

Employee Health in the Digital Era: Evidence on Relationships between
ICT-induced Changes in the Workplace and Perceived Health

D I S S E R T A T I O N

of the University of St.Gallen,

School of Management,

Economics, Law, Social Sciences,

International Affairs and Computer Science,

to obtain the title of

Doctor of Philosophy in Management

submitted by

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Dissertation no. 5045

Difo-Druck GmbH, Untersiemaun 2021

The University of St.Gallen, School of Management, Economics, Law, Social Sciences, International Affairs and Computer Science, hereby consents to the printing of the present dissertation, without hereby expressing any opinion on the views herein expressed.

St. Gallen, October 23, 2020

The President:

Prof. Dr. Bernhard Ehrenzeller

Acknowledgements

I would like to thank my supervisors Prof. Dr. Stephan Alexander Böhm and Prof. Dr. Florian Kunze who supported me throughout the doctorate. My special thanks go to my first referee Prof. Böhm for his confidence in my abilities and the constructive feedback on my work.

In addition, I thank all my colleagues at the University of St.Gallen, with whom I have spent the past three years to produce this work. The mutual support in research work and practical projects has always been greatly appreciated.

Furthermore, I would like to express my gratitude to my dearest friend Dr. Christian Jäkel. I am deeply grateful for the friendship, the always open ear and the honest opinions on all situations in life. Thank you for providing the impetus to follow this path.

Finally, I owe my deepest gratitude to my family, without whom this achievement would not have been possible. In particular, I thank my father Herbert Götz and my mother Daniela Götz for their unconditional love, care and support that I have experienced throughout my life. I would also like to thank my older brother Dennis Götz for paving the way and knowing that I can always rely on him. I am pleased to dedicate this dissertation to my family.

St. Gallen, October 31st, 2020

Tim M. Götz

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List of Abbreviations

aBIC	sample-size adjusted Bayesian Information Criterion
AIC	Akaike information criterion
aLMR	Lo-Mendell-Rubin likelihood ratio test
B	unstandardized regression coefficient
BIC	bayesian information criterion
BLR	bootstrapped likelihood ratio test
CD	coefficient of determination
Cd	test scaling correction difference
CFA	confirmatory factor analysis
CFI	comparative fit index
CI	confidence interval
CLPM	(standard) cross-lagged panel model
COR	Conservation of Resources
df	degrees of freedom
e.g.	example gratia (for example)
EE	emotional exhaustion
EFA	exploratory factor analysis
et al.	et alii
EU-OSHA	European Agency of Occupational Health and Safety
F	f-test value
FIML	full information maximum likelihood
FWAs	flexible work arrangements
FWC	family-work conflict
H	hypothesis
HMMR	hierarchical moderated multiple regression
HR	human resources

i.e.	id est (that is)
ICC	intra class correlation
ICTs	information communication technologies
INT	interaction term
IQ	intelligence quotient
IS	Information Systems
KIdB	Klassifikation der Berufe (German classification of occupations)
LCA	latent class analysis
LL	loglikelihood
LV	latent variable
M	mean
MI	measurement invariance
mi	multiple imputation
ML	maximum likelihood
mlmv	maximum likelihood with missing values
MLR	robust maximum likelihood
mvn	multivariate normal
N	number of observations
n.s.	not significant
p	level of significance
P	number of freely estimated parameters
p.	page
r	correlation coefficient
R ²	R-squared value
RE	random effects
RI-CLPM	random-intercept cross-lagged panel model
RIEE	random intercept of emotional exhaustion
RIIs	random intercepts

RIWF	random intercept of work-family conflict
RMSEA	root mean square error of approximation
sb	Satorra-Bentler adjusted
SCF	scaling correction factor
SD	standard deviation
SE	standard error
SEM	structural equation modeling
sem	structural equation model
SRMR	standardized root mean square residual
t	t-test value
T	timepoint of measurement
TLI	Tucker-Lewis index
TRd	chi-square difference
VLMR	Vuong-Lo-Mendell-Rubin likelihood ratio test
w.r.t.	with regard to
WAI	work-ability index
WDQ	The Work Design Questionnaire
WFC	work-family conflict
WPF	workplace flexibility
β	standardized regression coefficient
Δ	delta
χ^2	chi square value

Abstract

The digital era is accelerating the integration of new information and communication technologies (ICTs) in the workplace. These modern technologies determine how work is executed in the 21st century. Hence, employees see themselves confronted with complex ICT-induced changes which may threaten their health. The present work combines three studies addressing theoretical and methodological research gaps in three selected research streams that are particularly affected by ICTs and related to employee health: workplace flexibility, technostress and work-family conflict.

Study 1 follows the notion that prior research neglects to incorporate crucial contextual factors when examining the relation between workplace flexibility and employee health. The results indicate that a profound (virtual) communication behavior must be present for workplace flexibility to become beneficial. This connection becomes even more relevant in task interdependent work settings. Study 2 shows that the fear of losing ones' job due to technologies (i.e., technological insecurity), is associated with detrimental effects for employee health. Yet, results show that organizations can assist employees in coping with these modern forms of stress by creating a supportive organizational environment, i.e., support employees in using their individual strengths and enable friendship opportunities. At last, Study 3 challenges the current state of research on the causal relationship between work-family conflict (WFC) and employee health (i.e., reciprocal effect). Applying latest statistical methods to analyze longitudinal data it provides empirical evidence that supports the existence of a unidirectional effect of WFC on employee health, and not vice versa.

Taken together, these results indicate that the analyzed ICT-induced changes in the workplace affect employee health. Yet, employees are not affected equally as the influence depends on contextual factors. This also implies that the changes taking place can be managed. However, it is important that initiatives, that intend to uncover the influence of the 'new normal', rely on state-of-the-art statistical methods in order to draw the best possible conclusions.

Zusammenfassung

Das digitale Zeitalter beschleunigt die Integration neuer Informations- und Kommunikationstechnologien (IKT) in den Arbeitsplatz. Diese modernen Technologien bestimmen, wie sich Arbeit im 21. Jahrhundert ausgestaltet. Beschäftigte sehen sich daher auch mit IKT-induzierten Veränderungen konfrontiert, die ihre Gesundheit gefährden können. Die vorliegende Arbeit kombiniert drei Studien. Diese behandeln theoretische und methodische Forschungslücken in drei Forschungsströmen, die besonders von IKTs betroffen sind und mit der Gesundheit von Beschäftigten in Verbindung gebracht werden: Arbeitsplatzflexibilität, Technologischer Stress und Konflikte zwischen Arbeit und Familie (KAF).

Studie 1 untersucht, ob die bisherige Forschung zur Beziehung zwischen Arbeitsplatzflexibilität und Gesundheit entscheidende Kontextfaktoren vernachlässigt. Die Ergebnisse zeigen, dass ein ausgeprägtes (digitales) Kommunikationsverhalten gegeben sein muss, damit Arbeitsplatzflexibilität positive Effekte entfalten kann. Aufgabeninterdependenzen verstärken diesen Mechanismus. Studie 2 zeigt, dass Arbeitsplatzunsicherheit auf Grund von Technologien nachweislich negative Auswirkungen hat. Jedoch können Organisationen Beschäftigte bei der Bewältigung dieser modernen Stressformen unterstützen, indem sie ein durch Stärkenfokus und Freundschaften geprägtes Arbeitsumfeld etablieren. Zuletzt stellt Studie 3 den aktuellen Forschungsstand über den kausalen Zusammenhang zwischen KAF und Gesundheit in Frage. Neueste Längsschnittanalyseverfahren liefern empirische Evidenz, die einen gerichteten negativen Effekt von KAF auf die Gesundheit von Beschäftigten belegt, und nicht umgekehrt.

Zusammenfassend zeigt sich, dass sich die betrachteten IKT-induzierten Veränderungen auf die Gesundheitswahrnehmung auswirken. Allerdings sind Mitarbeiter nicht gleichermaßen betroffen, da die Auswirkungen von Kontextfaktoren wie Arbeits- und Organisationsmerkmale abhängen. Dies impliziert, dass der stattfindende digitale Wandel gemanagt werden kann. Die Bedeutung von modernen Analyseverfahren wird für die empirische Bewertung der Wirkung digitaler Veränderungsprozesse auf Beschäftigte hervorgehoben.

1 Introduction

Employee health and well-being is subject of many research streams. Hence, literature shows that decreased health perceptions are related with various detrimental consequences for individuals, such as physical (e.g., prolonged fatigue, mortality, headache and severe diseases; see Ahola et al., 2013; Ahola et al., 2010; Appels & Schouten, 1991; Leone et al., 2009; Toppinen-Tanner et al., 2009), psychological (e.g., depressive symptoms, sleep problems and insomnia; see Armon, 2009; Bianchi et al., 2015, Kim et al., 2011; Toker & Biron, 2012), and occupational consequences (e.g., low job satisfaction, absenteeism, job demands, presenteeism; see Demerouti et al., 2009; Figueiredo-Ferraz et al., 2012; Lizano & Barak, 2015; Wang et al., 2016). Thus, it is not surprising that employee health is also linked with organizational performance and effectiveness (Beehr & Newman, 1978; Ford et al., 2011; Gilbreath & Montesino, 2006; Merrill et al., 2013; Montano et al., 2017; Wolfe et al., 1994). Hence, it is reasonable for organizations to keep high value in a good state of employees' health.

Therefore, in order to support occupational health, managerial practice makes often use of workplace interventions that are based on scientific research findings (e.g., see Howarth et al., 2018; Martin et al., 2016; Williams et al., 2018). However, when new phenomena arise that change the conditions of how employees execute or experience work, this challenges the validity of present knowledge and interventions on this regard. Hence, research must follow up and investigate how the changed conditions affect employees in order to guide and implement the change on a rational and sound knowledge base. Indeed, literature shows that poorly managed change (e.g., that eventually only increases work demands; see Bambra et al., 2007) can come with detrimental effects for employee health (Bambra et al., 2007; Ferrie et al., 1998).

In fact, the digital era is such a phenomenon that is changing the world of work ever faster and on a larger scale in the 21st century. In their most recent foresight about the expected risks of digitalization for occupational health by 2025, the European Agency for Safety and Health at Work (EU-OSHA, 2018, p.9) acknowledges the emerging change in the work domain by stating that “Digitali[z]ation, including information and communication technology [...], is likely to have major impacts on the nature and location of work over the next 10 years. Many people are talking about a ‘Fourth Industrial Revolution’.”

The present dissertation starts from the above-mentioned realization that we are directly in the accelerating digitalization process and that there is a high degree of uncertainty regarding its influence on the health of employees (EU-OSHA, 2018). Recognizing the fact that one single dissertation is not sufficient to fully grasp its manifold changes for the nature of work (Wang et al., 2020), the present work adds knowledge to three ICT-induced literature streams within the scope of three independent studies.

At first, increased work flexibility is one of the most widely acknowledged changes due to ICTs, as they enable the exchange of information amongst individuals and technologies regardless of geographical or temporal boundaries (EU-OSHA, 2018; 2019; Haddon & Brynin, 2005; Messenger & Gschwind, 2016; Parker & Grote, 2019; Wang et al., 2020). Hence, this induces the emergence and increased intrusion of workplace flexibility into modern workplaces (Messenger & Gschwind, 2016). Although there are more and more employees making use of the new flexibility, little is known about the consequences of workplace flexibility behavior for employee health (Allen et al., 2015). Thus, Study 1 included in the present dissertation explores this relationship and shows that the beneficial health-related effect of workplace flexibility is strongly dependent on contextual work characteristics. The results only show positive health-effects for employees with a certain degree of both communication and task interdependence with colleagues.

In addition, the availability of more powerful ICTs can confront employees with new demanding situations that lead to modern forms of stress (i.e., technostress; Ayyagari et al., 2011; Ragu-Nathan et al., 2008; Tarafdar et al., 2007). As the capabilities of ICTs increase radically, they start to take over work tasks entirely (i.e., automation; Parker & Grote, 2019). Hence, employees increasingly see themselves in competition with technologies which causes technological insecurity (i.e., perceiving technologies as a threat to one's job position; Tarafdar et al., 2007). Study 2 examines the role of this modern stressor for employee health and further explores boundary conditions. Results indicate that organizational resources (i.e., support for strengths use and friendship opportunities) are able to mitigate the detrimental effects of technological insecurity.

At last, ICTs enable a 24/7 constant connectivity (Wang et al., 2020) and thus erode or even dissolve the boundaries between work and private life (i.e., higher boundary permeability; Duxbury et al., 2014), regardless of personal segmentation preferences (Derks et al., 2016). Hence, this inevitably facilitates the creation of work-family conflict. However, there is still a lot of inconsistency in the literature on how work-

family conflict and employee health are related. Study 3 applies modern statistical analyses to investigate the causal within-person relationship between both constructs with extensive longitudinal data (i.e., RI-CLPM; Hamaker et al., 2015). The results support a unidirectional and negative effect from work-family conflict to health and thus challenges the predominant opinion in the literature.

Accordingly, the present dissertation examines the role of three increasingly important changes in the new world of work for employee health in the digital era (i.e., workplace flexibility, technological insecurity and work-family conflict). This adds knowledge to various literature streams and sheds new light on the uncertainty regarding the change of work and the development of interventions. Study 1 and Study 2 both give strong reason to believe that the new normal can be managed: Workplace flexibility can only be performed in a healthy manner if a multitude of (virtual) communication possibilities are available and used; this relation becomes more salient with increased task interdependence between colleagues (Study 1). Further, an organizational environment with strong focus on employees' strengths use support and friendships makes employees less susceptible to detrimental effects of technological insecurity (Study 2). Study 1 and Study 2 both provide new knowledge for the management of ICT-induced change. At last, Study 3 shows that modern statistical methods must be applied to draw the right conclusions from scientific studies which form the basis for managerial practice.

1.1 ICT-induced Change and Employee Health

1.1.1 Defining Employee Health

Investigating employee health is intertwined with the concept of stress. In particular, in the context of work, Ganster and Rosen (2013, p.1088) define stress as “the process by which workplace psychological experiences and demands (stressors) produce both short-term (strains) and long-term changes in mental and physical health.” This means that work experiences trigger stress processes which manifest in changes in employee health, whereas the latter can manifest in various forms. For instance, changes in health perceptions can be, amongst others, of psychological (e.g., anxiety, emotional exhaustion), physiological (e.g., cortisol or epinephrine levels) or psychosomatic (e.g., fatigue, sleep problems) nature (Ganster & Rosen, 2013). Hence, in the course of this thesis, I follow this notion and investigate the role of ICT-induced changes from a theoretically founded stress and/or psychological strain process perspective (e.g., Conservation of Resources Theory, Hobfoll, 1989). In fact, changes in employee health outcomes are measured and empirically tested on the individual level (i.e., perceptions of emotional exhaustion and general health).

1.1.2 Defining ICT-induced Change

Information and Communication Technologies (ICTs) are defined as “any electronic device or technology that has the ability to gather, store or send information” (Day et al., 2012, p.473). As various forms of ICTs are increasingly being integrated in the workplace, they shape the way work is done and thus affect respective employees (Parker et al., 2017; Parker & Grote, 2019). For instance, in their recent review about how ICTs influence individuals due to changes in work design, Wang et al. (2020, p.695) introduce with the statement: “People design and use technology for work. In return, technology shapes work and people. As [...] [ICT] becomes ever more embedded in today’s increasingly digital organizations, the nature of our jobs and employees’ work experiences are strongly affected by ICT use”. This quotation gets to the core of how the term ‘ICT-induced change’ should be generally understood in the scope of this thesis: ICT-induced change is defined as any form of change in work characteristics and experiences which are directly or indirectly triggered by the use of ICTs.

1.1.3 Focus on three ICT-induced Changes

Not surprisingly, ICT-induced changes are still taking place in multiple ways (for a comprehensive overview, see Parker & Grote, 2019; Wang et al., 2020). However, one can categorize the work characteristics that are induced or affected by ICTs in three dimensions, i.e., “in job demands, job autonomy and relational aspects of work” (Wang et al., 2020, p.712). Due to the thematic relevance for this work, the following discussion will focus on the first two dimensions.

