Qualification → Techno-Overload	0.051	*
Occupational Qualification → Techno-Complexity	0.025	
Occupational Qualification → Techno-Insecurity	-0.023	
Occupational Qualification → Techno-Uncertainty	-0.015	
Occupational Qualification → Techno-Unreliability	0.036	

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

4.2 Social Support as Technostress Inhibitor: Even More Important During the COVID-19 Pandemic?

Abstract

Due to ongoing digitalization and the social distancing measures that came along with the COVID-19 pandemic, the working conditions and environments have changed for many individuals. Because of increased telework, the use of digital technologies for communicating and collaborating at work has been intensified which can cause technostress. With longitudinal data from two surveys – one before and one during the COVID-19 pandemic – the paper analyzes the relationship between four social support dimensions (supervisor support, co-worker support, sense of community at work, and family support) and technostress creators. The study shows that social support can be an effective inhibitor of technostress creators. However, social support dimensions have to be differentiated in that regard. Further, the results show that the inhibiting effect of family support has become even more important during the COVID-19 pandemic. The results contribute to technostress research and research with regard to the new normal of working after the pandemic.

Keywords: Technostress, Technostress Inhibitors, Social Support, Longitudinal Data, Structural Equation Modeling

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Status: Working paper.

4.2.1 Introduction

The COVID-19 pandemic has changed the working conditions for many people. Due to the social distancing measures in order to fight the pandemic, many employees were asked to engage in telework and work from home. In July 2020, one third of employees in the European Union worked entirely from home, almost 50 % at least partly (Ahrendt et al. 2020). This led to a higher amount of digital work and less contact with co-workers. On the other hand, contact with family members increased since many of them were working from home together.

One phenomenon that goes along with digital work is technostress, which refers to "stress that users experience as a result of their use of IS in the organizational context" (Tarafdar et al. 2015, p. 103). Technostress is associated with lower job satisfaction, productivity, and a higher risk of burnout (e.g., Day et al. 2012; Ragu-Nathan et al. 2008; Tu et al. 2008). To address such negative outcomes, literature on technostress has investigated potential mitigation strategies. While coping literature deals with behavioral, cognitive, and perceptional efforts of individuals (Weinert et al. 2020), literature on technostress inhibitors focuses on organizational or environmental mechanisms that reduce technostress creators or its negative consequences (Ragu-Nathan et al. 2008). Such inhibitors are, for example, the fostering of learning to deal with digital technologies, the provision of technical support, or the involvement of employees when launching new digital technologies (Ragu-Nathan et al. 2008).

However, organizational measures have been less available in times of the COVID-19 pandemic. Many companies, for example, introduced communication and collaboration tools almost over night in order to be able to stay connected and, thus, were not able to involve employees in this change. But, according to results from Ahrendt et al. (2020), the provision of help and social support from supervisors or co-workers did not change during telework.

In psychology research, social support has been considered as inhibitor of workplace stress (e.g., Barrera 1986; Eisenberger et al. 2002; Sass et al. 2011). There are different sources of social support (e.g., supervisors, co-workers, family members) (Barrera 1986). To the best of our knowledge, technostress research has not yet considered such variables as technostress inhibitors. Thus, we aim to understand whether social support can inhibit technostress and its importance during times of high telework and pose the following research questions:

> *RQ1: Are different dimensions of social support effective technostress inhibitors?*
>
> *RQ2: Is social support as technostress inhibitor more important during the COVID-19 pandemic?*

To answer these questions, we draw on literature from psychology on the effect of social support on stress creators and outcomes and develop hypotheses on the association of different social support dimensions (supervisor support, co-worker support, sense of community at work, and family support) with technostress creators (techno-invasion, techno-overload, techno-complexity, techno-insecurity, and techno-uncertainty) as well as the changes in times of telework. We collect longitudinal empirical data on the constructs at two points of time (i.e., before and during the COVID-19 pandemic) and analyze the data by structural equation modeling and regression analysis with interaction effects.

The paper is structured as follows: Section 4.2.2 introduces the theoretical background on technostress literature, technostress inhibitors, and other stress mitigation constructs from psychology literature. Section 4.2.3 develops the hypotheses. Section 4.2.4 describes the study design and procedures and Section 4.2.5 displays the corresponding results. Section 4.2.6 discusses the results as well as the theoretical contribution and practical implications of the findings. Finally, Section 4.2.7 concludes the paper.

4.2.2 Theoretical Background

Studies on technostress can be traced back to the clinical psychologist Brod (1982), who coined the term and described the phenomenon as an individual's inability to deal with new technology in a healthy way, which leads to a stressful experience. In psychology literature, Lazarus and Folkman (1984, p. 19) define stress as a "particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being." For technostress, the demands result from the use of digital technologies. Tarafdar et al. (2007) and Ragu-Nathan et al. (2008) have defined five technostress creators which, to date, are the most established and researched technostress creators in IS literature: techno-invasion, techno-overload, techno-complexity, techno-insecurity, and techno-uncertainty. Techno-invasion refers to the feeling of blurring boundaries between private and business lives and the need to be constantly available. Techno-overload describes the feeling of having to work faster and longer. Techno-complexity is the feeling of having inadequate skills to deal with digital technologies. Techno-insecurity refers to the fear of losing ones job due to automation or a lack of skills for dealing with digital technologies. Lastly, techno-uncertainty describes the experience of constant changes and updates of digital technologies and the need for constant learning (Ragu-Nathan et al. 2008).

Since technostress has been found to have negative effects on individuals and organizations such as reduced job satisfaction, increased burnout, or lower organizational commitment (e.g., Day et al. 2012; Ragu-Nathan et al. 2008; Tarafdar et al. 2007), much research focuses on the mitigation of technostress. Thereby, literature can be divided in two streams: technostress inhibitors and coping. Technostress inhibitors refer to "organizational mechanisms that have the potential to reduce the effects of technostress" (Ragu-Nathan et al. 2008, p. 422). Coping, in contrast, focuses on the individual perspective and "investigates how users themselves aim to reduce technostress by deploying behavioral, cognitive, and perceptional efforts" (Weinert et al. 2020, p. 1203). In our study, we focus on mechanisms from the individual's environment and, thus, draw on literature of technostress inhibitors.