Hence, the ‘job demands’ dimension represents the fact that ICTs change “physical, social, or organizational aspects of the job that require sustained physical or mental effort and are therefore associated with [...] physiological and psychological costs (i.e., job demands; Demerouti et al., 2001, p. 501). On the one side, ICTs can change job demands to the negative, i.e., to feelings of higher stress (Ragu-Nathan et al., 2008), workload (Ninaus et al., 2015), information overload (Morgeson & Humphrey, 2006) or hassles of use (Day et al., 2012). On the other side, they can also induce positive change, i.e., less coordination demands due to improved processes (Ninaus et al., 2015) or less burden of routine work (Chesley, 2010).

In addition, ICTs are an enabler for higher ‘job autonomy’ (Wang et al., 2020) which can be defined as the “degree to which a job provides discretion over daily work decisions, such as when and how to do tasks” (Parker, 2014, p. 664). This covers both decision-making autonomy as well as autonomy with respect to control about when and where an employee performs ones’ work-related tasks (Ninaus et al., 2015; Parker & Grote, 2019). Particularly for the latter, ICTs are the nurturing ground for changing work designs as they provide the technological venues to have access to critical information and allow to connect, interact, and work (together) with others despite geographical or temporal boundaries. This can become beneficial for employees as it unfolds in new forms of work flexibility (Messenger & Gschwind, 2016; Raghuram et al., 2019) which provides new opportunities to manage demands across different roles or domains (Wang et al., 2020).

Besides potential advantages, this also enables expectations towards a ‘constant connectivity’ which facilitates boundary crossing behavior, i.e., working despite being in the office (e.g., in spare time while being with ones’ family). Accordingly, ICTs increase boundary permeability by weakening or even dissolving the previously natural separation (i.e., due to different locations) between work and private life (Boswell et al., 2016; Haddon & Silverstone, 2000; Lewis & Cooper, 1999; Mazmanian et al., 2013;

Ninaus et al., 2015; Valcour & Hunter, 2005;), which can facilitate certain forms of stress, such as family-work or work-family conflict (Boswell & Olson-Buchanan, 2007; Delanoeije et al., 2019).

Although this selection depicts a rather dark side of technologies in the workplace, it must be stated that ICTs are still neither good or bad by itself (Kranzberg, 1986). In fact, ICTs affect and induce change in the workplace in multifaceted and complex ways (Parker & Grote, 2019) so that there is still high uncertainty on how ICTs actually affect work and individuals (Orlikowski & Scott, 2008; Wang et al., 2020). However, there are certain direct and indirect changes on work characteristics and experiences that are evident in almost every single workplace which may affect employee health and well-being (Wang et al., 2020). In a recent report about digitalization and occupational safety and health (OSH), the EU-OSHA (2019) highlights two main drivers in shaping working lives and employee health. In fact, they notice the role of advanced technologies on potentially detrimental effects on employee health (i.e., new forms of stress), and the role of increased work flexibility with associations to boundary blurring. This thesis is in line with this prioritization and intends to add new knowledge on the health-effects of three very common ICT-induced changes in the working life of employees in the 21st century: That are ICT-induced flexibility (i.e., ‘job autonomy’) manifested by forms of *workplace flexibility* (Allen et al., 2013; Hill et al., 2008), ICT-induced stress (i.e., ‘job demand’) appearing as *technostress* (Tarafdar et al., 2007), as well as ICT-induced boundary permeability (i.e., ‘job autonomy’) facilitating *work-family conflict* (Netemeyer et al., 1996). These three foci of this present dissertation are further outlined below.

1.2 The Role of ICT-induced Workplace Flexibility for Employee Health

1.2.1 Defining and Measuring Workplace Flexibility

In a recent review of scientific articles from 1970 – 2018 about workplace flexibility, Bal and Izak (in press, p.6ff.) synthesize that four distinct literature streams have emerged and developed in the realm of workplace flexibility since the introduction of this nowadays rather fuzzy term by Atkinson (1984). Hereby, they differentiate *organizational flexibility* (i.e., the adaptive ability of organizations towards environmental changes in the marketplace, see Hill et al., 2008), *employee flexibility* (i.e., the adaptive ability of employees towards environmental changes in their workplace, see Beltrán-Martín & Roca-Puig, 2013), *flexible work* (i.e., the adaptivity of employee contracts for the organization, see Wright & Bretthauer, 2010) and *flexible work arrangements* (FWAs, i.e., policies by the organization that allow employees to freely decide when and where to work, see Allen et al., 2013; Hill et al., 2008).

To reduce ambiguity due to these various meanings of the term ‘flexibility’, it must be stated that the conceptualization of workplace flexibility applied in this thesis is in line with the last concept of FWAs. Accordingly, Hill et al. (2008) define the overall concept of work flexibility as the “ability of workers to make choices influencing when, where, and for how long they engage in work-related tasks” (Hill et al., 2008, p.152).

However, this classification is not yet sufficient. Even in the field of FWAs, the scientific discourse developed many different terms over the years that are used more or less interchangeably to describe similar or distinct foci of this multi-faceted phenomenon. To name a few, next to FWAs, for instance ‘distributed work’, ‘distance work’, ‘telecommuting’, ‘telework’, ‘remote work’, and ‘flexplace’ are, amongst others, commonly applied terms (Allen et al., 2015, p.42). Thus, it is crucial to further specify the exact meaning of the term workplace flexibility in the scope of this thesis. I follow the prior argumentation and restrict its meaning to the location-specific aspect, i.e., working anywhere apart from the official workplace. Thus, I define workplace flexibility as the extent employees can freely decide where they perform their individual work physically in order to accomplish work-related tasks. Therefore, an employee is equipped with workplace flexibility when he/she is able to perform his/her work-related tasks at least one hour per week anywhere outside the designated workplace.

Due to the various foci within the workplace flexibility literature, different study designs and measurements are applied to study this phenomenon (Allen et al., 2015). This makes it difficult to locate a central measure for workplace flexibility. However, in order to examine effects of workplace flexibility behavior on outcomes, many studies apply dichotomous measures (i.e., yes/no) which captures the information whether an individual works outside the office (i.e., yes) or not at all (i.e., no). Allen et al. (2015) criticize this approach to be insufficient because it does not take into account the intensity of use. Hence, they claim the intensity to be an important dimension for the measurement of actual workplace flexibility behaviors. Therefore, although the insufficient unity in measuring workplace flexibility goes beyond the scope of this dissertation, it can be stated that quantitative studies should combine dichotomous (i.e., no/yes; if yes, frequency of use) and continuous measures (i.e., intensity of use).

1.2.2 Current State of Research on Workplace Flexibility and Employee Health

Tavares (2017, p.33) states that “the overall effect [of workplace flexibility] on health is neither well known nor consensual”. Therefore, I conducted a literature search for scientific articles being published between 1985 and 2020 to illustrate the state of current research on the respective relationship (see Table 1.1, exact search procedure is outlined in the note section of the Table). As a result, I was able to identify a total of 14 published studies within 35 years of research that examine the relationship between workplace flexibility and various operationalizations of employee health. The table shows and confirms that, even in this thematically very focused overview, different terms are used for the same phenomenon, such as ‘flexiplace’ (Hayman, 2010), ‘telecommuting’ (Hayman, 2010; Henke et al., 2016; Kröll et al., 2017), ‘remote work’ (Kaduk et al., 2019; Perry et al., 2018) and ‘telework’ (Anderson et al., 2015; Arvola & Kristjuhan, 2015; Arvola et al., 2017; Delanoeije & Verbruggen, 2020; Heiden et al. 2020; Konradt et al., 2003; Lundberg & Lindfors, 2002; Song & Gao, 2019).

In line with Allen et al. (2015, p.42), it shows that the various conceptualizations of workplace flexibility “impacts the types of study designs [...] that researches use to study” this phenomenon. Thus, the studies also differ in their measurements. For instance, most studies only apply a categorical comparison between employees that work or do not work outside a regular office on a certain day, in a week or on an overall basis (Anderson et al., 2015; Arvola et al., 2017; Delanoeije & Verbruggen, 2020; Kaduk et al., 2019; Konradt et al., 2003; Lundberg & Lindfors, 2002; Song & Gao, 2019). Others measure the frequency differently (e.g., by using the number of days per

week one is or is not mobile worker; see Hayman, 2010; Kim et al. 2020) and again others focus on the intensity of use (e.g. with hours of work outside the office per week; Arvola & Kristjuhan, 2015; Henke et al., 2016; Kaduk et al., 2019; Perry et al., 2018). Solely one single study considers both frequency and intensity of use (see Heiden et al., 2020) and thus, is in line with the measurement recommendation by Allen et al. (2015).

Apart from the problematic conceptualization, the study results are inconclusive. Indeed, two out of 14 studies report negative effects, five studies state no significant effect and seven studies find positive effects of the workplace flexibility on employee health. With respect to the latter, there are findings showing that working outside the office (at home or elsewhere) may be associated with higher affective well-being (Anderson et al., 2015), reduced number of health complaints (i.e., with regard to health, tired eyes, hypertension, stress; Arvola & Kristjuhan, 2015), lower perceived stress and depression (Delanoeije & Verbruggen, 2020; Kaduk et al., 2019; Hayman, 2010; Henke et al., 2016). In fact, Kröll et al. (2017) report a positive relation between workplace flexibility (i.e., operationalized as ‘telecommuting’) with psychological health (i.e., operationalized as a latent construct of perceived stress, anxiety, depression and burnout) as result from a meta-analytical study. This is also in line with the overall notion from the review conducted by de Menezes and Kelliher (2011), who argue for a positive relation between workplace flexibility (i.e., FWAs) and employees’ psychological health.

In contrast, there are studies that do not find a significant difference between employees with and without workplace flexibility. For instance, Konradt et al. (2003) and Arvola et al. (2017) compared the levels of perceived psychological strain and well-being, respectively, between both groups and did not find a significant difference. Likewise, Lundberg and Lindfors (2002) compared the levels of employee health proxies (i.e., general health, stress, and physiological arousal) on days when the individuals worked outside the office with office days. Although there was indication for a positive effect of this workplace flexibility behavior, there was no significant difference (e.g., potentially due to low sample sizes in the study). Further, no significant effects are reported for workplace flexibility frequency (Kim et al., 2020) and intensity (Perry et al., 2018) on health (i.e., fatigue and exhaustion, respectively).

Moreover, solely two recent studies show significant negative relationships: First, Heiden et al. (2020) conducted a study in which they examined the effect of frequency (i.e., number of days on which it is performed to any extent) and intensity (i.e., average

hours per week) on an individual's general health perception. Although they did not find a relation between intensity and health, a negative relation between frequency and health is supported. Second, Song and Gao (2019) examined, amongst others, the relationship of working at home on weekdays and various health outcomes. Significant results indicate that working outside the office (i.e., at home) is associated with higher stress levels for the respective employee.

Taken together, "there has been surprisingly little research investigating links between [workplace flexibility] and health-related behaviors and outcomes" (Allen et al., 2015, p.61). Besides, the existing studies show strong differences in the operationalization of the study constructs which complicates a comparability of the results. Moreover, they provide inconclusive results, i.e., positive, negative and no significant effects of workplace flexibility on health outcomes are reported all together.

Table 1.1: Quantitative Peer-Reviewed Journal Articles Examining the Effect of Workplace Flexibility and Employee Health between 1985 and 2020

Nr	Authors	Year	Journal	Applied Predictor (term used)	Measure	Strain/Health-Outcome	Effect of WPF
1	Anderson et al.	2015	EJWOP	Telework day (yes/no)	Binary	Affective well-being	Positive
2	Arvola, and Kristjuhan	2015	AR	Telework (hours/week)	Continuous	Nr. of health complaints (health, tired eyes, hypertension, stress)	Negative
3	Arvola et al.	2017	SAEB	Teleworker vs. Non-Teleworker	Binary	Well-being	None
4	Delanoeije, and Verbruggen	2020	EJWOP	Telework day (yes/no)	Binary	Stress	Negative
5	Hayman	2010	NZJER	Flexiplace/telecommuting (days/week)	Continuous	Stress	Negative
6	Heiden et al.	2020	HE	Telework (nr. of days)	Categorical	Overall health	Negative (days →)
				Telework (hours/week)	Continuous		None (hours →)
7	Henke et al.	2016	AJHP	Telecommuting (amount/week)	Categorical	Depression	Negative
8	Kaduk et al.	2019	CWF	Substantial voluntary remote work (> 20%/week) ^a	Binary	Emotional exhaustion,	None (→ EE)
						Perceived stress,	Negative (→ PS)
						Psych. distress	None (→ PD)
9	Kim et al.	2020	JMF	Flexplace (frequency)	Categorical	Fatigue	None
10	Konradt et al.	2003	EJWOP	Teleworker vs. Non-Teleworker	Groups	Psychological strain	None

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11	Kröll et al.	2017	EJWOP	Telecommuting	Meta-analysis	Psychological health	Positive
12	Lundberg, and Lindfors	2002	JOHP	Telework day vs. office day	Groups	Health, Stress Physiological Arousal	None ^b None
13	Perry et al.	2018	EJWOP	Remote work (%/week)	Continuous	Exhaustion	None
14	Song, and Gao	2019	JHS	Telework	Binary	Stress	Positive

Note. Selected quantitative peer-reviewed journal articles on forms of workplace flexibility being published between 1985 and 2020 that analyze relationships with health outcomes. The articles are selected from 197 scientific papers that were identified by a Web of Science Meta Search with the search term ‘*TS= ("workplace flexibility" OR flexplace OR telework OR telecommuting) AND (strain OR stress OR health)*’. After excluding non-quantitative studies, articles with a compound score of time and location flexibility that do not examine the isolated effect of workplace flexibility, and those that do not examine relations with forms of workplace flexibility as direct predictor for health-related outcomes, 14 relevant articles remain. AR = Agronomy Research, AJHP = American Journal of Health Promotion, CWF = Community, Work & Family, EJWOP = European Journal of Work and Organizational Psychology, HE = Higher Education, JHS = Journal of Happiness Studies, JMF = Journal of Marriage and Family, JOHP = Journal of Occupational Health Psychology, NZJER = New Zealand Journal of Employment Relations, SAEB = Scientific Annals of Economics and Business. ^a Also examined for substantial involuntary remote work with no significant effects on all three outcomes. ^b Although the statistical differences are not significant (e.g., due to small sample sizes in the study), there is clear tendency of negative effects on the indicated outcomes when having a telework day compared to an office day.

1.2.3 Research Gap and Intended Contributions

As outlined above, the current research on the relationship between workplace flexibility and health is rather sparse and inconclusive. This calls for further investigations of this relation in general. Moreover, the inconsistent findings of prior quantitative studies are reason to question whether important boundary conditions are neglected in empirical analyses about the effects of workplace flexibility. Following the assumption that context matters (Allen et al., 2015), one may assume that not every workplace setting is suited to perform spatially dispersed work behavior in a healthy manner. Hence, I expect that at least some part of the inconsistency is due to unobserved heterogeneity in the workplace setting of employees under investigation.

The role of contextual boundary conditions for certain links (i.e.; mechanisms), are commonly explored via categorical (i.e., comparison of groups) or continuous moderators (i.e., comparisons of high vs. low conditions). However, the prior studies on the relationship of interest (see Table 1.1) are rather sparse. Hence, the number of certain boundary conditions that has found scholarly attention with regard to the link with health outcomes is also rather little. For instance, some research has been conducted on the role of individual differences such as age (Arvola & Kristjuhan, 2015; Arvola et al., 2017), gender (Kim et al., 2020; Lundberg & Lindfors, 2002; Song & Gao, 2019), parental status (Song & Gao, 2019), personality (i.e., rumination, sensation seeking, openness to experience, Anderson et al., 2015; emotional stability, Perry et al., 2018), private social environment (i.e. social connections outside of the workplace, Anderson et al., 2015), voluntariness of workplace flexibility use (Kaduk et al., 2019), autonomy (Perry et al., 2018) and the time when workplace flexibility (i.e., working at home) takes place (i.e., weekends or weekends/holidays, Song & Gao, 2020).