Several studies can be found that investigate the effect of technostress inhibitors (e.g., Day et al. 2012; Ragu-Nathan et al. 2008; Tarafdar et al. 2010). While some studies investigate the effect on technostress creators, some focus on the direct effect on technostress outcomes, and some analyze the moderating effect between technostress creators and outcomes (Sarabadani et al. 2018). The most studied technostress inhibitors are three organizational mechanisms: literacy facilitation (i.e., promoting the sharing of knowledge on digital technologies), involvement facilitation (i.e., involving employees in the change process when introducing new digital technologies), and technical support provision (i.e., the provision of an adequate end-user support for problems with digital technologies). Tarafdar et al. (2015), for example, find them to be negatively associated with technostress creators. Direct negative effects on technostress creators have also been found by Tarafdar et al. (2010) (for involvement facilitation) and Tarafdar et al. (2011) (for involvement facilitation, technical support provision, and innovation support). For the direct effects on technostress outcomes, the three inhibitors and other inhibitors such as innovation support, stress management trainings, and job control have been found to have a positive effect on, for example, end-user satisfaction, job satisfaction, organizational commitment, continuance commitment, and productivity (Ahmad et al. 2014; Fuglseth and Sørebø 2014; Ragu-Nathan et al. 2008; Tarafdar et al. 2010; Tarafdar et al. 2011; Tu et al. 2008) and a negative effect on ICT stress, strain, or burnout (Day et al. 2012). Regarding the moderating effect of technostress inhibitors on the relationship between technostress creators and outcomes, Ahmad et al. (2014), for example, find technical support to moderate the relationship between techno-overload and organizational commitment. Other studies such as Ragu-Nathan et al. (2008), Tu et al. (2008), and Hung et al. (2011) do not find moderating effects of technostress inhibitors.

In psychology literature, different dimensions of social support and their relationship with different types of stress and strain have been researched (Barrera 1986). One important dimension is perceived social support, that refers to the "perceived availability and adequacy of supportive ties" (Barrera 1986, p. 416). Another dimension of social support is social embeddedness, which "refers to the connections that individuals have to significant others in their social environments" (Barrera 1986, p. 415). There are many studies that investigate perceived social support and social embeddedness and their relationship with stress in the organizational context. Witt and Carlson (2006, p. 347), for example, investigated perceived organizational support and define it as "the employee's assessment of the extent to which the organization is 'on my side'." Organizational support (i.e., social support from various sources in the organization) has been found to be associated with increased satisfaction, job performance, and continuance commitment (Eisenberger et al. 1990; Patrick and Laschinger 2006). More specific than organizational support in general, support for individuals at their workplaces can stem from different groups of people of an individual's environment: supervisors, colleagues, and family members (e.g., Mansour and Tremblay 2016; Sass et al. 2011; Wolgast and Fischer 2017).

According to Barrera (1986), social support can relate to stress and stress outcomes in different ways: by directly affecting the occurrence of stress events, perceived stress, or stress outcomes. This is along the lines with prior literature on technostress inhibitors (Sarabadani et al. 2018). Technostress literature has mostly neglected dimensions of social support and their possible consideration as technostress-inhibitors. To close this gap, we aim to transfer knowledge on social support and sense of community from psychology literature to the context of technostress and analyze their effect on technostress creators. Thereby, we especially want to understand whether the importance of social support and sense of community has changed in times of high telework (i.e., during the COVID-19 pandemic).

4.2.3 Hypotheses Development

According to Lazarus and Folkman (1984), stress is the result of an interplay of environmental demands and the individual's resources. This is in line with related psychology theories like the conservation of resources theory (Hobfoll 1989) or the job demands-resources model (Demerouti et al. 2001). Thereby, social support is considered as one important resource for inhibiting stress creators (Barrera 1986).

We aim to understand the relationship of different dimensions of social support with technostress creators. Therefore, we investigate four dimensions of social support: supervisor support, co-worker support, sense of community at work, and family support. The first three of them refers to the "perceived social support" dimension and the last one refers to the "social embeddedness" dimension of Barrera (1986).

Supervisor support is the "degree to which supervisors value their [employees'] contributions and care about their well-being" (Eisenberger et al. 2002, p. 565). Sass et al. (2011) found supervisor support to be negatively associated with workload stressors and job dissatisfaction. Sosik and Godshalk's (2000) results show lower job stress of employees when their leaders engage in a mentoring function. Co-worker support refers to a "cooperative peer-level effort amongst employees to provide work-related assistance" (Jia et al. 2008, p. 307). Sass et al. (2011) as well as Wolgast and Fischer (2017) detected negative effects of co-worker support on job dissatisfaction and strain. McCarty et al. (2007) discovered a negative effect of camaraderie on work-related strain. Family support is defined as the "degree of […] support [from family members] employees perceive as directed at their roles as worker" (King et al. 1995, p. 236). Barnett et al. (2012) as well as Mansour and Tremblay (2016) found it to be negatively associated with job strain and Asbari et al. (2021) found a positive effect on job satisfaction. Lastly, sense of community refers to "the overall quality of social interaction at work" (Leiter and Maslach 2003, p. 98). Cicognani et al. (2009) found a negative correlation between sense of community and burnout. In the same regard, Gascón et al. (2021) detected negative effects on burnout. They also found sense of community to negatively moderate the relationship between workload and cynicism and lack of job fulfillment (Gascón et al. 2021).

In line with these findings, we propose a negative relationship of social support (i.e., supervisor support, co-worker support, sense of community at work, and family support) with technostress creators. The reasons are as follows: Higher social support from supervisors, co-workers, and family members gives employees the feeling that they can expect help when having problems with digital technologies and, thus, feel less threatened in the first place. For supervisor support, for example, it is easier for an employee to talk to their supervisors about their fear of losing the job (i.e., techno-insecurity) if the supervisor is concerned with the employee's needs. Also, they can more easily take precautions in the task portfolio of the employee so that the feeling of having to much to do (i.e., techno-overload) will not occur.

To sum it up, we pose the following hypothesis:

> *H1: Social support dimensions (a) supervisor support, b) co-worker support, c) sense of community at work, and d) family support) are negatively related with technostress creators.*

During the COVID-19 pandemic, many employees were forced to telework and work from home. Thus, their working environment and the availability of organizational resources changed rapidly. Whereas, before the pandemic, many employees worked in the organization's office and were surrounded by their co-workers and supervisors, they now worked from home or in less frequented offices. Because of rapidly introduced new digital technologies for being able to stay in contact with co-workers and supervisors, traditional technostress inhibitors such as involvement facilitation were less available. Therefore, not only demands changed but employees had to adapt to the new environmental conditions and find effective and available sources of support. Thus, we hypothesize:

> *H2: The negative relationship between social support and technostress creators is stronger during the COVID-19 pandemic.*

4.2.4 Study Design and Procedures

To test our hypotheses empirically, we conducted a longitudinal online survey and measured all constructs from the research model in the questionnaire. For technostress creators, we used the items from Ragu-Nathan et al. (2008). For supervisor support and family support, we built on the scale by Graen and Uhl-Bien (1995). Items for co-worker support and sense of community at work were collected from Burr et al. (2019). Where possible, we used validated German translations of the items. For all other items, we translated the English versions to German. Appendix 4.2.A provides an overview of all items.

We recruited participants via a German panel provider. Respondents were paid a small compensation for their participation. The first survey was conducted in March 2019 (T1). In December 2020, during the second lockdown in Germany, we surveyed the same participants for the second time (T2).