However, prior research on workplace flexibility also mentions that ICTs per se, and its way of use, may play an important role for the effects of workplace flexibility (Blount, 2015; Boell et al., 2013; Hertel et al., 2005; Rice, 2017; Scholefield & Peel, 2009). This is mainly due to the notion that ICTs counterbalance elements that are challenged when employees work spatially dispersed, such as information exchange (i.e., virtual communication, Hertel et al., 2005). Another aspect, which has gained some theoretical attention is the task interdependence between colleagues. It constitutes an important parameter which inherently affects the nature of (joint) work between employees (Hertel et al., 2005). Thus, both boundary conditions might inevitably affect the role of workplace flexibility in work settings and subsequently its effect on health. However,

as outlined, these contextual factors have not been taken into account in empirical studies in the respective field of research. Therefore, Study 2 seeks to address this gap by being the first to explore the influence of these two contextual conditions on the relation between workplace flexibility and employee health.

In addition, this study contributes methodologically by applying a modern technique of exploratory analysis to the data, i.e., latent class analysis with a secondary model (Asparouhov & Muthén, 2014). Indeed, Marlow et al. (2017) highlights the importance of communication in virtual teams and respective future research. Thus, applying this method to means of (virtual) communication constitute a cross-literature contribution (i.e., literatures of virtual teamwork and communication sciences) by showing an improved analytical procedure to jointly analyze compositional variables, compared to treating them as individual variables.

1.2.4 Methodological Approach

To test the developed hypothesis based on Conservation of Resources (COR) theory (Hobfoll, 1989), Study 2 analyzes survey data from a total of 7,178 German employees that work in organizations with more than one employee (thus, having the possibility to interact with colleagues in the workplace). An advanced form of latent class analysis was performed for this exploratory analysis: In technical terms, I applied a 3-step latent class analysis (LCA) with an arbitrary secondary model (Asparouhov & Muthén, 2014, p.10ff.) and conducted an auxiliary structural equation model (SEM) for the hypothesis testing of the postulated effects within latent classes. In abstract terms, this means that a LCA was conducted on seven communication media variables which reflect the extent of usage with regard to every single communication media (i.e., face-to-face, phone, e-mails, texting/messaging, internal social network, public social network, videoconferencing/-call) for every single individual in the data set. This allows to analytically identify common distributions across all communication channels amongst the employees and extract a categorical ‘latent class’ variable for all individuals. This categorical variable assigns every single individual to the most similar communication behavior (i.e., class). Hence, this variable was used in an extended latent class analysis which allows to model an additional SEM model with all relationships of interest and incorporate the latent class variable as categorical moderator in the analytical process (i.e., a ‘LCA with an arbitrary secondary model’). To make full use of the available data, Full-Information Maximum Likelihood (FIML) was applied to take missing values into account.

The findings support the notion that incorporating contextual information, i.e., communication structures with colleagues and task interdependence, is important when examining relationships between workplace flexibility and health outcomes (i.e., emotional exhaustion). Results show that an increase in workplace flexibility behavior (intensity) is particularly positively related with health for employees with high levels of virtual communication and high task interdependence. For employees with low levels in both boundary conditions, no relationship is examined. In no case, even indications of a negative relationship are identified. This supports the notion that workplace flexibility can be beneficial for employees - if the work context is taken into account. Moreover, this is preliminary evidence that the inconsistent findings in prior studies can be affected to some extent by unobserved heterogeneity. This study adds new knowledge to the literature by offering insights on the relevance of two new contextual information. These are recommended to be considered in further empirical examinations of workplace flexibility and employee health.

1.3 The Role of ICT-induced Technostress for Employee Health

1.3.1 Defining and Measuring Technostress

In line with Tarafdar et al. (2007, p.302), I refer to technostress as “any forms of stress created by information and communication technology (ICT)”. In order to enable scientific examinations of technostress as a construct, Tarafdar et al. (2007) first introduced a conceptualization of stress dimensions that employees perceive due to the use of technologies, which has been validated by Ragu-Nathan et al. (2008). The so called “technostress creators” comprise perceptions of increased techno-overload, -invasion, -complexity, -uncertainty and -insecurity. In brief, the overload component refers to stress due to perceptions of being forced to work more, faster and longer due to technologies (Tarafdar et al., 2007). Further, the invasion dimension focuses on the potential of ICTs to enable constant connectivity of employees with the work environment. Thus, it is the stressor that individuals experience when they see their private life being invaded by work demands. Next, individuals are constantly forced to adapt to a changing or developing Information Systems (IS) environment by learning new skills. When those changes appear too quickly it causes techno-uncertainty. Techno-complexity encompasses stress that may arise from a certain ICT quality which implies complexity, and thus may cause an inherent feeling of having insufficient skills to use the technologies properly. At last, the insecurity component refers to situations in

which individuals feel their job position being threatened by (modern) technologies (Tarafdar et al., 2007).

These concepts and measures are commonly applied in scientific research to examine creators of technostress (Ayyagari et al., 2011; Gaudioso et al., 2017; Wang et al., 2008). They are more or less flexibly transferred to different technology contexts, for instance, to social networks (Maier et al., 2015), communication media (Lee, Son, & Kim, 2016) or the use of ICTs in general (Reinke & Chamorro-Premuzic, 2014).

1.3.2 Current State of Research on Technostress and Employee Health

A recent review by Tarafdar et al. (2017) shows that there is existing research on the overall effects of technostress on various stress or strain outcomes as a proxy for health (Galluch et al., 2015; Maier et al., 2015; Zhang et al., 2016). To verify and deepen the insight on the existing scientific examination regarding the relationship between technostress and employee health, I conducted an additional meta search (see Table 1.2, exact search procedure is outlined in the note section of the Table). A total of 14 studies from the review by Tarafdar et al. (2017) are classified as examining well-being/health-related outcomes from direct relationship with technological stressors. The search procedure resulted in a total of 98 studies in the time span from 2007 to 2019. Thereof, only 39 are quantitative papers that examine relations with any form of technology-related stress. After checking all papers according to their variables and models under investigation, a total of 21 studies is identified that focus on relationships between technostress and any form of strain and health-related outcomes.

The results are conclusive in a way, that all studies show that technostress creators are positively related with strain and stress outcomes. More specifically, the studies show support for the detrimental effects of technostress in various settings: For instance, in the context of general (information) technology use (Ayyagari et al., 2011; Barber & Santuzzi, 2015; Chen et al., 2009; Day et al., 2012; Galluch et al., 2015; Gaudioso et al., 2017; Khedhaouria, & Cucchi, 2019; Nimrod, 2018; Srivastava et al., 2015; Yan et al., 2013; Zheng, & Lee, 2016), communication media use (i.e., various media: see Barley et al., 2011; e-mail: see Brown, et al., 2014; Lee, Lee, & Suh, 2016; Reinke, & Chamorro-Premuzic, 2014; computer-mediated communication: see Stich et al., 2017), social network use (Lee, Son, & Kim, 2016; Maier et al., 2015; Zhang et al., 2016) and in IT implementation settings (Korunka, and Vitouch, 1999; Sykes, 2015). This supports the notion that technostress is a multifaceted phenomenon that occurs in various

technological settings and is related with detrimental effects for employee health. Thus, technostress needs to be managed in the digital era.

Table 1.2: Quantitative Peer-Reviewed Journal Articles Examining the Effect of Technology-Related Stress and Employee Health between 2007 and 2019

Nr	Authors	Year	Journal	Technostress Predictor	Strain/Health-Outcome	Effect of Technostress
1	Ayyagari et al.	2011	JAP	Technological characteristics	Strain	Positive
2	Barber & Santuzzi	2015	JOHP	ICT demands	Absenteeism, Burnout	Positive
3	Barley et al.	2011	OS	E-mail and other media usage	Overload	Positive
4	Brown, Duck, and Jimmieson	2014	IJSM	E-mail stress creators	Emotional exhaustion	Positive
5	Chen et al.	2009	JOHP	IT workload	Emotional exhaustion	Positive
6	Day et al.	2012	JOHP	ICT demands	Strain, Stress, Burnout	Positive
7	Galluch et al.	2015	JAIS	ICT-enabled interruptions	Stress, Physical strain	Positive
8	Gaudio et al.	2017	CHB	Technostress creators	Distress	Positive
9	Khedhaouria, and Cucchi	2019	JBR	Technostress creators	Job burnout	Positive
10	Korunka, and Vitouch	1999	WS	New ICT implementation	Strain	Positive
11	Lee, Son, and Kim	2016	CHB	Social network service demands	Strain	Positive
12	Lee, Lee, and Suh	2016	TQMBE	Mobile communication technostress creators	Strain	Positive

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13	Maier et al.	2015	ISJ	Social network service technostress creators	Social network exhaustion	Positive
14	Nimrod	2018	AMH	Older people technostress creators	Life satisfaction	Negative
15	Reinke, and Chamorro-Premuzic	2014	CHB	E-mail stress creators	Burnout	Positive
16	Srivastava et al.	2015	ISJ	Technostress creators	Job burnout	Positive
17	Stich et al.	2017	NTWE	Computer-mediated communication use	Workplace stress	Positive
18	Sykes	2015	MISQ	New enterprise system implementation	Stress	Positive
19	Yan et al.	2013	ITP	Technostress creators	Strain	Positive
20	Zhang et al.	2016	IM	Social network stressors	Fatigue	Positive
21	Zheng, and Lee	2016	CHB	Technostress creators	Strain	Positive

Note. Selected quantitative peer-reviewed journal articles on forms of technostress being published between 2007 and 2019 that analyze relationships with health outcomes. The articles are selected from 98 scientific papers that were identified by a Web of Science Meta Search with the search term ‘*TS=(technostress AND (strain OR stress))*’ and 14 articles mentioned in the technostress review by Tarafdar et al. (2017). After excluding non-quantitative studies and those that do not examine relations with any form of technology-related stress, 39 individual studies remain. Thereof, this table shows 21 studies that examine relations with any form of technology-related stress and health-related outcomes. AMH = Ageing & Mental Health, CHB = Computers in Human Behavior, ICS = Information, Communication & Society, IJSM = International Journal of Stress Management, IM = Information Management, ISJ = Information Systems Journal, ITP = Information Technology & People, JAP = Journal of Applied Psychology, JAIS = Journal of the Association for Information Systems, JBR = Journal of Business Research, JOHP = Journal of Occupational Health Psychology, MISQ = MIS Quarterly, NTWE = New Technology, Work and Employment, OS = Organization Science, TQMBE = Total Quality Management & Business Excellence, WS = Work & Stress.

Table 1.3: Quantitative Peer-Reviewed Journal Articles Examining Moderators for the Effect of Technology-Related Stress and Employee Health between 2007 and 2019

Nr	Moderator	Example item/Definition	Level ^a	ICT ^b	Studies
1	Involvement facilitation	‘As end users, we are encouraged to try out new ICT solutions.’	I	Yes	Ahmad et al. (2014); Fuglseth & Sorebo (2014), Ragu-Nathan et al. (2008); Tarafdar et al. (2015)
2	Technical support provision	‘Our end user help desk is well staffed by ICT knowledgeable individuals.’	O	Yes	<i>same as stated in #1</i>
3	Literacy facilitation	‘Our organization emphasizes teamwork in dealing with new ICT related problems.’	O	Yes	<i>same as stated in #1</i>
4	Timing control	‘Whether the individual can decide when to view messages, rather than responding to intruding messages from ICTs.’	I	Yes	Galluch et al. (2015)
5	Job autonomy	The individual ability to decide when, where, and how the job is to be done.	I	No	Brooks & Califf (2017)
6	Job feedback	Receiving information from staff members/ management about performance on job expectations.	I	No	<i>same as stated in #5</i>
7	Task identity	The extent to which the employee does an entire or whole piece of work and can clearly identify the results of his/her efforts.	I	No	<i>same as stated in #5</i>
8	Task significance	Judgments that one’s individual job has a positive impact on other people.	I	No	<i>same as stated in #5</i>

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9	Task variety	The degree of non-repetitiousness in ones' individual job.	I	No	<i>same as stated in #5</i>
10	Agreeableness	'I see myself as warm.'	I	No	Khedhaouria & Cucchi (2019); Srivastava et al. (2015)
11	Openness to experience	'I see myself as imaginative.'	I	No	<i>same as stated in #10</i>
12	Extraversion	'I see myself as extraverted.'	I	No	<i>same as stated in #10</i>
13	Neuroticism	'I see myself as anxious.'	I	No	<i>same as stated in #10</i>
14	Conciousness	'I see myself as organized.'	I	No	<i>same as stated in #10</i>
15	Knowledge of ICT functions	'I do not know this function.'	I	Yes	Soucek & Moser (2010)
16	Application of ICT functions	'How often do you utilize rules for automatic sorting and filing of incoming emails?'	I	Yes	<i>same as stated in #15</i>
17	Age	Age of the individual.	I	No	Tams et al. (2018)
18	Personal inhibitor effectiveness	The extent to which a person can deliberately inhibit or down-regulate the processing of interruptions, preventing interrupting stimuli from entering working memory.	I	No	<i>same as stated in #17</i>
19	Computer experience	The extent to which people have been using computers over their lifetimes.	I	Yes	<i>same as stated in #17</i>

Note. This selection of articles is based on the same 39 quantitative articles identified in the meta search procedure described in the Notes of Table 1.2. This table shows 11 studies that examine 19 distinct moderators of the technostress-outcome relationship. ^a I = Individual level, O = Organizational level; ^b ICT-related moderator: yes or no.

1.3.3 Research Gap and Intended Contributions

As outlined above, there is strong support that technostress is negatively related to health. However, in their review on technostress, Tarafdar et al. (2017, p. 13) conclude that “many of the key IS-related variables and processes that constitute distinctive aspects of the phenomenon of technostress [...] are under-studied, and the related insights have not been incorporated into the understanding of psychological stress”. Thus, the current research primarily takes place in the realm of IS research and the studied (techno-)stress processes lack in their theoretical foundation. It is recommended to follow a cross-disciplinary approach and apply theories from psychological stress literature to the field of technostress (Tarafdar et al., 2013).

Further, technostress research would profit from further examinations on how to mitigate the negative effects of technostress creators. Referring to the 39 quantitative articles of my literature search that investigate effects of technology-related stress (see Notes of Table 1.2), solely 11 studies are identified that examine moderators of the stressor-outcome relationship (see Table 1.3). The identified moderators can be categorized in focusing on the individual or organizational level¹, and in being ICT-related or not². For instance, examined moderators with ICT focus on the organizational level are technical support provision and literacy facilitation (Ahmad et al., 2014; Fuglseth & Sørenbø, 2014; Ragu-Nathan et al., 2008; Tarafdar et al., 2015). Examined moderators with ICT focus on the individual level are involvement facilitation (Ahmad et al., 2014; Fuglseth & Sørenbø, 2014; Ragu-Nathan et al., 2008; Tarafdar et al., 2015), timing control (Galluch et al., 2015), knowledge and timing of ICT functions (Soucek & Moser, 2010), and computer experience (Tams et al., 2018). Further, non-ICT-related moderators that refer to the individual job characteristic of the employee under investigation are job autonomy, job feedback, task identity, task significance, task variety (Brooks & Califf, 2017). The role of personality traits such as agreeableness, openness to experience, extraversion, neuroticism and conscientiousness for the technostress-outcome relationship has also been investigated (Khedhaouria & Cucchi, 2019; Strivastava et al., 2015). At last, Tams et al. (2018) examined the moderating role

¹ Individual-level moderators directly relate to the individual or his/her respective workplace (i.e., task significance; personality). Organizational-level moderators relate to factors that are related to the organizational environment and thus, to employees per se (i.e., organizational support for ICT use).

² ICT-related moderators directly affect ICTs or the ICT environment (i.e., ICT support). Contrary, moderators without ICT-relation are not directly associated to the ICT dimension at all (i.e., job autonomy).

of personal characteristics such as age of the individual and his/her personal inhibitor effectiveness. Hence, based on this analysis, it follows that no scientific investigation was conducted that examines the moderating effect of certain non-ICT-related organizational characteristics for the technostress-outcome relationship.

Therefore, Study 1 seeks to address these major gaps and is the first to explore the effect of non-ICT-related organizational characteristics (i.e., organizational support for strengths use, Keenan & Mostert 2013; and friendship opportunities, Sims, Szilagyi, & Keller, 1976), on the relationship between a certain technostress creator (i.e., technological insecurity, Tarafdar et al., 2007) and health (i.e., general health, Tuomi et al., 1998), while applying a theoretical cross-disciplinary approach through a theoretical derivation from traditional psychological stress theory (i.e., COR theory, Hobfoll, 1989).

1.3.4 Methodological Approach

To test the hypothesis, survey data from a total of 11'269 German employees were collected in two waves with a time interval of 9 months. The data are weighted to be a representative of 33 million employees in the German workforce. Hierarchical moderated multiple regression (HMMR) with a time-lagged dependent variable was applied for statistical tests of the hypothesized relationships. We also applied chained multiple-imputation in order to make full use of the available data and take potential empirical biases due to missing values into account. The findings support the notion that non-technology-related organizational factors act as resources that show additive buffering effects on the detrimental relation between technostress creators and employee health. This buffering mechanism can be as high as no negative relation between technostress and employee health is apparent under certain conditions. This supports the notion that the organizational environment can be designed in a way that supports employees in their coping with technology-induced psychological stress.

1.4 The Role of ICT-induced Work-Family Conflict for Employee Health

1.4.1 Defining and Measuring Work-Family Conflict

Work-family conflict (WFC) is defined as “a form of interrole conflict in which the general demands of, time devoted to, and strain created by the job interfere with performing family-related responsibilities” (Netemeyer et al., 1996, p.401). Thus, the concept of WFC incorporates a clear direction on the extent to which work demands interfere in the family domain, and not vice versa. Indeed, the contrary direction is defined as a separate construct called family-work conflict (FWC, see Netemeyer et al., 1996). The latter is not the subject of consideration in the present work because the main scope is to examine how changes in the work domain affect individuals. Hence, the direction of interest are interferences from the work to the private domain, i.e., WFC. Regarding the measurement of WFC, Study 3 applies three items from a widely accepted measure developed by Netemeyer et al. (1996) (see Derks et al., 2016; Hammer et al., 2005; Rupert, 2009).

1.4.2 Current State of Research on Work-Family Conflict and Employee Health

The relationship between WFC and health of individuals is a field of research that has been the subject of many empirical papers in recent decades, which have given rise to several meta-analytical reviews on this topic (e.g., Allen et al., 2000; Eby et al., 2005; Amstad et al., 2011; Nohe et al., 2015). Overall, due to the large number of studies and reviews that empirically support the notion that work-family conflict and health are negatively related, there is very limited reason to question this view (i.e., WFC and health is negatively related, WFC and strain or stress are positively related; e.g., for an overview see: Allen et al., 2000; Demerouti et al., 2004; Innstrand et al., 2008; Jensen, 2016; Nauman et al., 2018; Nohe et al., 2015; Schaufeli et al., 2009; Zhang et al., 2014).

1.4.3 Research Gap and Intended Contributions

Indeed, the negative relationship between WFC and employee health is well established. However, not the nature of the relationship is questionable but the current findings about the causal direction of this relationship. This notion derives from the finding that prior quantitative research that intends to analyze individual longitudinal data in order to examine the causality of this relationship, shows scattered and inconsistent results. For instance, studies that show a relationship between WFC and health variables (e.g.,

psychological strain) provide support for a unidirectional (i.e., WFC $\rightarrow$ health; Dettmers, 2017), reverse (i.e., WFC $\leftarrow$ health; see Hornung et al., 2013) or reciprocal causality (i.e., WFC $\leftrightarrow$ health, see Babic et al., 2016). This could be to some part due to the application of statistical methods (e.g., the standard cross-lagged panel model, CLPM; see Bergs et al., 2017; Jensen, 2016; Kinnunen et al., 2010; Neto et al., 2016; Van der Heijden et al., 2008) which fail to adequately separate the effect of interest, i.e., within-person effect estimates (Zyphur et al., 2020a, 2020b). Doing so, prior research neglects to make full use of extensive longitudinal data which has the capability to examine theoretical processes on different levels of observation. For instance, this includes the separation of theoretical tenets and corollaries that rather describe why and how certain individuals may constantly differ from others in relation to a specific phenomenon from those that intend to explain processes and changes within one individual over time (i.e., between-person and within-person, respectively).

Hence, recent methodological research strongly questions the applicability of traditional procedures like the CLPM, but at the same time offers an improved method, i.e., the random-intercept cross-lagged panel model (RI-CLPM; Hamaker et al., 2015). The latter should overcome these former statistical drawbacks since it is now actually able to adequately account for stable between-person differences (Hamaker et al., 2015; Zyphur et al., 2020a, 2020b). Indeed, there is no single study that applies the RI-CLPM to the relationship between WFC and health. Therefore, there is the possibility that prior longitudinal research on this connection, and thus also the conclusions drawn from recent meta-analytical reviews that rely on prior study results (Nohe et al., 2015), is affected by biased effect estimates. Hence, Study 3 seeks to address this primarily methodological research gap by replicating and extending prior research due to the empirical comparison of the CLPM and the RI-CLPM.

1.4.4 Methodological Approach

First, a systematic literature review of longitudinal analyses is conducted to verify the notion that current research on this topic is dominated by statistical approaches that fail to separate stable between-person differences from within-person variance. This provides an overview of the inconsistent study results on the causal direction between WFC and health. Second, the prior survey data collection from German employees was extended by a third annual wave in order to empirically compare the CLPM and the RI-CLPM with appropriate longitudinal data. Thus, three-wave data from 12'241 working adults were used for the statistical analyses. Results indicate that the RI-CLPM

yields significantly better model fit compared to the CLPM. This supports the notion that accounting for stable between-person differences is indeed important for the relationship at hand. In fact, the CLPM replicates prior meta-analytical conclusions (i.e., reciprocal causality), whereas the superior RI-CLPM provides support for a different conclusion (i.e., a unidirectional causality from WFC on health, and not vice versa).

1.5 Outline of the Dissertation

The present thesis comprises five consecutive chapters: introduction, three quantitative studies, and the closing discussion. As illustrated in Figure 1, this dissertation examines employee health against the background of three changing factors in the workplace that are affected by ICT integration efforts in the digital era. Study 1 explores contextual factors that are crucial for examining the health-effect of workplace flexibility behaviors. Study 2 is the first in explaining the moderating role of non-ICT-related organizational factors on the relationship between technological insecurity and employee health. Study 3 adds to the literature by revealing potential bias in former examinations of causality between work-family conflict and employee health. Combined, all three studies provide empirical support for yet undiscovered theoretical and methodological insights on ICT-induced changes to the nature of work and their role for health perceptions of employees in the digital era.

Figure 1.1: Thesis Concept based on Three Quantitative Studies

	Digital Era <i>Information & Communication Technologies</i>		
Triggered Change	ICT-induced Flexibility	ICT-induced Stress	ICT-induced Boundary Permeability
Research Stream	Workplace Flexibility	Technostress	Work-Family Conflict
	Study 1: “Conditional Effects of Workplace Flexibility on Health across Communication Classes – A LCA analysis”	Study 2: “Am I outdated? The Role of Strengths Use Support and Friendship Opportunities for Coping with Technological Insecurity”	Study 3: “Effect Direction between Work-Family Conflict and Psychological Strain: A Replication and Extension Study”
Study Focus	Exploring Conditions: <i>Effect of workplace flexibility on health moderated by communication profile and task interdependence</i>	Explaining Mechanisms: <i>Effect of technological insecurity on health moderated by strengths use support and friendship opportunities</i>	Revealing Bias and Causal Relations: <i>Effect of work-family conflict on health: unidirectional, reversal or reciprocal</i>
Health Outcome	Emotional Exhaustion	General Health	Emotional Exhaustion
Study Data	1 wave of data	2 waves of data	3 waves of data
Study Design	Cross-sectional study	Time-lagged study	Longitudinal study
Core Method	Latent-Class Model	Regression Model	Random-Intercept Cross-Lagged Panel Model
Research Design	Exploratory	Explanatory	Causality

The individual chapters are briefly summarized below to provide a better outline of the present work.

Chapter 1: Introduction

The introduction covers definitions of the core concepts employee health, ICTs and ICT-induced change, followed by a derivation of how the three study projects are embedded in the field of ICT-induced change. In addition, the definition and measurement of the predictor variable, the current state of research with respect to health outcomes, contributions and methodologies are subsequently presented for each study individually.

Chapter 2: *Conditional Effects of Workplace Flexibility on Health across Communication Classes – A LCA analysis*

This study explores unobserved heterogeneity in prior studies on the relation between workplace flexibility and health (i.e., emotional exhaustion) as a possible explanation for the inconsistent findings in the literature. In fact, communication channels used to interact with colleagues and task interdependence are examined as contextual conditions, which have been neglected in prior research. The study follows an exploratory research design by applying a rarely used combination between a latent-class analysis and a structural equation model (i.e., latent class analysis with an arbitrary secondary model, see Asparouhov & Muthén, 2014) to survey data once drawn from a sample of 7'178 employees in Germany (2016).

Chapter 3: *Am I outdated? The Role of Strengths Use Support and Friendship Opportunities for Coping with Technological Insecurity*

Study 2 examines the relationship between technological insecurity and employee health (i.e., general health), while considering respective mechanisms with non-ICT-related organizational boundary conditions. In detail, the latter represents two factors. That is organizational support for strengths use and friendship opportunities. The study follows an explanatory research design by applying a time-lagged regression analysis to two-wave survey data drawn from a sample of 8'019 employees in Germany (2016 and 2017). Structurally weighting the data to be representative for 33.3 million employees in Germany as a robustness check increases the external validity of the study. Hence, it supports the notion of technostress to be an important ICT-induced change that is challenging for the entire workforce.

Chapter 4: *Effect Direction between Work-Family Conflict and Psychological Strain: A Replication and Extension Study*

Study 3 examines and confirms the superiority of a recent statistical method (i.e., the random-intercept cross-lagged panel model, RI-CLPM) to analyze longitudinal panel data against its commonly applied predecessor (i.e., the cross-lagged panel model, CLPM). Hence, the study is guided by the notion that the CLPM is inappropriate in separating stable between-person effects from within-person effects (Hamaker et al., 2015; Zyphur et al., 2020a; 2020b). This in turn leads to biased coefficients used to interpret causal directions between work-family conflict and employee health (i.e., emotional exhaustion), and subsequently to biased conclusions for research and

management. To examine this rather critical view, a review of prior longitudinal studies is conducted that confirms the dominant application of the inferior CLPM. Further, the CLPM and the RI-CLPM are applied and statistically compared on the basis of longitudinal three-wave panel data drawn annually from 12'241 employees in Germany (2016, 2017 and 2018).

Chapter 5: *Discussion*

The final discussion outlines the key findings and contributions of the three studies. In detail, it summarizes the key theoretical implications, methodological and empirical contributions, as well as respective limitations and recommendations for future research. Practical implications for scholarly and managerial practice are discussed. At last, it closes the present thesis with a final conclusion.

2 Conditional Effects of Workplace Flexibility on Health across Communication Classes – A LCA analysis

Authors: Goetz, T. M.

Presentations: This paper was accepted and presented virtually at the 80th Annual Meeting of the Academy of Management in Vancouver, Canada, from August 7th-11th, 2020.³ A prior version was also presented at the EAWOP Small Group Meeting on “Teamworking Virtually: Business as usual?” in Lisbon, Portugal, from July 22nd-24th, 2019.

Current Status: This paper project is a working paper being prepared for a journal submission.

Abstract

In the 21st century, flexible work is one of the megatrends shaping how modern work is executed. Particularly prior research on the relationship between workplace flexibility and health has shown inconsistent findings. Following the assumption that not every workplace setting is suited for spatially dispersed working behavior, it is expected that this inconsistency may be due to unobserved heterogeneity in the workplace setting of employees. Respectively, specific communication behavior with colleagues and task interdependence characteristics might explain some part of this heterogeneity. Using latent class analyses, five communication classes, are identified based on employee responses regarding their use of several communication channels. Based on Conservation of Resources (COR) theory, it is theorized that there are different relations between workplace flexibility behavior and health, i.e., emotional exhaustion, for employees in different communication classes. Hence, the role of varying task interdependency levels is examined within those classes. It is hypothesized that workplace flexibility can unfold positive effects on employee health particular for employees that are used to communicate virtually. Moreover, I follow that high task

³ Goetz, T. M. (2020). Conditional Effects of Workplace Flexibility on Health Across Communication Classes-A LCA Analysis. In *Academy of Management Proceedings* (Vol. 2020, No. 1: 19853). Briarcliff Manor, NY 10510: Academy of Management.

interdependence implies high communication requirements, and thus, workplace flexibility can only be beneficial when strong and diverse virtual communication is practiced to satisfy these needs. The study follows an exploratory person-centered approach by applying latent class analyses with a secondary model (Asparouhov & Muthén, 2014) to explore the sample of 7'178 German employees. Results support the hypotheses and indicate that workplace flexibility is particularly beneficial for employees with high virtual communication and high task interdependencies. Thus, these factors represent important boundary conditions for examining relations of workplace flexibility.

Keywords: latent class analysis, secondary model, task interdependence, virtual communication, workplace flexibility, telework, emotional exhaustion, occupational health

2.1 Introduction

Work flexibility has become a highly discussed and popular topic in modern society. Although with certain conditions, some European countries plan or already passed laws to give employees the legal right to demand work flexibility (e.g., Germany, Netherlands, and the United Kingdom; see European Monitoring Centre on Change, 2018; The Guardian, 2019; Zeit Online, 2019). These societal and political movements let assume that workplace flexibility is one of the most relevant and radical factors in shaping work in the 21st century.

Thereby, work flexibility generally refers to “the ability of workers to make choices influencing when, where, and for how long they engage in work-related tasks” (Hill et al., 2008, p.152). ‘Workplace flexibility’ and ‘worktime flexibility’ are the two major distinct domains in this definition that refer to where (location) and when (time) work tasks are performed. Different terms, e.g., flexible work arrangements (FWAs), distributed work, distance work, telecommuting, telework, flextime, flexplace, are used in the literature more or less interchangeably to describe flexibility in the workplace with various foci (Allen et al., 2015).

In the course of prior research, work flexibility has been linked to employee stress and health perceptions (Allen et al., 2015; Butler et al., 2009; Halpern, 2005). Thereby, studies dominantly report a positive relation between worktime flexibility with employee health (Grzywacz et al., 2008; Kattenbach et al., 2010; Moen et al., 2011; Nijp

et al., 2012). However, studies examining the link between workplace flexibility and health show a rather mixed picture: profound evidence exists for a positive (Anderson et al., 2015; Kaduk et al., 2019; Kröll et al., 2017), a negative (Arvola & Kristjuhan, 2015; Henke et al., 2016; Song & Gao, 2019) or even no relationship at all (Arvola et al., 2017; Konradt et al., 2003; Lundberg & Lindfors, 2002).

As the relationship for worktime flexibility and health tends to be quite constant in showing a positive relation, “the overall effect [of workplace flexibility] on health is neither well known nor consensual” (Tavares, 2017, p.33). The different relationships with health might be due to the fact that worktime flexibility implies enhanced control of the employee over his/her time schedule (Moen et al., 2011), while the employee still works in the designated workplace (Grzywacz et al., 2008). Hence, no dramatic changes in one’s work behavior is required. However, when workplace flexibility takes place, the entire work environment changes and thus, work behavior must be adapted (i.e., changed). Therefore, the impact of workplace flexibility on employees is much more pervasive as of worktime flexibility. In consequence, the multifaceted research results regarding workplace flexibility and employee health might indicate that not every work or work environment is suitable to reveal the benefits of workplace flexibility. Thus, the current research on this relationship might be, at least to some part, affected by unobserved omitted variable bias that accounts for the deviations in the study results.