4.2.5 Results

637 participants completed the survey in both iterations. Of the respondents, 41.1 % were female and 58.9 % were male. On average, respondents were 47 years old at the first time of participation.

Our analysis strategy was threefold: First, we conducted paired t-tests in order to compare the variables at the two points in time (T1 and T2). Second, we assessed two structural equation models at the two points of time through covariance-based structural equation modeling (CB-SEM). Each of the models consisted of the five technostress creators as dependent variables and the four social support dimensions as independent variables. Each technostress creator was explained by each social support dimension. We started with an evaluation of the measurement models and proceeded by assessing the structural models and testing our first hypothesis. Third and last, we conducted clustered regression analyses to test whether changes in paths between the two points of time were significant and to test our second hypothesis.

4.2.5.1 Comparison of Variables for T1 and T2

We started with a mean comparison of our variables at both points of time and conducted paired t-tests to test whether mean differences were statistically significant. Table 4.2-1 shows the results. Only techno-invasion, techno-uncertainty, and family support showed significant differences between T1 and T2. Techno-invasion has become higher during the COVID-19 pandemic, techno-uncertainty and family support have decreased. The other technostress creators and social support dimensions did not change significantly.

Construct	Mean T1	Mean T2	Difference (T2 – T1)	sig. of paired t-test
Techno-Invasion	0.902	1.021	0.119	**
Techno-Overload	1.429	1.389	-0.040	
Techno-Complexity	1.063	1.130	0.067	
Techno-Insecurity	1.726	1.467	-0.258	***
Techno-Uncertainty	1.042	0.977	-0.066	
Supervisor Support	2.433	2.390	-0.042	
Co-Worker Support	2.427	2.464	0.037	
Sense of Community	2.925	2.948	0.023	
Family Support	2.838	2.728	-0.110	***

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Table 4.2-1: Results of Paired t-tests

4.2.5.2 Assessment of the Measurement Models at T1 and T2

Next, we used CB-SEM to assess the two models at T1 and T2 and started with an evaluation of the measurement models. For the reliability assessment, we used Cronbach's Alpha. All scales' values for Cronbach's Alpha exceeded the threshold of 0.708 with a minimum of 0.810, which indicates internal consistency reliability (Nunnally and Bernstein 1994). Also, convergent validity is satisfactory as the minimum of all indicators' outer loadings is 0.623 and the minimum average variance extracted (AVE) is 0.581. For discriminant validity, we examined whether each construct's square root of the AVE was higher than the highest correlation with other constructs (Fornell-Larcker criterion). The data met this criterion. Thus, discriminant validity was supported for both models. Table 4.2-2 and Table 4.2-3 show means, standard deviations (SD), loadings, Cronbach's Alpha (Alpha) values as well as the AVE values for all constructs at T1 and T2. Information on the Fornell-Larcker criterion can be found in Appendix 4.2.B.

Construct	# Items	Mean	SD	Loadings	Alpha	AVE
Techno-Invasion	3	0.902	1.213	0.633-0.891	0.815	0.612
Techno-Overload	4	1.429	1.305	0.710-0.892	0.896	0.693
Techno-Complexity	5	1.063	1.166	0.770-0.883	0.912	0.680
Techno-Insecurity	5	1.726	1.197	0.694-0.825	0.871	0.581
Techno-Uncertainty	5	1.042	1.238	0.756-0.875	0.875	0.639
Supervisor Support	6	2.433	1.186	0.720-0.899	0.933	0.706
Co-Worker Support	4	2.499	1.186	0.800-0.852	0.810	0.681
Sense of Community	2	2.925	0.844	0.901-0.909	0.901	0.820
Family Support	5	2.838	1.059	0.623-0.882	0.879	0.604

Table 4.2-2: Descriptive Statistics, Main Factor Loadings, Cronbach's Alpha, and AVE at T1

Construct	# Items	Mean	SD	Loadings	Alpha	AVE
Techno-Invasion	3	1.021	1.214	0.659-0.870	0.813	0.605
Techno-Overload	4	1.389	1.252	0.771-0.893	0.915	0.729
Techno-Complexity	5	1.130	1.169	0.755-0.886	0.922	0.705
Techno-Insecurity	5	0.977	1.134	0.709-0.850	0.887	0.618
Techno-Uncertainty	5	1.467	1.205	0.783-0.921	0.906	0.717
Supervisor Support	6	2.390	1.194	0.761-0.904	0.939	0.726
Co-Worker Support	4	2.521	1.003	0.810-0.887	0.836	0.720
Sense of Community	2	2.948	0.838	0.909-0.915	0.908	0.832
Family Support	5	2.728	1.073	0.758-0.886	0.901	0.647

Table 4.2-3: Descriptive Statistics, Main Factor Loadings, Cronbach's Alpha, and AVE at T2

4.2.5.3 Assessment of Structural Models at T1 and T2

We proceeded with the assessment of the structural models. Table 4.2-4 displays several fit-indices that we used to asses the models' fit. Almost all indices comply with the respective thresholds indicating satisfactory model fit for both models.

Fit Measures		Threshold	Source of Threshold	Model T1	Model T2
Global measures	RMSEA	< 0.06	Lei and Wu (2007)	0.054 ✓	0.061 X
	SRMR	< 0.05	Gefen et al. (2000)	0.049 ✓	0.050 ✓
Incremental measures	NFI	> 0.90	Gefen et al. (2000)	0.903 ✓	0.900 ✓
	TLI	> 0.90	Gefen et al. (2000)	0.927 ✓	0.918 ✓
	CFI	> 0.90	Gefen et al. (2000)	0.936 ✓	0.927 ✓
Parsimony	AGFI	> 0.80	Gefen et al. (2000)	0.835 ✓	0.802 ✓

Note: Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Normed Fit Index (NFI), Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Adjusted Goodness of Fit Index (AGFI)
✓ indicates that a threshold is met, X indicates that it is not met.

Table 4.2-4: Fit Indices for the Research Models at T1 and T2

After the evaluation of the models' fit, we tested our hypothesis about the relationship of social support with technostress creators. Table 4.2-5 presents the path estimates for both models as wells as their significance level.

Relationship	Model T1		Model T2	
	Estimate	sig.	Estimate	sig.
Supervisor Support → Techno-Invasion	0.117	*	0.112	*
Supervisor Support → Techno-Overload	-0.035		-0.054	
Supervisor Support → Techno-Complexity	-0.007		-0.018	
Supervisor Support → Techno-Insecurity	0.107	*	-0.029	
Supervisor Support → Techno-Uncertainty	0121	*	-0.026	
Co-Worker Support → Techno-Invasion	-0.100		0.101	
Co-Worker Support → Techno-Overload	-0.044		0.122	
Co-Worker Support → Techno-Complexity	0.006		0.092	
Co-Worker Support → Techno-Insecurity	-0.114		0.172	**
Co-Worker Support → Techno-Uncertainty	-0.060		0.126	
Sense of Community at Work → Techno-Invasion	-0.374	***	-0.303	***
Sense of Community at Work → Techno-Overload	-0.276	***	-0.320	***
Sense of Community at Work → Techno-Complexity	-0.335	***	-0.290	***
Sense of Community at Work → Techno-Insecurity	-0.291	***	-0.434	***
Sense of Community at Work → Techno-Uncertainty	-0.113		-0.138	*
Family Support → Techno-Invasion	0.062		-0.229	***
Family Support → Techno-Overload	0.030		-0.123	**
Family Support → Techno-Complexity	-0.032		-0.174	***
Family Support → Techno-Insecurity	0.012		-0.154	***
Family Support → Techno-Uncertainty	0.093		-0.092	

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Table 4.2-5: Results of Structural Models

The results show differences between the social support dimensions. Supervisor support is significantly related with techno-invasion, techno-insecurity, and techno-uncertainty in T1 and with techno-invasion in T2. However, the relationship is positive and not negative as expected. For co-worker support, we only find one significant relation with techno-insecurity in T2. Again, it is positive other than hypothesized. Sense of community at work is negatively associated as expected with all technostress creators at both points of time except for techno-uncertainty in T1. Family support has a negative effect on techno-invasion, techno-overload, techno-complexity, and techno-insecurity, but only in T2.

To sum it up, supervisor support and co-worker support are associated only with some of the technostress creators and the effect is positive, which means the two dimensions increase technostress creators. However, sense of community as well as family support can be effective measures to inhibit technostress creators as they are negatively related with technostress creators. Thus, we can partially support our first hypothesis.

4.2.5.4 Comparison of Relationships between T1 and T2

For the last step of our analysis, we tested whether there are significant changes in relationships between the two points of time in order to test our second hypothesis. Therefore, we conducted clustered regression analyses (accounting for repeated measures for each survey participant) of the interaction of each social support dimension with a binary time variable (T1 = 0, T2 = 1) on each technostress creator. We used factor scores from the prior SEM for the regression analysis. Table 4.2-6 presents the results. For purpose of readability, we only include the results for the interactions. The results for the direct effects can be seen in Appendix 4.2.C.

Relationship	Clustered Std. Error	Estimate	sig.
Supervisor Support x Time → Techno-Invasion	0.055	-0.011	
Supervisor Support x Time → Techno-Overload	0.065	-0.003	
Supervisor Support x Time → Techno-Complexity	0.061	-0.014	
Supervisor Support x Time → Techno-Insecurity	0.053	-0.097	
Supervisor Support x Time → Techno-Uncertainty	0.064	-0.111	
Co-Worker Support x Time → Techno-Invasion	0.067	0.160	*
Co-Worker Support x Time → Techno-Overload	0.074	0.142	
Co-Worker Support x Time → Techno-Complexity	0.066	0.069	
Co-Worker Support x Time → Techno-Insecurity	0.062	0.209	***
Co-Worker Support x Time → Techno-Uncertainty	0.071	0.144	*
Sense of Community at Work x Time → Techno-Invasion	0.080	0.091	
Sense of Community at Work x Time → Techno-Overload	0.092	-0.028	
Sense of Community at Work x Time → Techno-Complexity	0.080	0.063	
Sense of Community at Work x Time → Techno-Insecurity	0.080	-0.108	
Sense of Community at Work x Time → Techno-Uncertainty	0.089	-0.029	
Family Support x Time → Techno-Invasion	0.066	-0.250	***
Family Support x Time → Techno-Overload	0.073	-0.182	*
Family Support x Time → Techno-Complexity	0.063	-0.133	*
Family Support x Time → Techno-Insecurity	0.061	-0.160	**
Family Support x Time → Techno-Uncertainty	0.067	-0.193	**

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Table 4.2-6: Results of the Interaction Analyses

Again, the results show differences between the social support dimensions. Supervisor support as well as sense of community did not significantly change. The relationship between co-worker support with techno-invasion, techno-insecurity, and techno-uncertainty has become more positive in T2. For family support, the effect has become more negative on all five technostress creators. Thus, family support has significantly become more important as technostress inhibitor in T2 in comparison to T1. This is in line with H2. Thus, we also find partial support for our second hypothesis.

4.2.6 Discussion

The presented research was motivated in two ways: First, technostress research has increasingly investigated possible mitigation of technostress via individual coping or organizational mechanisms. However, social support as technostress inhibitor has been mostly neglected so far even though it is an inhibitor of stress in general and our results show that it is also an inhibitor of technostress. Second, the COVID-19 pandemic has changed the working environment for many employees and increased their amount of telework. In this changed environment, organizational measures such as technical support cannot take the same effect as during times of high physical presence in the organizational offices and, thus, individuals had to find other sources of support.

Our results shed light on the effect of social support to inhibit technostress. Thereby, it is important to notice that the amount of supervisor support, co-worker support as well as sense of community at work did not significantly change before and during the pandemic. Thus, the results are not influenced by the availability of each source of support but may be due to other changed conditions during the pandemic.

We find that sense of community at work is an effective technostress inhibitor and is negatively associated with technostress creators before and during the pandemic. Supervisor support, however, cannot be confirmed as technostress inhibitor as it even increases techno-invasion, techno-insecurity, and techno-uncertainty. This means that a good relationship with the supervisor increases the perception of these technostress creators. This is in contrast to prior findings on the effect of supervisor support on work stress (e.g., Sass et al. 2011). For techno-invasion, the reason might be that if an employee has a close relationship with his or her supervisor, they are more willing to be reachable during non-work hours when this appears important to the supervisor. For techno-insecurity and techno-uncertainty, the explanation for this positive relationship is less intuitive and needs further investigation. The same is the case for the discovered positive relationship between co-worker support and techno-insecurity during the pandemic. Apart from that relationship, co-worker support could not be found as technostress inhibitor.

Family support did become slightly lower during the pandemic. Yet, in this time period, it was important as a technostress inhibitor. While it did not have an effect before the pandemic, it significantly decreased technostress creators during the pandemic. This is one important finding indicating that employees found alternative sources of support during the pandemic and found this source in their own family members. Even though the availability of family support slightly decreased, it helps to inhibit technostress creators.

4.2.6.1 Theoretical Contribution

Our results contribute to literature in several ways: First, we extend literature on technostress inhibitors and transfer knowledge from psychology to technostress literature. We find that sense of community at work helps to inhibit technostress creators and that family support has the same effect in work settings with high amounts of telework. This adds to the previously highly investigated technostress inhibitors (literacy facilitation, involvement facilitation, and technical support provision) and may inspire research to further investigate the effects of social support on technostress creators and the relationship between technostress creators and strain. For future research, it is important to investigate whether different groups of employees (e.g., male vs. female employees) lean on different dimensions of social support.

Second, we find evidence that not all social support dimensions are related to technostress creators in the same direction. According to our results, supervisor support does not function as technostress inhibitor. Rather, it increases technostress. This is an important finding and shows that social support dimensions have to be differentiated. Future research should analyze the reasons for the differences between different social support dimensions.