Herewith, prior research on workplace flexibility mentions the role of information and communication technologies (ICTs) (Blount, 2015; Boell et al., 2013; Hertel et al., 2005; Rice, 2017; Scholefield & Peel, 2009) as they enable elements that are challenged when people are working apart from each other, such as information exchange (i.e., virtual communication; Hertel et al., 2005). Besides, studies also highlight another important factor as an important characteristic that influences how employees work together, i.e., task interdependence (Hertel et al., 2005). Hence, task interdependencies might also affect the role of workplace flexibility in work settings. In addition, Hertel et al. (2005, p.77f.) state that task interdependence and technologies are tightly linked, as technologies might provide the means of communication necessary when performing highly interdependent tasks. Although the interdependency between ICT-enabled communication and task interdependence is recognized as being relevant for dispersed work settings, their role on the relationship between workplace flexibility and health has not been explored yet.

Therefore, this study addresses this gap in the literature and argues that neglecting the role of communication behavior and task interdependence amongst colleagues represents yet unobserved heterogeneity. For this purpose, the study analyzes the individual communication behaviors according to yet unobserved but characteristic communication patterns amongst the study participants. The relation between workplace flexibility and employee health is then examined within these subgroups of communication, while incorporating the contextual factor task interdependence.

As communication behavior is measured with a compositional variable, this poses challenges for empirical examinations. Methodologically, mixture modeling is one method capable to deal with such data. It is able to identify subgroups of communication based on individual reports about the use of distinct communication channels at work. At this, subsets of the observed variables are used to empirically uncover heterogeneity amongst participants in a sample (Masyn, 2013; Peel & McLachlan, 2000). One form of mixture modeling is latent class analysis (LCA), which allows to examine cross-sectional data and generate categorical variables for different subgroups based on response data (Muthén, 2008). Therefore, this study identifies yet unexamined heterogeneity in work settings of an entire workforce, i.e., various communication classes and task interdependency levels, and their intertwined role for detecting relations between workplace flexibility and health.

In doing so, this study contributes methodologically by applying and outlining modern ways of combining exploratory data analysis and structural equation modeling (i.e., ‘latent class analysis with an arbitrary secondary model’; see Asparouhov & Muthén, 2014). Specifically, applying this method to means of (virtual) communication yields a cross-literature contribution by showing an improved analytical procedure to jointly analyze compositional variables (i.e., compositional data analysis, CODA), instead of treating them as individual variables. And last, this study contributes to the literature of flexible work by showing that communication patterns and task interdependencies constitute important boundary conditions for the relationship between workplace flexibility and health (Boell et al., 2013; Hertel et al., 2015; Rice, 2017). Neglecting these conditions might to some part explain the inconsistent estimation results in prior quantitative studies.

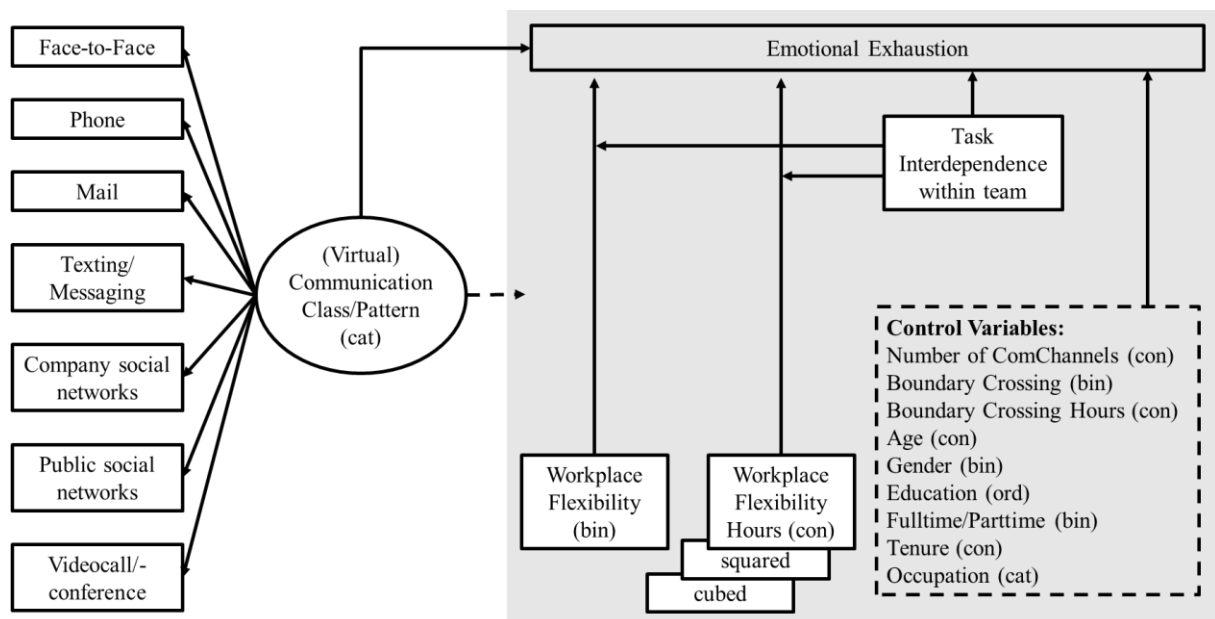
The paper is structured as follows: First, a theoretical rationale for the relationship of workplace flexibility and health is outlined (i.e., COR theory, Hobfoll 1989). Then, theoretical explanations of the role of the two proposed boundary conditions are

presented. To test the hypotheses, a person-centered approach is followed by applying an exploratory latent class analysis on a sample of 7'178 employees in Germany from 2016. It concludes on a summary of the study results and implications for future research in the field of workplace flexibility.

2.2 Theory and Hypotheses

This exploratory study follows the notion that different work characteristics, for instance, communication patterns and task interdependence levels, determine whether and how employees benefit from workplace flexibility behaviors. Relying on COR theory (Hobfoll, 1989), it is assumed that workplace flexibility behavior both promotes and threatens certain resources of employees. Herein, boundary conditions change the value of certain resources. Therefore, they determine whether workplace flexibility can unfold its beneficial potential for employee health. The hypothesized model is shown in Figure 2.1.

Figure 2.1: Overview of the Model under Investigation.



2.2.1 The Conservation of Resources Theory

The Conservation of Resources Theory (COR; Hobfoll, 1989) is one of the most applied theories when rationalizing the development of stress for individuals. It relies on the notion that employees are equipped with certain resources (Hobfoll, 1989, Hobfoll et al., 1996). These resources determine how and how well people are suited to handle stressful situations. Generally, it is stated that more resources enable people to better

cope with stressful events, which reduces strain and thus, positively affects their health and well-being (Hobfoll, 1989).

Since its introduction, many studies applied the COR theory in order to discover the psychological processes and elements that are suited to increase individual coping capabilities, i.e., what constitutes the so called ‘resources’ (for a detailed review on ‘resources’ see Halbesleben et al., 2014). Thus, resources can generally be classified as 1) *objects/conditions* (e.g., marriage, employment, security, network), 2) *social support* (e.g., affect, advice, help from others), 3) *energies* (e.g., recovery experiences, time apart from work, time), and 4) *constructive resources* (e.g., autonomy, control, skills, mental resilience), 5) *key resources* (e.g., self-esteem, optimism, locus of control), or 6) *macro resources* (e.g., policies, culture, social equality) (Halbesleben et al., 2014; ten Brummelhuis & Bakker, 2012),

According to COR theory, “individuals [...] strive to obtain, retain, foster, and protect [these] resources” (Hobfoll et al., 2018, p.104). Hence, stress occurs when resources are in danger of depletion or actually depleted (Hobfoll, 2002). This implies that people perceive increased levels of strain when they associate certain situations with potential or actual loss of resources. This in turn has detrimental effects on well-being.

Hence, this study applies COR theory and assumes that the execution of workplace flexibility behavior in general yields both beneficial and detrimental effects on certain resources. However, distinct work environments might provide settings that allow workplace flexibility to promote the beneficial aspects instead of the detrimental ones. The rationalities behind this assumption are outlined in the following sections.

2.2.2 Advantages and Challenges of Work Flexibility

Literature shows that workplace flexibility constitutes a double-edged sword for employees while showing both *advantages* and *disadvantages* (for a detailed review on this see Boell et al., 2013). Hence, certain *challenges* are attached to workplace flexibility. For instance, these are increased work-life blurring (Baard & Thomas, 2010), socialization problems (Baard & Thomas, 2010; Gajendran & Harrison, 2007; Pyöriä, 2011) and higher interruptions (Davis, 2002), as well as reduced career and workplace involvement (Baard & Thomas, 2010; Gajendran & Harrison, 2007; Pyöriä, 2011), trust (Gajendran & Harrison, 2007; Pyöriä, 2011), and technical support, if needed (Scholefield & Peel, 2009).

However, workplace flexibility is also associated with several *advantageous* effects for employees. The most prominent are financial and productivity advantages (Baard & Thomas, 2010; Pyöriä, 2011), spatial mobility (Baard & Thomas, 2010), increases in one's work-life balance (Gajendran & Harrison, 2007), work autonomy (Gajendran & Harrison, 2007; Pyöriä, 2011), and job satisfaction (Baard & Thomas, 2010; Gajendran & Harrison, 2007).

Thereby, following the categorization of resources (ten Brummelhuis & Bakker, 2012, Halbesleben et al., 2014) employees might associate the aforementioned advantages and challenges with a (potential) promotion or depletion of certain resources when executing workplace flexibility behavior (see Table 2.1). First, financial advantages may promote *objects/condition resources* as they decrease costs for travel. However, lacks in career and workplace involvement could be regarded as negative for employment and network components, which threatens these resources. Second, *social support resources* can be threatened by increased socialization problems and reduced technical support because both reduce the ease of advice and help from others due to spatial distance. Third, *energy resources* might be promoted by job satisfaction and work-life balance as they trigger an increase in mood when being at work and recovery experiences when being apart from work, if needed. However, when not managed properly, interruptions can increase and thus, work-life can be blurred, which leads to contrary threatening effects on recovery experiences. And last, *constructive resources* are affected particularly by increased work autonomy as it increases one's autonomy and control about where and how work is to be executed.

Overall, workplace flexibility is expected to trigger a variety of promoting and threatening aspects for employee resources. Hence, workplace flexibility is regarded as a 'double-edged sword' for employees. Therefore, it is assumed that the positive and negative effects of increased workplace flexibility cancel each other out empirical analyses, particularly in cross-sectional data. This would imply that the overall effect of workplace flexibility on health cannot be examined properly when neglecting unobserved heterogeneity within the study sample. Hence, dimensions of heterogeneity and how they affect the assessment of workplace flexibility effects are outlined below.

Table 2.1: Resource Promoting and Threatening Attributes of Workplace Flexibility and Information and Communication Technologies

Resource Dimension	Examples	Promotion due to WPF	Threat due to WPF	Promotion due to ICTs	Threat due to ICTs
Objects/ Condition resources	money, marriage, employment, security, network	financial advantages, spatial mobility	lack of career and workplace involvement	time savings, mobility	lack of workplace involvement
Social support resources	affect, advice, respect, help from others	-	socialization problems, technical support	socialization opportunities	-
Energy resources	recovery experiences, time apart from work, mood, physical energy, cognitive energy, attention, time	work-life balance, job satisfaction,	work-life blurring, interruptions	flexibility and balance of work and private life	blurring of one's work and private life
Constructive resources	autonomy, control, skills, knowledge, experience, mental resilience and health	work autonomy	-	work autonomy, control	-
Key resources	self-esteem, optimism, locus of control	-	-	-	-
Macro resources	policies, culture, social equality	-	-	-	-

Note. Resource dimensions and examples derived from ten Brummelhuis & Bakker (2012) and Halbesleben et al. (2014). References and rationalities of the assignments for promoting and threatening attributes of workplace flexibility (WPF) and Information and Communication Technologies (ICTs) are outlined in section 2.2.2 and 2.2.3, respectively.

2.2.3 The Role of Virtual Communication Classes for Work Flexibility

Communication constitutes the means how individuals exchange information with each other. It represents the venue of coordinated work between individuals (team work), which is the existence criterion for organizations (Baker et al., 2006). In the 21st century, traditional means of communication (e.g., face-to-face, phone) are complemented by the use of ICTs. As ICTs cover a broad range of technological aspects, there is no stable list of ICTs (Rice, 2017). However, one can differentiate ICTs by technical components, features and requirements (Faraj & Adzad, 2012), or distinguish ICTs by the communication aspect, while focusing on the specific technological medium/channel used to process the communication (Rice, 2017). The current study follows the latter characterization and encompasses means of communication being used to exchange information with one's colleagues in the workplace via traditional and ICT-induced means. Therefore, to reflect a more or less comprehensive set of communication channels commonly used in the 21st century, the following means of communication are distinguished: face-to-face (talk), phone, e-mail, texting/messaging, social networks (intranet), social networks (public), and videocall-/conferencing (adapted from Braun et al., 2015).

In recent years, some studies mention the role of technologies (i.e., ICTs) for workplace flexibility as it enables and facilitates the quality of spatially dispersed work behavior between colleagues (Blount, 2015; Boell et al., 2013; Hertel et al., 2005; Rice, 2017). In fact, workplace flexibility implies the absence of traditional face-to-face communication. Thus, virtual communication via ICTs gains relevance and determines how work is executed and information are exchanged, particularly when working location-independent (Boell et al., 2013).

Hence, literature also shows that the use of ICTs is associated with both positive and negative effects for employees (e.g., see ICT demands and resources conceptualized by Day et al., 2010). As ICT's main property is to allow virtual communication, those associations apply similarly to the latter. The following drawbacks are noticed: It is stated that ICTs lead to an increased blurring of one's work and private life due to higher accessibility and availability for colleagues, and thus a higher pressure to respond and stay connected 24/7 (Ayyagari et al., 2011; Frissen, 2000; Schlosser, 2002; Tarafdar et al., 2007; Valcour & Hunter, 2008). In addition, ICTs are also associated with increased isolation from the workplace (i.e., and colleagues), as well as decreased visibility in the organization as they reduce the use of traditional interactions between individuals

(Orhan et al., 2016). Thus, they reduce information control and security (Day et al., 2010). Due to these consequences for the individual in the workplace, ICT-use is also linked with higher stress and turnover intentions (Ayyagari et al., 2011; Fenner & Renn, 2010; Valcour & Hunter, 2008).

However, the use of ICTs is also associated with certain advantages: They allow increased levels of flexibility in the private and work domain and enable increased access, autonomy, skill development and abilities to accomplish tasks (Chen & McDonald, 2015; Day et al., 2010; Gajendran & Harrison, 2007; Valcour & Hunter, 2008). They also open possibilities in reducing interferences between work and private life due to enhanced balancing of roles in both domains (Kreine et al., 2009; Voydanoff, 2005). In addition, ICTs are associated with increased control, flexibility, mobility, time savings, recovery from changes, and accessibility to others (Day et al., 2010; Frissen, 2000). Enhanced social presence and subsequently increased sense of connectivity are positive effects mentioned and supported in the study conducted by Fonner and Roloff (2012).

Hence, likewise workplace flexibility behavior promotes and threatens certain resources of employees, this also applies to the use of ICT-induced communication. For instance, increased accessibility and visibility for others can decrease *energy resources* due to higher interruptions and less recovery time. Further, the sense of connectedness might blur work-life boundaries which can further threaten employees' energies. However, it can also increase work-life balance due to increased flexibility and balance in role transitions, and thus promote energies. However, ICTs can also increase *social support resources*, as the flexibility due to virtual communication decreases communication barriers and thus overcomes socialization problems. ICTs also yield positive as well as negative effects on *objects/condition resources* as increased ease and flexibility of communication may lead to beneficial time savings, whereas the transition from traditional to virtual communication may also cause involuntary lack of workplace involvement. Moreover, *constructive resources* can be promoted due to higher autonomy and control. Hence, the integration and use of ICTs in the workplace can affect employee resources positively and negatively.

However, the outlined consequences of ICTs mainly derive from the notion that ICTs enable and facilitate changes in the communication behavior of employees (Day et al., 2010). For instance, engaging a shifting process from traditional (e.g., face-to-face) towards modern (i.e., virtual) means of communications; thus, affecting social

interaction (van den Berg et al., 2012). Likewise, the spatial dispersion between colleagues due to workplace flexibility also requires a change from traditional to virtual communication (Coenen & Kok, 2014). This illustrates that workplace flexibility and virtual communication are highly interrelated and should not be examined in isolation (Scott & Timmerman, 1999). Already 20 years ago, Cascio (2000, p.87) mentions this relationship by recommending that “it is important not to rely solely on e-mail, [...] [one] should learn how to conduct effective audio meetings, and to balance e-mail, voice mail, video conferencing, and face-to-face communications” for effective virtual collaboration. Thus, it stresses the importance to apply a diversified use of virtual means of communication for spatially-dispersed work. Hence, this fosters the notion that the connection between workplace flexibility and health is not independent from one’s virtual communication behavior.

Table 2.1 summarizes the resource promoting and threatening elements of both ICTs (i.e., virtual communication) and workplace flexibility. It shows that both factors pose similar promoting and threatening attributes for employee resources. However, it also shows that an intensified use of ICTs might be able to counterbalance resource threatening attributes of workplace flexibility on *social support resources* (i.e., socialization problems) and strengthen already promotional attributes such as job autonomy and control to enhance *constructive resources*.

Therefore, based on this resource perspective, I assume that employees that are used to communicate more virtually (i.e., a larger extent and variety of virtual communication channels to exchange information with their colleagues) will be better able to handle location-independent work than those who communicate less virtually. Therefore, it is assumed that the use of virtual means of communication is beneficial, or even necessary, in allowing that workplace flexibility unfolds its positive properties. Thus, we hypothesize the following:

Hypothesis 1: *Virtual communication moderates the negative relationship between workplace flexibility and emotional exhaustion such as the negative relationship is stronger for individuals in a communication class with a higher virtual communication compared to individuals in a communication class with less virtual communication.*

2.2.4 The Role of Task Interdependence for the Interrelatedness of Work Flexibility and Virtual Communication

Furthermore, also *task interdependence* has been argued to play a significant role in spatially-dispersed work settings. It characterizes the requirement or degree of task-related interaction between group members (Shea & Guzzo, 1987). For instance, high task interdependence describes a situation in which group members need frequent and intense task coordination activities because the possibility and quality of work of one individual relies on the prior execution of a specific task of another individual (Thompson, 1967). The increased degree of coordination thus can increase the need for communication amongst team members (Bouas & Arrow, 1996).

Yet, workplace flexibility challenges the communication needs due to a lower degree of face-to-face communication (Hertel et al., 2005). Hence, particularly when high task interdependence characterizes one's work environment (i.e., high communication needs), this challenges the beneficial properties of workplace flexibility. This is because the problems associated with unsatisfied communication needs might outweigh the resource promoting attributes of workplace flexibility. However, increased accessibility, availability and communication flexibility with others constitute the key attributes of using ICTs for virtual communication (Dijst, 2004; Thomée et al., 2010). Therefore, high virtual communication behavior is assumed to overcome the lack of communication caused by workplace flexibility, and thus, is suited to fulfill the urgent need of communication in task interdependent work settings. Hence, it is assumed that employees in high task interdependent work environments can only benefit from workplace flexibility behavior when they show high levels of virtual communication. Therefore, it is hypothesized:

Hypothesis 2: There is a three-way interaction among workplace flexibility, virtual communication and task interdependence in explaining emotional exhaustion. Hence, the negative relationship between workplace flexibility and emotional exhaustion in a class with high virtual communication is stronger for individuals with high task interdependence compared to individuals with low task interdependence.

2.3 Methods

2.3.1 Data Collection and Sample

For hypothesis testing, data was collected from the German labor force in 2016. A German market research institute was instructed with the data collection process. All participants have to be of full age and currently employed. Further, they need to have access to internet-enabled communication technologies. All participants of the survey are part of a panel from the market research institute. Relying on existing panels is common practice when collecting longitudinal across multiple waves. In order to ensure high data quality, the research institute thoroughly checks for survey manipulation. To ensure measure validity, the survey versions were translated to German by professional translators following a double-blind back-translation procedure. This ensures semantic equivalence with the original English items (Schaffer & Riordan, 2003). In total, 8'019 employees successfully responded to the survey.

From the full data set, we excluded 527 respondents that indicated to be the only employee in the organization (6.6%) and thus not having the possibility to communicate with colleagues in the workplace, resulting in 7'492 participants. From those, 314 did not answer the items on communication media use, resulting in a missingness of 4.2%. Hence, the full study sample consists of 7'178 respondents.

In the full sample of 7'178 respondents the age ranged from 18 to 77 years, with an average of 44.0. Hence, the sample consisted of 3,510 women and 3,668 men (i.e., 48.9% were female). Of all respondents, 31.0% hold a university degree, 21.2% a higher education entrance qualification, 39.7% a secondary school leaving certificate, 7.9% hold a lower vocational background and .02% have no education. On average, 22.0% of the employees work in a part-time, and 88.0% in a full-time position. The mean organizational tenure is 141.9 months (approx. 11.8 years). Additionally, on average two to three (2.7) communication channels are used in the workplace.

2.3.2 Measures

Means, standard deviations, and standardized factor loadings of the respective measurement items are shown in Table 2.2. All items were translated to German to sustain semantic equivalence by following a double-blind back-translation process (Schaffer & Riordan, 2003).

Workplace Flexibility. Workplace flexibility was measured with two scales, a categorical and a continuous scale. An adapted version of the categorical measure developed by Lapierre and Allen (2006) is applied: “Does your organization allow for working from home, a virtual office (i.e., work from anywhere), or a satellite office/telework center during regular office hours?”. Answers were provided as categories with 0 (*no*), 1 (*yes*) and 2 (*not applicable – I do not have a regular workplace*). For this study, answer 2 was recoded to 0 in order to represent a binary variable with 0 (*no*) and 1 (*yes*). This was further recoded to 0 (*yes*) and 1 (*no*) in order to isolate the binary effect of having the opportunity for workplace from the extent of workplace behavior shown (continuous). To measure the latter, an adapted version from Gajendran et al. (2015), which was previously adapted from Thatcher & Zhu (2006), is used. For respondents who indicate ‘yes’ in the binary measure, the following item was requested additionally: “If yes, how many hours do you work outside your regular workplace during your regular working hours in an average working week?”.

Table 2.2: Means, Standard Deviations, and Standardized Factor Loadings of Latent Study Variables

Measurement items of latent study variables					
Items	M	SD	N	Load.	Source
<i>Task Interdependence (N = 7'178)</i>					
“The job requires me to accomplish my job before others complete their job.”	3.01	1.54	7122	(fixed)	Morgeson, and Humphrey (2006), adapted from Sims, and Kiggundu (1983)
“Other jobs depend directly on my job.	3.40	1.40	7150	.95	
“Unless my job gets done, other jobs cannot be completed.”	3.25	1.54	7141	1.07	
<i>Emotional Exhaustion (N = 7'178)</i>					
“During my work, I often feel emotionally drained.”	2.58	1.44	7126	(fixed)	Demerouti et al. (2010)
“After my work, I usually feel worn out and weary.”	2.99	1.31	7127	.95	
“There are days when I feel tired before I arrive at work.”	2.83	1.44	7126	.89	

Note. N = 7'178. Mean, SDs, and Loadings of items shown for Confirmatory Factor Analyses in the full data sample using full-information robust maximum-likelihood estimation (FIML and MLR). All items measured on a 5-point Likert scale with 1 (*completely disagree*) to 5 (*completely agree*). All loadings (coefficients) significant with $p < .01$.

Virtual Communication with colleagues. The use of different communication channels was measured by an adapted scale from Braun et al. (2015). The degree of use for various channels used to communicate with one's colleagues was assessed by the following item: "Thinking of an average working week, how often do you use the following opportunities to exchange information with your direct colleagues (e.g., your team)? 0% means that you do not communicate at all with your colleagues in the indicated way. 100% means that you only communicate with your colleagues in this way. All communication possibilities together must result in 100%." The following eight answers were provided: (1) face-to-face; (2) phone; (3) e-mail; (4) texting or messaging (SMS, WhatsApp etc.); (5) internal social networks or platforms of the company; (6) public social networks or platforms; (7) videoconferencing/-calls (skype, facetime etc.); (8) others (please specify).

Task Interdependence. Three items from the interdependence scale validated by Kiggundu (1983), and later adapted and included in the Initiated Interdependence Scale as part of the The Work Design Questionnaire (WDQ) (Morgeson and Humphrey, 2006; adapted from Kiggundu 1983) were used. The WDQ was modeled to capture work characteristics for research purposes. Specifically, survey participants were asked about their perception to which extent they think that the tasks/job of others depends on the task accomplishment of their respective tasks/job. The items used are as follows: "The job requires me to accomplish my job before others complete their job", "Other jobs depend directly on my job", and "Unless my job gets done, other jobs cannot be completed". Answers were provided on a 5-point Likert scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

Emotional Exhaustion. Emotional exhaustion was measured with three items from the Exhaustion scale from The Oldenburg Burnout Inventory developed by Demerouti et al. (2010). The English reference items used are "During my work, I often feel emotionally drained", "After my work, I usually feel worn out and weary", and "There are days when I feel tired before I arrive at work". Answers were provided on a 5-point Likert scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

Worktime Flexibility. As being part of the work flexibility continuum, formal worktime flexibility in the respondent's workplace was measured and used as covariate in order to isolate the effect of workplace flexibility on health. A self-developed categorical variable was used, including the following statement: "Which working time regulation or system applies to you?". The potential responding items were: (1) "I have fixed

working hours which are the same every day (e.g., 8 a.m. to 4.30 p.m.)”; (2) “I work in shifts, i.e., I have fixed working hours which may vary from day to day or week to week.”; (3) “My company/organization offers me a certain flexibility by specifying core times (e.g., 9 a.m. to 4 p.m.) during which I have to work. I can choose the actual start/end of working hours freely, taking core time into account.”; (4) “My company/organization only gives a time window (e.g., from 6 a.m. to 8 p.m.) within which I can freely decide when I want to work”; (5) “I can work my hours completely free, there are no fixed times”. For complexity reasons, we bundled items 2, 3, and 4 as all of them represent different manifestations of partial worktime flexibility. Finally, worktime flexibility was used with three categories in the analyses: (1) “no worktime flexibility”; (2) “partial worktime flexibility”; and (3) “full worktime flexibility”.

2.3.3 Confirmatory Factor Analysis

To check whether the latent constructs are distinct from one another, two confirmatory factor analyses of the measurement model were applied. It showed that a two-factor model with both latent variables, i.e., task interdependence and emotional exhaustion, loading on two separate factors ($\chi^2(8) = 26.54$, $p < .01$, RMSEA = .02, SRMR = .01, CFI = .99, TLI = .99) fits significantly better to the data than a respective one-factor model with the items loading on one single factor ($\Delta\chi^2_{SB} = 6486.99$, $df = 1$, $p < .01$, RMSEA = .36, SRMR = .22, CFI = .38, TLI = -.03) fits significantly better to the data than a one-factor model with both constructs loading on one single factor.

2.3.4 Control Variables

Next to worktime flexibility, the number of communication channels was included as control variable because the study intends to separate and isolate the effect of the distribution of communication across channels from the raw number of channels. The different communication patterns might differ in the actual number of channels used to communicate with one's colleagues, which may bias the results. In similar vein, boundary crossing activities are incorporated, such as whether the respondent uses ICTs for work purposes during spare time. The item used was: “Think of [ICTs] such as the telephone, mobile phone, computer and tablet. Do you use such means of [ICTs] to perform your job during non-work hours?” (*binary*; 0 = no, 1 = yes; adapted from Barber & Jenkins, 2014). And if one does, it is additionally requested to indicate how much this is executed over the course of one week, including the following item: “How many hours per week do you actually use [ICTs] to perform your job during non-work hours?” (*continuous*; adapted from Barber & Jenkins, 2014; formerly adapted from

Olson-Buchanan & Boswell, 2006). This procedure was applied because working in one's spare time is associated with negative effects on recovery from work (Kossek & Lautsch, 2012; Park & Jex, 2011; Park et al., 2011), which negatively relates to individual health (Allen & Armstrong, 2006; Härmä, 2006). Furthermore, the amount of work (*binary*; 0 = *part time*, 1 = *full time*, *by contract*) was measured as a proxy of how much people interact within their work environment. This control captures the relevance (and impact) of work on employee health ratings (McDowell, 2006; Sluiter et al., 2003). Being exposed to work conditions for a longer period of time, the impact of work-related conditions for one's health perception might be higher. In addition, having participants from different companies and occupational backgrounds can have an effect in study designs due to self-selection bias (Antonakis et al., 2010). Thus, the type of occupation was included as categorical control variable (*i.e.*, 14 categories ranging from "Occupations in business management" to "Occupations in cleaning services"; adapted from the Federal Agency of Employment, 2011). In addition, gender (0 = *female*; 1 = *male*), age (*in years*), organizational tenure (*in years*) and educational level (*i.e.*, six categories ranging from "still in education or training" to "university degree", treated as continuous in analysis) are incorporated in the estimation process.

2.3.5 Analysis

Studies on (virtual) communication commonly use the shares of the single dimensions (*i.e.*, face-to-face, phone, etc.) as independent continuous variables for estimation purposes. This implies to interpret the respective coefficients in relation to other variables. For instance, the estimation parameter would describe the empirical relation with the dependent variable when the respective predictor variable (*e.g.*, face-to-face communication) is changed by 1 unit, while *holding everything else equal* (*e.g.*, in ordinary least squares regression). But communication variables are by nature *compositional variables*. This means that the variables and their distinct values are not independent from the values of the other variables.

To illustrate: The entire amount of communication of an individual with others (100%) is completely distributed among a plurality of communication channels, such as face-to-face, phone, e-mail, texting/messaging, social networks (internal, public) and videocalls/-conferencing. Assuming an increase of communication via e-mail by one unit (*i.e.*, one percentage point), it is by nature not possible to hold everything equal. The increase of e-mail communication by one unit would inevitably require a decrease of other channels by the sum of also one unit. Otherwise one would estimate a

questionable case: the effect of an impossible situation, i.e., using communication channels for more than 100% (i.e., 101% in this illustration) to interact with colleagues with colleagues.

To overcome this issue, an alternative approach is proposed particularly for the examination of such compositional variables, a latent class analysis (LCA). Conducting LCA on (virtual) communication allows to examine classes (groups) of individuals with a common distribution across all communication channels. Hence, this enables to compare individuals (relationships between variables) across groups, which no longer violates the aforementioned independence assumption for predictor variables. Therefore, the analysis of the present study was carried out as follows:

To estimate the LCA based on virtual communication, a three-step approach recommended by Asparouhov & Muthén (2014) was applied. The analyses were conducted with Mplus 8.2 (Muthén & Muthén, 1998-2017). The variables on virtual communication are treated as continuous variables in LCA. Further, the LCA was applied with robust standard errors (Yuan & Bentler, 2000). The Vuong-Lo-Mendell-Rubin likelihood ratio test (VLMR) and the adjusted Lo-Mendell-Rubin likelihood ratio test (aLMR) to test the model with K classes to a model with K-1 classes. Next, the bootstrapped likelihood ratio test (BLR) was examined if the best loglikelihood has not been replicated during bootstrap runs. Statistical significance in all tests indicates a better fit to the data for the K classes model (Asparouhov & Muthén, 2012). In addition, the Bayesian Information Criterion (BIC), sample-size adjusted Bayesian Information Criterion (aBIC) and entropy were examined (Nylund et al., 2007). To conclude, the K class model with lower BIC/aBIC and higher entropy compared to the respective K-1 class model, significant VLMR, LMR, and BLRT is the preferred model.