Third, we find differing results between the technostress creators. Prior research often builds a higher-order construct of technostress creators (e.g., Ragu-Nathan et al. 2008) instead of investigating the relationship of the first-order constructs with, for example, antecedents and outcomes of technostress. We show the importance of differentiating the different technostress creators.

4.2.6.2 Practical Implications

Our results suggest different practical implications for organizations. Organizations must be aware of the fact that not only organizational mechanisms such as the provision of technical support or training with digital technologies can inhibit technostress but also more soft mechanisms such as the sense of community at work. However, building such a sense of community among the employees takes time and it is hard to influence it by one single measure but by numerous measures (such as trust-building or team-building measures).

Also, it is important for organizations as well as supervisors to notice that their behavior may imply too high expectations in terms of, for example, reachability during non-work hours on their employees when they have a good relationship. According to our results, such a behavior may increase technostress. Thus, supervisors have to challenge their behavior in that regard and actively communicate their expectations.

4.2.6.3 Limitations

Our study has several limitations. We used data from two cross-sectional surveys which limits the possibility to find causal effects between social support and technostress creators. Even though the causal motivation for each relationship stems from theory and prior literature, future research should follow up with generating further data sets to test robustness and generalizability. Further, the COVID-19 pandemic has come along with a large variety of changes in the private and business environment of employees. Thus, it may be that the surveyed constructs in our study do not completely cover all these changes. Future research should further investigate these changes that have not been regarded in our study. This is also important in order to draw conclusions for the new normal of working after the COVID-19 pandemic.

4.2.7 Conclusion

Digitalization as well as the COVID-19 pandemic have dramatically changed workplaces and working environments. The resulting technostress can be inhibited by different organizational mechanisms as well as support from an individual’s environment. Our results give evidence that social support can be an effective technostress inhibitor and that it becomes even more important when the amount of telework is high. Even when the social distancing measures due to the COVID-19 pandemic will be terminated, many studies show that the new normal of working will include higher amounts of telework than before the COVID-19 pandemic. Thus, our results remain relevant even after the pandemic and may inspire research and organizations when preparing for the new normal of working.

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4.2.9 Appendix

Appendix 4.2.A. Measurement Items

Techno-Invasion (source: Ragu-Nathan et al. 2008)[1)]	
TIV01	I have to be in touch with my work even during my vacation due to this technology.
TIV02	I have to sacrifice my vacation and weekend time to keep current on new technologies.
TIV03	I feel my personal life is being invaded by this technology.
Techno-Overload (source: Ragu-Nathan et al. 2008)[1)]	
TO01	I am forced to change my work habits to adapt to new technologies.
TO02	I am forced by this technology to work with very tight time schedules.
TO03	I am forced to change my work habits to adapt to new technologies.
TO04	I have a higher workload because of increased technology complexity.
Techno-Complexity (source: Ragu-Nathan et al. 2008)[1)]	
TC01	I do not know enough about this technology to handle my job satisfactorily.
TC02	I need a long time to understand and use new technologies.
TC03	I do not find enough time to study and upgrade my technology skills.
TC04	I find new recruits to this organization know more about computer technology than I do.
TC05	I often find it too complex for me to understand and use new technologies.
Techno-Insecurity (source: Ragu-Nathan et al. 2008)[1)]	
TIS01	I feel constant threat to my job security due to new technologies.
TIS02	I have to constantly update my skills to avoid being replaced.
TIS03	I am threatened by coworkers with newer technology skills.
TIS04	I do not share my knowledge with my coworkers for fear of being replaced.
TIS05	I feel there is less sharing of knowledge among coworkers for fear of being replaced.
Techno-Uncertainty (source: Ragu-Nathan et al. 2008) [1)]	
TUC01	There are always new developments in the technologies we use in our organization.
TUC02	There are constant changes in computer software in our organization.
TUC03	There are constant changes in computer hardware in our organization.
TUC04	There are frequent upgrades in computer networks in our organization.
Supervisor Support (source: Graen and Uhl-Bien 1995; Schyns 2002)[1)]	
SUS01	My leader understands my job problems and needs.
SUS02	My leader recognizes my potential.
SUS03	My leader would use his/her power to help me solve problems in my work.
SUS04	I have enough confidence in my leader that I would defend and justify his/her decision.
SUS05	Regardless of the amount of formal authority my leader has, he/she would “bail me out”, at his/her expenses.
SUS06	I know how my leader generally assesses me.
Co-Worker Support (source: Burr et al. 2019)[2)]	
SSW01	How often do you get help and support from your colleagues if needed?
SSW02	How often are your colleagues willing to listen to your problems at work if needed?
Sense of Community at Work (source: Burr et al. 2019)[2)]	
SCW01	Is there a good atmosphere between you and your colleagues?
SCW02	Do you feel part of a community at your place of work?

Family Support (source: Graen and Uhl-Bien 1995; Schyns 2002)[1)]	
FS01	People from my close private environment (e.g., partner, children, parents) understand my job problems and needs.
FS02	People from my close private environment (e.g., partner, children, parents) would use their possibilities to help me solve problems in my work.
FS03	People from my close private environment (e.g., partner, children, parents) would "bail me out", at their expenses.
FS04	People from my close private environment (e.g., partner, children, parents) understand my private problems and needs.
FS05	I know how people from my close private environment (e.g., partner, children, parents) generally assess me.

[1)] Measured on a five-point Likert scale ranging from "strongly disagree" to "strongly agree".
[2)] Measured on a six-point Likert scale ranging from "never" to "always".

Appendix 4.2.B. Fornell-Larcker Criterion

Inter-Factor-Correlations for T1 (square root of AVE in the diagonal)

	TIV	TO	TC	TIS	TUC	SUS	CWS	SCW	FS
Techno-Invasion (TIV)	0.782								
Techno-Overload (TO)	0.577	0.832							
Techno-Complexity (TC)	0.608	0.626	0.825						
Techno-Insecurity (TIS)	0.687	0.720	0.621	0.762					
Techno-Uncertainty (TUC)	0.473	0.592	0.477	0.659	0.800				
Supervisor Support (SUS)	-0.020	-0.133	-0.130	-0.021	0.094	0.840			
Co-Worker Support (CWS)	-0.244	-0.190	-0.182	-0.233	-0.057	0.282	0.825		
Sense of Community (SCW)	-0.369	-0.303	-0.343	-0.311	-0.078	0.343	0.525	0.905	
Family Support (FS)	-0.035	-0.070	-0.125	-0.070	0.081	0.307	0.306	0.275	0.777

Inter-Factor-Correlations for T2 (square root of AVE in the diagonal)

	TIV	TO	TC	TIS	TUC	SUS	CWS	SCW	FS
Techno-Invasion (TIV)	0.778								
Techno-Overload (TO)	0.654	0.854							
Techno-Complexity (TC)	0.634	0.665	0.839						
Techno-Insecurity (TIS)	0.767	0.756	0.711	0.786					
Techno-Uncertainty (TUC)	0.471	0.588	0.508	0.626	0.847				
Supervisor Support (SUS)	-0.064	-0.187	-0.173	-0.059	-0.201	0.852			
Co-Worker Support (CWS)	-0.107	-0.152	-0.161	-0.007	-0.171	0.538	0.849		
Sense of Community (SCW)	-0.273	-0.315	-0.307	-0.106	-0.397	0.475	0.634	0.912	
Family Support (FS)	-0.268	-0.224	-0.260	-0.112	-0.272	0.380	0.337	0.380	0.804

Appendix 4.2.C. Results for Direct Effects of the Regression Analysis

Relationship	Clustered Std. Error	Estimate	sig.
Supervisor Support → Techno-Invasion	0.044	0.095	*
Supervisor Support → Techno-Overload	0.053	-0.047	
Supervisor Support → Techno-Complexity	0.048	-0.007	
Supervisor Support → Techno-Insecurity	0.044	0.078	
Supervisor Support → Techno-Uncertainty	0.045	0.094	*
Co-Worker Support → Techno-Invasion	0.052	-0.091	
Co-Worker Support → Techno-Overload	0.058	-0.053	
Co-Worker Support → Techno-Complexity	0.052	-0.014	
Co-Worker Support → Techno-Insecurity	0.051	-0.114	*
Co-Worker Support → Techno-Uncertainty	0.055	-0.061	
Sense of Community at Work → Techno-Invasion	0.061	-0.393	***
Sense of Community at Work → Techno-Overload	0.061	-0.327	***
Sense of Community at Work → Techno-Complexity	0.058	-0.368	***
Sense of Community at Work → Techno-Insecurity	0.061	-0.310	***
Sense of Community at Work → Techno-Uncertainty	0.060	-0.122	*
Family Support → Techno-Invasion	0.052	0.023	
Family Support → Techno-Overload	0.058	0.032	
Family Support → Techno-Complexity	0.051	-0.052	
Family Support → Techno-Insecurity	0.050	0.005	
Family Support → Techno-Uncertainty	0.053	0.088	
Time → Techno-Invasion	0.228	0.177	
Time → Techno-Overload	0.262	0.198	
Time → Techno-Complexity	0.239	0.098	
Time → Techno-Insecurity	0.234	0.408	
Time → Techno-Uncertainty	0.249	0.298	

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

5 General Discussion and Conclusion

The purpose of this dissertation is to contribute to a deeper understanding of how the ongoing digitalization is affecting individuals. Specifically, it sets out to examine individual information systems, their use, and their impact on technostress as well as resources of individuals that are important in that context. This chapter illustrates the key findings of this dissertation and their contributions to literature in Section 5.1, then lists limitations and directions for future research in Section 5.2, and concludes with Section 5.3.

5.1 Summary of Results and Meta-Inferences

This section summarizes the findings, theoretical contributions, and practical implications of each individual research paper and provides meta-inferences for each part of the dissertation.

5.1.1 Results of Chapter 2: Individual Information Systems and their Use

Paper 1 introduces a four-layer conceptualization of IIS. The four layers are: devices, digital identities, relationships, and information. Furthermore, Paper 1 defines IIS integration as the overlap of the IIS sub-systems from the business and private domains on each of the four layers. In other words, it defines IIS integration as the degree to which components of the IIS are used for both business and private purposes. Paper 1 then proposes a method to measure this integration. A quantitative empirical study is conducted with 205 individuals to assess this conceptualization and evaluate IIS integration in a nomological network based on boundary theory literature. The findings support the four-layer conceptualization as well as the theoretical model. The results of the quantitative study shed light on IIS integration and how it differs depending on demographic variables, such as age, gender, marital status, and working hours. These insights include that IIS integration varies in the respective layers and in regard to marital status and working hours, which indicates differences between individuals with alternate private and business responsibilities.

Paper 1 makes several contributions to theory: First, the conceptualization of IIS as comprising four layers takes a more comprehensive view of IIS than prior literature, which allows a more nuanced perspective on IIS and its use. Second, the definition of IIS integration as being more or less developed on each of the four layers extends the understanding of IIS integration since prior literature has not yet taken into account that integration lies on a continuum between complete segmentation and complete integration and that it may differ between the four layers.

Third, the measurement method of IIS integration makes it possible for future research to collect data on IIS integration and analyze it in greater depth. Fourth, Paper 1 finds support for the transfer of boundary theory concepts to IS literature. Regarding practical implications, the conceptualization can help individuals, organizations, and IT designers to build IIS and thus take advantage of individual as well as organizational benefits of IIS use and IIS integration.

Paper 2 analyzes a net-valence model on benefits and risks of IT service consumerization (i.e., the use of private IT services for business purposes) and their effects on attitude towards IT service consumerization and its use behavior. An empirical survey with 221 respondents and quantitative as well as qualitative elements reveals the following results: On the benefit side, functionalities of IT services and their fit with the individual's tasks at work are a critical factor of their attitude to IT service consumerization. On the risk side, Paper 2 finds that the threat of sanctions for the use of private IT services in the business domain does not prevent individuals from using private IT services for business purposes, nor does the occupational hazard that one could lose control over business data due to IT services consumerization. These findings are corroborated with qualitative data from the survey to offer further insights into how the functionalities of IT services affect IT consumerization behavior. This includes, for example, the finding that certain respondents indicated that they deliberately use their private IT services due to IT security concerns as they perceive the business IT service and its security functionalities to be less secure than their private alternative.

With these results, Paper 2 makes contributions to literature since it provides a detailed understanding of what drives IT consumerization on the service layer: First, the paper considers IT service consumerization, rather than IT consumerization in general. It applies a net-valence model and finds evidence that the benefits outweigh the risks in this context. Second, it shows that the benefits are mainly predicted on the better functionalities of the private IT service, as opposed to those of the business IT service. Third, it finds that individuals with a higher IT mindfulness better recognize the functionalities of their IT services. Fourth, the paper offers qualitative insights on reasons for the small impact of data security risks on the IT consumerization decision of individuals. The relevance that Paper 2 holds for IT departments is that it reveals the need to provide their employees with suitable business IT services in order to manage IT service consumerization more effectively.

In summary, Chapter 2 sets out to provide a better understanding of IIS and its different components at the intersection of the business and private domains of individuals. In this notion, Paper 1 presents four layers on which components have to be taken into account and points out to consider the integration of IIS when using business as well as private IT components. Paper 2 further explores IT services as part of the digital identity layer of IIS and investigates one direction of IIS integration: the use of private IT services for business purposes. On a meta-inference level, both papers emphasize the increasing empowerment of individuals when it comes to building their own IIS. Whereas the management of IS used to be done mainly by organizational IT departments, individuals can now do this by themselves. This makes it ever more difficult for IT departments to enforce their policies for IS use. As this development of individual empowerment is expected to continue, interest should grow among practitioners as well as academics. Increasingly, it will be a matter of IT departments having to leave the one-size-fits-all approaches behind so as to consider the needs of individuals with regard to their IIS, rather than persevere with impositions of organizational IS use policies on individuals. To support this development, researchers in that area should further engage themselves with the deeper rationale underlying the individual use of IIS on the different layers and at the intersection of the business and private domains. In that regard, Chapter 2 provides a more comprehensive understanding of IIS on which future research can build.