After class identification, the three-step method was applied with an arbitrary secondary model (Asparouhov & Muthén, 2014, p.10ff.) to test the relations postulated in the hypotheses within the identified latent classes, while taking misclassification from posterior probability estimation into account. More specifically, the secondary model constitutes an auxiliary structural equation model (sem).

For model specification within classes, the final model was first optimized by conducting multi-class confirmatory factor analyses for the latent constructs to ensure validity within each class. Further, measurement invariance of the latent constructs between classes was examined, and respective invariance constrained if applicable, in order to ensure comparability of estimation coefficients between classes (Milfont &

Fischer, 2010). Next, the independent variables, covariates and interaction terms were added to the model. The interaction terms with a latent variable were constructed by using Mplus *xwith* command. The continuous independent variables were centered at the grand-mean which rescales all variables across classes to an equal mean level. Centering was applied to further reduce estimation bias by increasing the comparability of estimation coefficients across classes due to level differences between classes. This also reduces multicollinearity between predictors and the cross-product interaction term (Shieh, 2011). Moreover, monte carlo integration was specified in order to apply Full-Information Maximum Likelihood (FIML) during sem estimation in mixture models, which enables to take missing data into account (Cham et al., 2017).

2.4 Results

2.4.1 Descriptive Statistics

Table 2.3 shows means, standard deviations, and correlations between the average scores of the predictors, covariates, and the outcome variable for the entire sample.

2.4.2 Primary LCA results

Table 2.4 details the LCA estimation results for estimation models from 1 to 7 classes without covariates. BIC and aBIC indicate a better model fit for more complex models. VLMR and LMR was not statistically significant for the 3-class model and more complex models as 5 classes. Thus, more complex models are preferred up to 5 classes. Evidence for the 5-class solution compared to less complex models is also provided by the highest entropy of .93. Correct classification according to classification probabilities for the five classes were 98%, 99%, 97%, 95%, and 93% for classes 1 to 5, respectively.

Table 2.5 shows the distribution of the virtual communication channels used within each class in the 5-class solution. Figure 2.2 illustrates these distributions for all five communication classes, respectively. The classes are sorted from lowest (1) to highest (5) variety in their use of different communication channels. Class 1 shows the least variance on their communication behavior by focusing strongly on face-to-face communication (82%⁴) and a minor use of phone (9%) and e-mails (6%). Class 2 represents employees that communicate most with their colleagues via texting/messaging (47%), followed by face-to-face (24%) and phone (14%). They do

⁴ For reasons of clarity, values are rounded on integer values.

not use much other forms (< 3% combined) of digital communication. Employees in class 3 show a relatively balanced communication behavior with traditional means, such as face-to-face (34%), phone (29%) and e-mail (28%). They also do not use other digital communication channels (< 7% combined) on a regular basis. Class 4 and 5 show similar usage patterns in traditional communication, such as face-to-face (26%; 24%), phone (16%; 15%), and e-mail (20%; 17%), but differ strongly in the communication via more virtual channels. Hence, class 4 shows less variance by extensively focusing on the use of videocall/-conferencing (24%). Communication via texting (6%), internal social networks (4%), and public social networks (3%) is present, but less common and of minor priority compared to class 5. On the other hand, employees in class 5 commonly use all digital communication channels quite frequently with texting (9%), internal social networks (19%), public social networks (10%) and videocall/-conferencing (5%). Thus, Class 5 shows the most diverse communication behavior across all communication channels available.

Figure 2.2: Five-Class Solution with Estimated Means

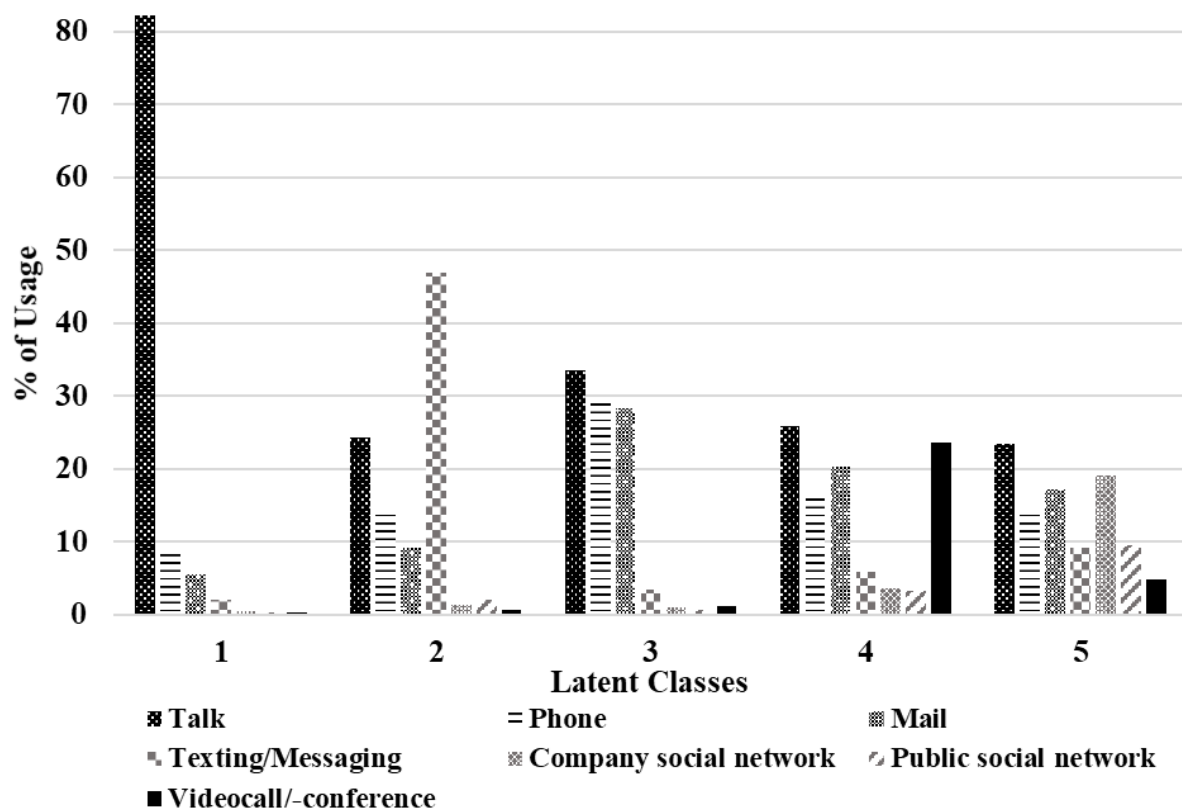


Table 2.3: Means, Standard Deviations, and Correlations between the Study Variables

Nr	Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Gender (0 = <i>female</i> , 1 = <i>male</i>)	.49	.25													
2	Age (<i>in years</i>)	44.04	128.2	-.12												
3	Educational level ^a	3.75	.98	-.05	-.12											
4	Organizational tenure	141.9	15521	-.15	.49	-.07										
5	Amount of work (0 = <i>fulltime</i> , 1 = <i>parttime</i>)	.22	.17	.34	.05	-.11	-.14									
6	Occupation segment ^b	-	-	-	-	-	-	-								
7	Nr. of communication channels	2.71	1.58	-.10	-.08	.19	.02	-.12	-							
8	Boundary crossing (0 = <i>yes</i> , 1 = <i>no</i>)	.48	.25	-.10	-.00	.18	-.01	-.06	-	.29						
9	Boundary crossing (in hours per week)	3.75	58.26	-.09	.02	.09	.01	-.06	-	.26	.52					
10	Task interdependence ^c	3.25	1.12	-.16	-.04	.11	.02	-.18	-	-.17	.13	.10				
11	Worktime flexibility	-	-	-	-	-	-	-	-	-	-	-	-			
12	Workplace flexibility (0 = <i>yes</i> , 1 = <i>no</i>)	.30	.21	-.14	-.00	.29	.03	-.09	-	.28	.33	.22	.14	-		
13	Workplace flexibility (in hours per week)	6.55	330.83	.07	.03	.16	.03	-.08	-	.18	.20	.19	.06	-	.55	
14	Emotional exhaustion	2.78	1.08	.08	-.16	-.06	-.06	-.04	-	.01	.02	.02	.07	-	-.09	-.06

Note. $N = 7'178$. Results based on full study sample. ^a Although educational level is operationalized as categorical variable, the categories follow an internal order. Therefore, an aggregated value and its correlations offer some valuable information and thus, is shown. ^b Correlations with aggregated categorical variables (with no internal order) are not interpretable and therefore not executed. ^c For descriptive purposes, the means and standard deviations derived from an aggregated construct (index) consisting of all respective indicator variables (without centering). As Mplus analysis command 'type = basic' does not show significant levels, none are shown for this representation.

Table 2.4: Summary of LCA Model Results for Model Comparison

Nr	LCA Model	LL	BIC	aBIC	VLMR	LMR	BLRT	Entropy
1	One-Class Model	-188306.67	376737.63	376693.15	-	-	-	-
2	Two-Class Model	-184685.73	369566.79	369496.88	.0	.0	.0	.0
3	Three-Class Model	-181715.21	363696.78	363601.45	.54	.55	.0	.89
4	Four-Class Model	-179191.81	358721.01	358600.26	.04	.04	.0	.92
5	<i>Five-Class Model</i>	<i>-176661.12</i>	<i>353730.66</i>	<i>353584.49</i>	<i>.0</i>	<i>.0</i>	<i>.0</i>	<i>.93</i>
6	Six-Class Model	-174556.41	349592.28	349420.68	.55	.56	.0	.94
7	Seven-Class Model	-172795.06	346140.60	345943.57	.36	.36	.0	.93

Note. $N = 7'178$. Means and variances were freely estimated across profiles, with 10,000 random starts, 400 iterations each, and the best 400 solutions for final optimization.

Table 2.5: Distribution of Virtual Communication Channels across Classes in 5-Class LCA model

Nr	Communication Class	N	%	Talk	Phone	E-Mail	Texting	I. Social Network^a	P. Social Network^a	Videocall / -conference
1	Class/Pattern One	3500	48.8	82.2	8.7	5.6	2.0	0.4	0.3	0.2
2	Class/Pattern Two	235	3.3	24.3	14.2	9.3	47.0	1.4	2.1	0.6
3	Class/Pattern Three	2805	39.1	33.5	28.9	28.3	3.5	1.1	0.7	1.2
4	Class/Pattern Four	254	3.5	25.9	16.1	20.3	5.9	3.6	3.3	23.6
5	Class/Pattern Five	384	5.4	23.4	14.5	17.1	9.1	19.2	9.5	4.8

Note. $N = 7'178$. Values for the respective communication channels represent shares in %. ^a I. Social Network: Internal social networks; P. Social networks: Public social networks. Illustrated in Figure 2.2.

2.4.3 Measurement Invariance between Classes

Unobserved heterogeneity between classes might influence the interpretation of the emotional exhaustion items used to calculate the dependent latent construct. This decreases comparability of the dependent variable between classes as the measure may be interpreted differently (i.e., means something else) from the individuals in different classes due to unobserved structural differences (Milfont & Fischer, 2010; Steinmetz et al., 2009). Therefore, testing and constraining invariance across classes is necessary to derive meaningful interpretations based on between-class comparisons.

Hence, a LCA with secondary structural equation model was specified to estimate independent confirmatory factors analyses within each classes. Measurement invariance between classes for all latent constructs was set following the approach outlined by Bialosiewicz et al. (2013). Configural, metric (weak), scalar, and strict measurement invariance were estimated stepwise (see Table 2.6 for details on respective model specifications). The fit of the various models was compared by calculating scaled chi-square difference tests using the loglikelihood and scaling correction factors obtained with the MLR estimator (Bryant & Satorra, 2012). In order to yield meaningful comparisons of the relationships with the dependent variable (i.e., emotional exhaustion) across classes, setting (full) scalar invariance is the required condition (Milfont & Fischer, 2010). As there is no intention to compare the classes with regard to the predictor variable task interdependence, the measurement invariance condition is not as strict as for the dependent construct. However, in order to make meaningful conclusions it is at least required that the respective measurement items actually measure the same construct across classes. Hence, equal item measurement loadings are required which is covered by metric (weak) invariance. Thus, metric invariance is set as requirement for the task interdependence construct.

Table 2.7 shows the chi-square difference tests for comparing different specifications of invariance for emotional exhaustion. The chi-square difference test for comparing a model with metric invariance across all 5 classes with a freely estimated model (baseline) is significant ($p < .05$). This means, that the freely estimated model fits better to the data than the constrained model (metric invariance; constrains on loadings) and thus, no measurement invariance can be set across all 5 classes. The same comparison is non-significant for a 4 class- (classes 2, 3, 4, and 5) and a 3 class- (classes 3, 4, and 5) invariance ($p > .05$, respectively). Following the same rationality for of chi2 testing for scalar and strict invariance, the latter and most valuable invariance in terms of group

comparison is just allowed to be set across 3 classes ($p > .05$ for metric, scalar, strict invariance I and II, respectively; see Table 2.7). This implies that in the identified 5-class model, the measure of emotional exhaustion means statistically the same for employees in classes 3, 4, and 5. On the other hand, this leads to the conclusion that participants in classes 1 and 2 differ from employees assigned to the classes 3, 4 and 5 in a certain way (e.g., structurally different job types, industries, etc.), that the item formulation of emotional exhaustion, or ‘being emotionally exhausted’, is differently interpreted. Thus, meaningful comparisons are only possible between the latter classes. Accordingly, strict invariance II is set for emotional exhaustion across classes 3, 4, and 5 in the final estimation model.

Further, Table 2.8 shows the test results for the construct task interdependence. As the model comparison has already been restricted to the classes 3, 4 and 5, it is only necessary to check for the necessary invariance condition (i.e., at least metric (weak) measurement invariance) between these classes. The chi-square difference test for comparing a model with metric invariance to a freely estimated model (baseline) is non-significant ($p > .05$). This implies, that metric invariance can be assumed for task interdependence which fits the necessary condition. Thus, metric invariance is set for task interdependence across classes 3, 4, and 5 in the final estimation model.

Table 2.6: Criteria (constraints) for Different Levels of Measurement Invariance of Latent Variables between Classes

Nr	Description	Factor Means	Item Loadings	Item Intercepts	Factor Variances	Item Residual Variances
1	Free (No Invariance)	<i>Fixed to 0^a</i>	Free	Free	Free	Free
2	Metric/weak Invariance	Fixed to 0	<i>Invariant</i>	Free	Free	Free
3	Scalar Invariance	Fixed to 0	Invariant	<i>Invariant</i>	Free	Free
4	Strict Invariance I	Fixed to 0	Invariant	Invariant	<i>Invariant</i>	Free
5	Strict Invariance II	Fixed to 0	Invariant	Invariant	Invariant	<i>Invariant</i>

Note. Factor Means = Mean of latent factor; Item Loadings = factor loadings of measurement items; Item Intercepts = Intercepts of measurement items; Factor Variance = Variance of latent factor; Item Residual Variances = residual variances of measurement items; Free = freely estimated within each class; Invariant = parameters constrained to be equal across classes; ^a Fixing factor means to 0 across all classes.

Table 2.7: Model Comparison for Measurement Invariance Testing of Emotional Exhaustion (5, 4, and 3 class solution)

Nr	LCA Model	LL	P	SCF	CD	TRd	ΔP	p-value ^c
1	Free (No Invariance)	-37020.46	49	1.1040	-	-	-	-
Invariance across 5 classes								
2a	Metric/Weak Invariance	-37032.84	41	1.0010	1.1240	22.0305	8	.004
Invariance across 4 classes^a								
2b	Metric/Weak Invariance	-37025.89	43	1.1002	1.1312	9.6037	6	.142
3b	Scalar Invariance	-37036.12	34	1.1281	.9948	20.5690	9	.015
Invariance across 3 classes^a								
2c	Metric/Weak Invariance	-37025.78	45	1.1004	1.1445	9.2984	4	.054
3c	Scalar Invariance	-37032.04	39	1.1139	1.0127	12.3760	6	.054
4c	Strict Invariance I ^b	-37032.48	37	1.1337	.7476	1.1691	2	.557
5c	Strict Invariance II ^b	-37034.01	31	1.0787	1.4179	2.1652	6	.904

Note. $N = 7'178$. Each step is nested under the previous one; P = Number of freely estimated parameters; SCF = Scaling Correction Factor; LL = Loglikelihood; CD = Test Scaling Correction Difference; TRd = Chi-Square Difference; ΔP = Number of Parameters Difference; p-value = Significance level of scaled chi-square difference test; ^a Invariance set in 4 class solution for class 2, 3, 4, and 5. Invariances set in 3 class solution for class 3, 4 and 5; ^b Strict Invariance I = Invariance on latent factor variances; Strict Invariance II = Invariance on latent factor variances and item residual variances; ^c Significant chi-square difference test implies the comparison model (more freely estimated parameters, more complex) to fit significantly better to the data than the nested model (less parameters, more parsimonious) model.