5.1.2 Results of Chapter 3: Technostress as a Negative Outcome of Individual Information Systems Use

Paper 3 extends the research on IT consumerization and investigates a potential adverse outcome: techno-unreliability. The paper uses a mixed-methods study design that draws on qualitative and quantitative data collected from 224 employees to analyze the relationship between IT consumerization and techno-unreliability. In doing so, it accounts for the individual's computer self-efficacy as well as the extent of IT portfolio integration. The analysis reveals that IT consumerization is positively associated with techno-unreliability, which in turn has adverse effects on several outcomes regarding the IT portfolio. Furthermore, techno-unreliability is experienced stronger when IT portfolio integration and the individual's computer self-efficacy are low. In the qualitative part of the analysis, reasons are identified why business and private integrated IT portfolios cause techno-unreliability. These reasons include a lack of compatibility between the business and private components of the IT portfolio.

With these findings, Paper 3 makes several contributions to literature: First, it is one of the first research endeavors to link the study of IT consumerization with that of technostress, and while the former has largely come to be discussed in terms of its positive outcomes for individuals, Paper 3 highlights a significant negative outcome that has to be regarded. Second, the paper sheds light on the extent of integration between business and private IT components of an individual's IIS and presents challenges associated with integrated IT portfolios.

Paper 4 examines the characteristics of digital technologies that are related to technostress. It does so by employing a mixed-methods study including a structured literature analysis, a set of qualitative interviews, and a quantitative survey among 4,560 users of digital technologies. This data is condensed into ten characteristics of digital technologies, each of which is related to at least one technostress creator, and a measurement instrument is developed for every one of them. The ten characteristics and measurement methods are of further value in that they contribute to the literature on technostress and support future research efforts to investigate technological antecedents of technostress. Further, Paper 4 highlights the importance of investigating the entire IT portfolio at a workplace, rather than focusing exclusively on the particular digital technologies that individuals are using. For such comprehensive investigations, the paper also provides future research with profiles on the perception of characteristics for 26 common digital technologies in the workplace. Along with the insights on the relationships of each characteristic with different technostress creators, practitioners can better combine different digital technologies with their different characteristics in the workplace in order to mitigate technostress.

Paper 5 deals with the concept of technostress and its creators. Using a similar study design as Paper 4, it compiles twelve different technostress creators – some of which have already been discussed in prior literature, while others are newly conceptualized in the qualitative phase of this study. Paper 5 thus makes five key contributions to IS theory: First, it adds three new technostress creators to the nine previously discussed. In doing so, it provides a more comprehensive view of the phenomenon. Second, the paper presents and evaluates a measurement model for the twelve technostress creators. This helps future research to collect data on the constructs. Third, Paper 5 reveals the creators' underlying hierarchical structure of four second-order factors: impediment, interference, constant change, and exposure. This may inspire future research and provides parsimony to the twelve technostress creators when needed. Fourth, the empirical analysis brings the four second-order factors into relation with work- and health-related effects. This extends the current body of knowledge on the outcomes of technostress. Fifth and final, Paper 5 suggests digital stress as an evolved concept of technostress. With this, the paper helps to establish a unifying terminology for the multi-disciplinary research field on stress caused by digital technologies. As far as practitioners are concerned, Paper 5 contributes to a deeper, more holistic understanding of the potential sources of stress in the workplace. Also, with the measurement instrument, it provides practitioners with a tool for psychological risk assessment of workplaces.

In summary, Chapter 3 leads to an understanding of technostress as a negative consequence of the increased use of digital technologies among individuals. In that regard, Paper 3 builds a bridge from IT consumerization, as examined in Chapter 2, to technostress literature. Paper 4 goes deeper into the relationship between various components of IIS on the technological layers and its associated characteristics with technostress whereas Paper 5 advances the technostress concept as a whole. All three papers highlight the importance of investigating technostress along with its multiple technostress creators and their relationships with digital technologies. While Chapter 2 considers the ongoing digitalization of individuals, Chapter 3 emphasizes the importance of also considering the negative outcome of this current development. With this, Chapter 3 contributes to literature in two ways: by establishing a link between technostress and the digitalization of individuals and their workplaces, and by advancing the understanding of its antecedents.

5.1.3 Results of Chapter 4: Organizational and Social Mechanisms as Technostress Inhibitors

Paper 6 investigates the impact of workplace digitalization on technostress and whether organizational measures such as literacy facilitation, involvement facilitation, and technical support provision can influence this relationship and serve as technostress inhibitors. To establish this, a quantitative survey was conducted among 2,640 German employees. The results indicate that a higher degree of workplace digitalization is associated with higher levels of technostress in general, but the effect varies between different technostress creators. The same applies to the organizational measures which are only partially effective in inhibiting technostress. The contributions to theory of Paper 6 are threefold: First, the results highlight the importance of investigating the degree of workplace digitalization and its impact on technostress. While prior literature focused, for the most part, on single digital technologies, Paper 6 is one of the first studies to expand this narrow focus to a comprehensive investigation of the entire IT portfolio in the digital workplace. Second, the paper finds that the digitalization of workplaces affects individual technostress creators in different ways. This is important for the further refinement of theory since prior work on technostress inhibitors has largely investigated technostress as a higher-order construct. Instead, Paper 6 shows that a differentiated examination is required to account for different technostress creators. Third, Paper 6 finds evidence that technostress inhibitors have a notable impact on the relationship between the degree of workplace digitalization and technostress. Since this effect varies depending on the different technostress inhibitors and technostress creators, it further illustrates the need for a differentiated consideration. Concerning practical implications, Paper 6 reveals the effect of ongoing workplace digitalization on technostress as one aspect that affects employees' well-being. To address this health issue, the paper specifies potential measures that can be taken at an organizational level to inhibit this negative outcome of workplace digitalization.

Paper 7 examines how effective social support dimensions can be as technostress inhibitors. By employing a quantitative longitudinal study among 637 German employees, the study finds evidence that a sense of community at work lowers technostress and, therefore, acts as an effective technostress inhibitor. The same applies to family support which has been found to be even more important as technostress inhibitor in times of extended telework. With these findings, Paper 7 makes several contributions to IS literature: First, it advances the knowledge on technostress inhibitors since IS literature to date has not yet considered social support dimensions in terms of technostress inhibitors. Second, while a sense of community at work was found to act as a technostress inhibitor on the five examined technostress creators, the other analyzed social support dimensions have not been found to be related to all five technostress inhibitors. Instead, the findings have indicated that supervisor support can be positively rather than negatively related to some technostress creators, such as techno-insecurity. This should be taken as further evidence that social support dimensions and the associated technostress creators have to be differentiated in future research. As far as practitioners are concerned, Paper 7 indicates further mitigation mechanisms to deal with potentially adverse effects of workplace digitalization and thus support the familiar organizational measures that have already been discussed in prior literature. However, practitioners also have to be aware of the potentially increasing effects of, for example, supervisor support. Further worth noting is the fact that mechanisms like a sense of community at work do not take effect over night. Instead, they have to be implemented and nurtured over a long period of time.

In summary, Chapter 4 sets out to identify potential mechanisms that help mitigate technostress. While the ongoing digitalization of workplaces has been found to cause technostress along with its associated negative outcomes for individuals as well as organizations, Chapter 4 presents resources to inhibit these adverse effects. Paper 6 and Paper 7 serve this purpose by investigating technostress inhibitors from two perspectives: organizational measures and social support dimensions. In both papers, the former as well as the latter are found to have potential efficacy in mitigating technostress. However, they have different relationship with different technostress creators. Therefore, both papers emphasize the need for a differentiated theorizing around single technostress creators, rather than discussing technostress in general. In short, both papers advance the knowledge on technostress mitigation in the workplace and help direct future endeavors in both research and practice.

5.2 Future Research

One purpose of this dissertation is to inspire future research. Areas in which this may be most beneficial are discussed in this section. Furthermore, each paper comes with some limitations, which will also be discussed here.

5.2.1 Future Research on the Topics of Chapter 2: Individual Information Systems and their Use

Paper 1 and Paper 2 advance the knowledge on IIS and their different components at the intersection of the business and private domains. However, both papers have several limitations that leave room for future research. First, the conceptualization of IIS integration in Paper 1 does not differentiate the direction of integration which would indicate whether private IIS components are used in the business domain or whether business IIS components are used in the private domain. Meanwhile, Paper 2 accounts for one of those directions as it investigates the use of private IT services for business purposes. Thus, it makes one step towards overcoming this limitation, yet future research could detail the understanding of IIS integration and its measurement method with regard to both directions of IIS integration. Second, both papers use self-reported data on the usage of different IIS components and IT services consumerization. Since log-file data is becoming ever-more readily available, future studies could use such data to make the measurement more objective. Third, the data collection on IIS usage in Paper 1 was restricted to IIS components that serve the purpose of communication. The rationale here was keeping the questionnaire short. Yet although communication is one of the main use cases of IIS, future research could expand on this by investigating all potential components of IIS. For Paper 2, responses were restricted to two IT services: instant messaging and file sharing, which are two important IT services at most digital workplaces. However, other IT services, such as emailing or social networks could also be beneficial avenues of research. Also, asking all respondents to rate both IT services may have led to unobserved homogeneity in the answers. Fourth, both quantitative studies were conducted as cross-sectional studies measuring all constructs at one point in time. This brings limitations concerning causality of the relationships and generalizability of the results.

With a view to future research potential, it would be worth further exploring the rationales of IT service consumerization. As the qualitative analysis of Paper 2 has revealed, the use of private IT services can foster informal relationships with business contacts, and private IT services may be seen as less risky in terms of data security than their business equivalents, and yet to date, neither of these considerations have found their way into established adoption models for IT consumerization. Deepening the understanding of such considerations promises to refine the theory on IT consumerization. Furthermore, while Paper 2 contributes to the literature of IT consumerization on the service layer, the other layers discussed in Paper 1 should also be considered in future research. The notable benefit would be a more comprehensive understanding of IT consumerization and the rationales behind the use of different IIS components for different purposes.

5.2.2 Future Research on the Topics of Chapter 3: Technostress as a Negative Outcome of Individual Information Systems Use

Paper 3, Paper 4, and Paper 5 add to the understanding on technostress but come with some limitations that may inspire future research. All three papers contain a quantitative survey with a cross-sectional design. This limits generalizability and claims of causality for all three papers. Furthermore, the data collection for Paper 4 and Paper 5 was restricted to German employees. With this in mind, future researchers would be well-advices to cross-validate the results among other countries.

Another area in which research of Paper 4 could be refined is the assessment of characteristics of digital technologies. In the quantitative study of Paper 4, individuals were asked to assess the ten characteristics of one digital technology of which they made frequent use. They were not asked to assess the characteristics of all digital technologies in their workplace. Further, the survey respondents were ordinary users of the digital technologies, rather than IT experts. As a result, the assessment resulted in perceived characteristics instead of an objective assessment. Future research could examine the objective characteristics of each technology and analyze differences between the perceived and the objective assessment. If there are notable differences, researchers should investigate the reasons for these differences.

Bringing the three papers together, Papers 3 and 4 assessed only a selection of potential technostress creators. Since Paper 5 advances the knowledge of these creators presenting twelve of them, future research should study these additional technostress creators and their association with IT consumerization on the one hand (Paper 3) and with the characteristics of digital technologies on the other (Paper 4). This new set of technostress creators may also inspire future research in other areas of technostress research, such as coping strategies for each of the twelve technostress creators.

5.2.3 Future Research on the Topics of Chapter 4: Organizational and Social Mechanisms as Technostress Inhibitors

While Paper 6 and Paper 7 make certain contributions to the understanding of how to mitigate technostress as one adverse effect of workplace digitalization, both papers come with some limitations that should be addressed by future research. First, both data sets were collected among the German workforce, which limits generalizability across other countries and cultures. Second, both for Paper 6 and for the first part of Paper 7, the data was collected via a cross-sectional survey design. This goes along with limitations regarding causality of the revealed relationships. Third, the 40 digital technologies analyzed in Paper 6 may not cover all potential technologies in a digital workplace, and they may change in the future. In that regard, Paper 7 was conducted in the context of the COVID-19 pandemic, a time when certain major changes occurred in the respective workplaces. Future research should, therefore, consider potential adjustments to digital work that may affect technostress and technostress mitigation.

On top of that, future researchers would do well to bring together organizational and social support mechanisms and investigate potential interdependencies between them in the digital workplace of the future. Also, other technostress creators than the ones investigated in Papers 6 and 7 may be of value in future research in order to be able to tailor the mitigation of technostress at individuals' workplaces according to the technostress creators that the individuals experience the most.

5.3 Conclusion

The purpose of this dissertation has been to contribute not only to the understanding of the ongoing digitalization of individuals but also to that of technostress as one negative outcome of this development. All seven research papers included in this dissertation serve this purpose by providing new insights into IIS and their use, the emergence of technostress in digitalized workplaces, and organizational as well as social support mechanisms that help to mitigate technostress. In summary, this dissertation supports current efforts in both research and practice to reduce technostress while leveraging the positive opportunities of workplace digitalization.