Table 2.8: Model Comparison for Measurement Invariance testing of Task Interdependence (3 class solution)

Nr	LCA Model	LL	P	SCF	CD	TRd	ΔP	p-value^b
1	Free (No Invariance)	-38277.81	49	1.2237	-	-	-	-
Invariance across 3 classes^a								
2b	Metric/Weak Invariance	-38283.28	45	1.2258	1.2001	9.1128	4	.058
3b	Scalar Invariance	-38299.91	39	1.2433	1.1121	29.9087	6	.000

Note. $N = 7'178$. Each step is nested under the previous one; P = Number of freely estimated Parameters; SCF = Scaling Correction Factor; LL = Loglikelihood; CD = Test Scaling Correction Difference; TRd = Chi-Square Difference; ΔP = Number of Parameters Difference; p-value = Significance level of scaled chi-square difference test; ^a Invariances set in 3 class solution for class 3, 4 and 5; ^b Significant chi-square difference test implies the comparison model (more freely estimated parameters, more complex) to fit significantly better to the data than the nested model (less parameters, more parsimonious) model.

2.4.4 Estimation Results of Effect Sizes within Communication Classes

For the sake of comparability with other studies that do not apply LCA analysis, but estimate the overall relation between workplace flexibility and health across all study participants, a general model without the identified classes was estimated. Hence, Table 2.9 shows the parameter estimates for the full study sample without differentiation between classes. Results show no significant relationship between workplace flexibility and emotional exhaustion when the full sample is examined, and the proposed heterogeneity dimensions (i.e., communication class and task interdependence) are neglected ($B_{P1} = -.04$; $B_{P2} = .01$; $B_{P3} = -.00$; all with $p > .05$, see Table 2.9). This might support the notion that neglecting sample heterogeneity hinders to examine the relation of workplace flexibility and health.

Table 2.9: Regression Analysis Predicting Emotional Exhaustion From Workplace Flexibility and Covariates

Independent Variables	Emotional Exhaustion	
	Estimate	SE
Flexplace possibility (0 = yes, 1 = no) (P0)	.09	.05
Flexplace hours / month (incl. 0) (P1) ^a	-.04	.04
Squared (P2)	.01	.01
Cubed (P3)	-.00	.00
Partial worktime flexibility	-.10**	.03
Full worktime flexibility	-.38**	.05
Covariates	^b	

Note. $N = 7'178$. Estimation using full sample, but neglecting heterogeneity dimensions 'communication class' and 'task interdependence'. ^a Path coefficients (estimates) indicate a change of 10 units. ^b Control variables were not included in this overview, except worktime flexibility. * $p < .05$, ** $p < .01$.

Besides, Table 2.10 shows the respective parameter estimates for estimations within every single communication class (although, as noted before, meaningful comparisons can just be drawn amongst coefficients of classes 3, 4 and 5). Supporting hypothesis 1, there is no significant relationship between workplace flexibility and emotional exhaustion in class 3 (i.e., employees with the lowest virtual communication; $B_{P1} = -.02$; $B_{P2} = .01$; $B_{P3} = -.00$; all with $p > .05$), while a significant relation is shown for both class 4 ($B_{P1} = -.39$, $p > .05$; $B_{P2} = .25$, $p < .05$; $B_{P3} = -.02$; $p < .05$) and 5 ($B_{P1} = -.45$; $B_{P2} = .18$; $B_{P3} = -.02$; all with $p < .05$), i.e., both classes with rather high virtual communication.

Table 2.10: Latent Class Analysis (LCA) with a Secondary Structural Equation Model Predicting Emotional Exhaustion From the Interactions Among Workplace Flexibility and Task Interdependence within Virtual Communication Classes

Independent Variables	Emotional Exhaustion									
	Class 1		Class 2		Class 3		Class 4		Class 5	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Flexplace possibility (0 = <i>yes</i> , 1 = <i>no</i>) (P0)	-.13	.36	.20*	.08	.09	.08	-.21	.24	.01	.20
Flexplace hours per month (incl. 0) (P1) ^a	-.16	.56	.04	.13	-.02	.10	-.39	.29	-.45*	.23
Squared (P2)	-.11	.37	-.03	.06	.01	.04	.25*	.12	.18*	.08
Cubed (P3)	.03	.06	.01	.01	-.00	.00	-.02*	.01	-.02*	.01
Partial worktime flexibility	.08	.23	-.15**	.05	-.10	.06	-.23	.18	.01	.14
Full worktime flexibility	-.48	.29	-.38**	.08	-.40**	.08	-.48	.29	-.23	.21
Task Interdependence (M)	-.24	.22	.07	.07	.09	.07	.26	.18	.34*	.14
INT P0 x M	.46	.43	.00	.10	.04	.10	-.80	.41	-.39	.22
INT P1 x M	.54	.61	-.08	.16	.06	.13	-.95**	.36	-.55*	.24
INT P2 x M	.04	.35	.01	.06	-.01	.05	.35**	.16	.20*	.08
INT P3 x M	-.04	.05	.00	.01	-.00	.00	-.03**	.01	-.02*	.01
Covariates	b		b		b		b		b	

Note. $N = 7'178$. Strict measurement invariance for dependent variable set between classes 3, 4 and 5. ^a Path coefficients (estimates) indicate a change of 10 units.

^b Control variables were not included in this overview. For categorical control variables, path coefficients were not estimated for Categories with $N < 5$ participants. For reasons of clarity, results for categorical controls are excluded in the results table * $p < .05$, ** $p < .01$.

In a similar vein, no direct relationship between task interdependence and emotional exhaustion is examined in one of the classes ($B = .04$; $B = -.80$; $B = .39$; all with $p > .05$; for class 3, 4 and 5, respectively). Further, no significant interaction between workplace flexibility and task interdependence is present in class 3 ($B = .06$; $B^2 = -.01$; $B^3 = -.00$ all with $p > .05$). However, in line with prior theoretical argumentation, workplace flexibility strongly interacts with task interdependence in the classes with high virtual communication, i.e., classes 4 and 5 ($B = -.95$; $B^2 = .35$; $B^3 = -.03$; all with $p < .01$ for class 4 and $B = -.55$; $B^2 = .20$; $B^3 = -.02$; all with $p < .05$ for class 5). For illustration purposes, the relationship between workplace flexibility and emotional exhaustion is plotted for different levels of task interdependence (i.e., mean, as well as low ($-1 SD$) and high ($+1 SD$) conditions) for the classes with rather high virtual communication behavior (i.e., classes 4 and 5, respectively). First, Figure 2.3 and 2.4 illustrate the relationship between workplace flexibility and emotional exhaustion for employees with *low task interdependence* (for both classes 4 and 5, respectively). Second, Figures 2.5 and 2.6 show the same relation for employees in the condition of *mean task interdependence* (for classes 4 and 5, respectively). Third and last, the relationship between workplace flexibility and emotional exhaustion for employees in the *high task interdependence* condition is illustrated in Figures 2.7 and 2.8 (for classes 4 and 5, respectively).

This supports hypothesis 3, that particularly in work settings with high task interdependence, and thus high communication requirements, high virtual communication is needed to enable workplace flexibility to unfold positive health-effects for employees.

Figure 2.3: Plot (hazard ratios) of the Relationship between Workplace Flexibility and Emotional Exhaustion for Employees with *Low Task Interdependence* in *Class 4* (not statistically significant, $p > .05$).

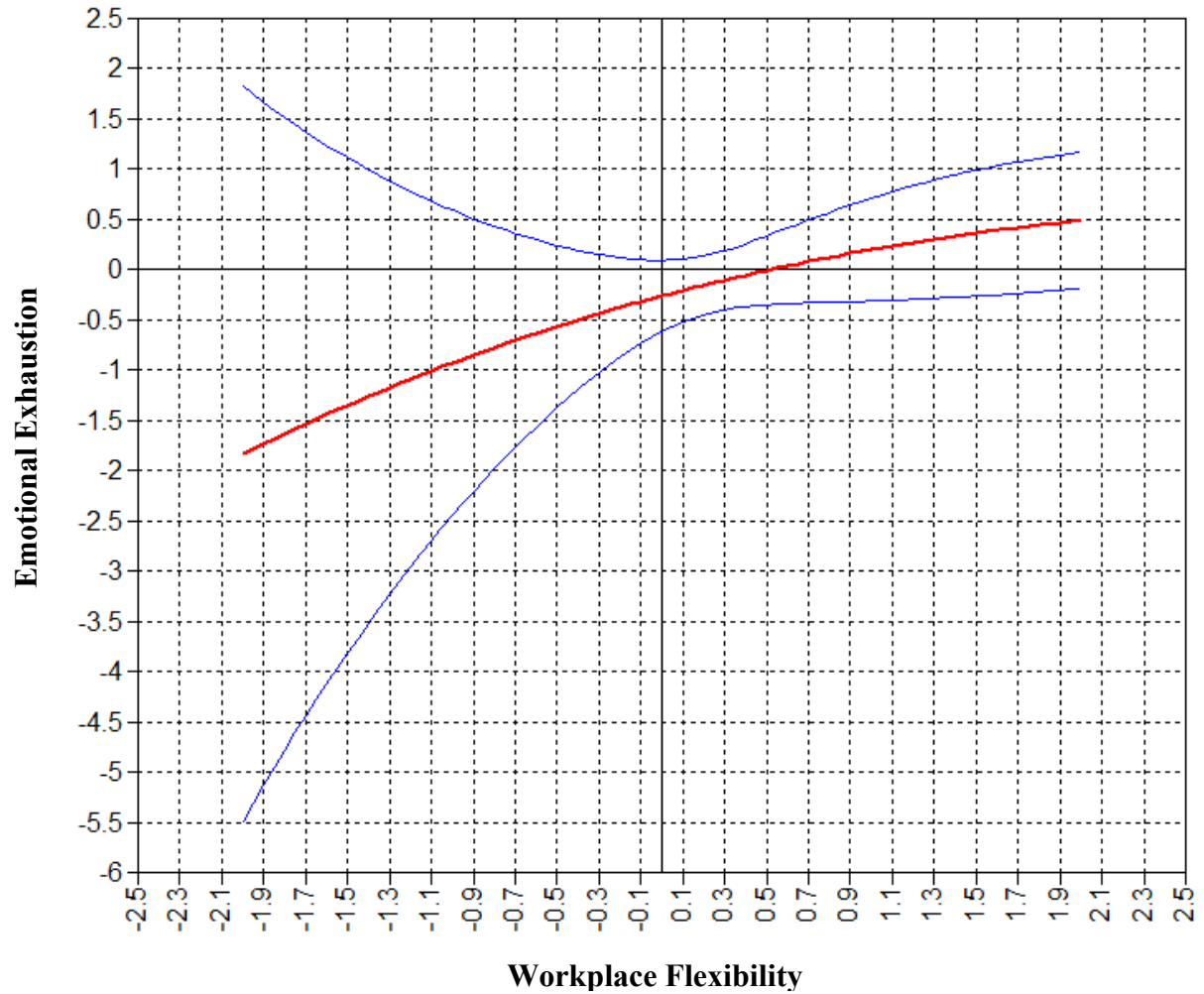


Figure 2.4: Plot (hazard ratios) of the Relationship between Workplace Flexibility and Emotional Exhaustion for Employees with *Low Task Interdependence* in *Class 5* (not statistically significant, $p > .05$).

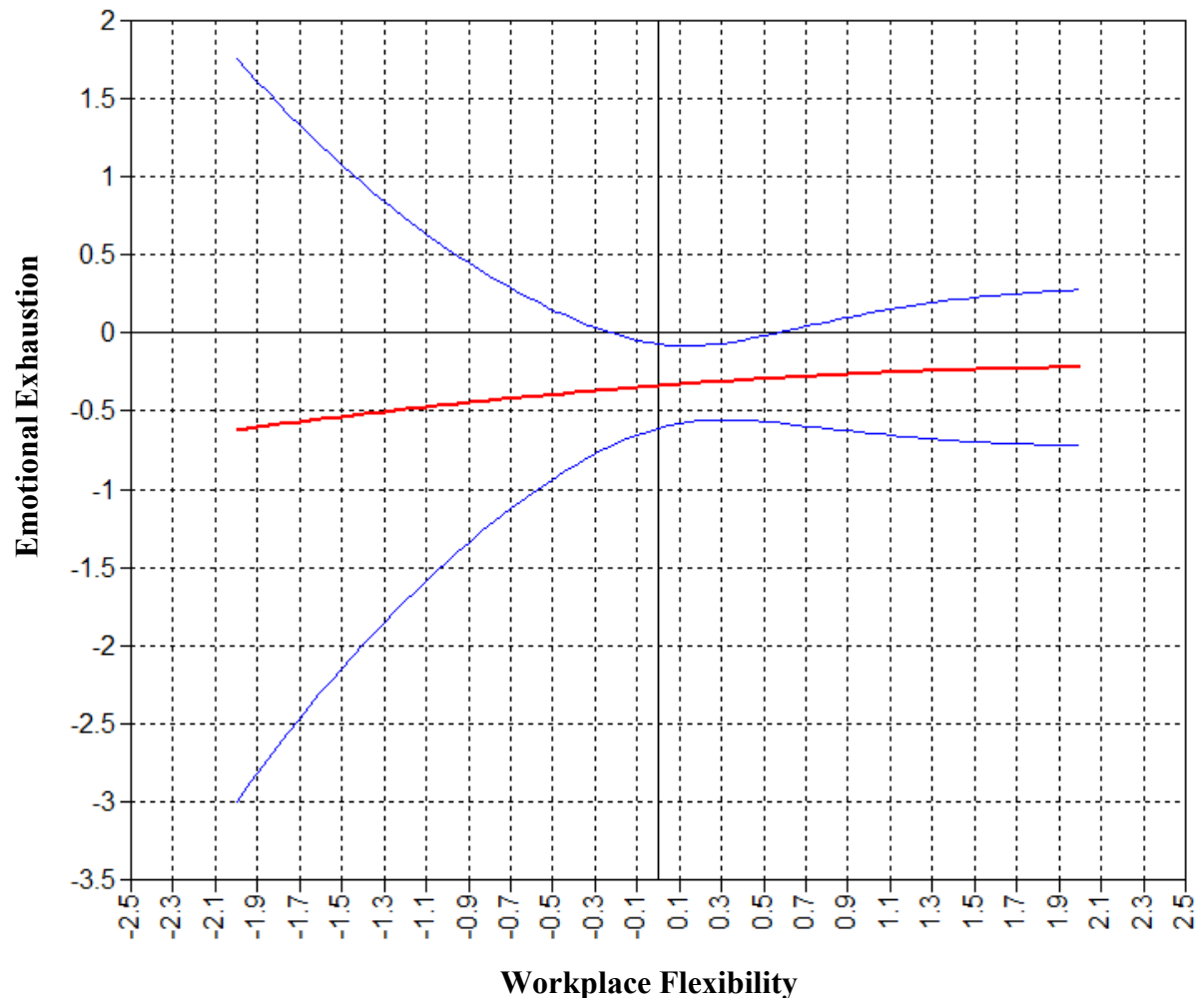


Figure 2.5: Plot (hazard ratios) of the Relationship between Workplace Flexibility and Emotional Exhaustion for Employees with *Mean (average) Task Interdependence* in *Class 4* (not statistically significant, $p > .05$).

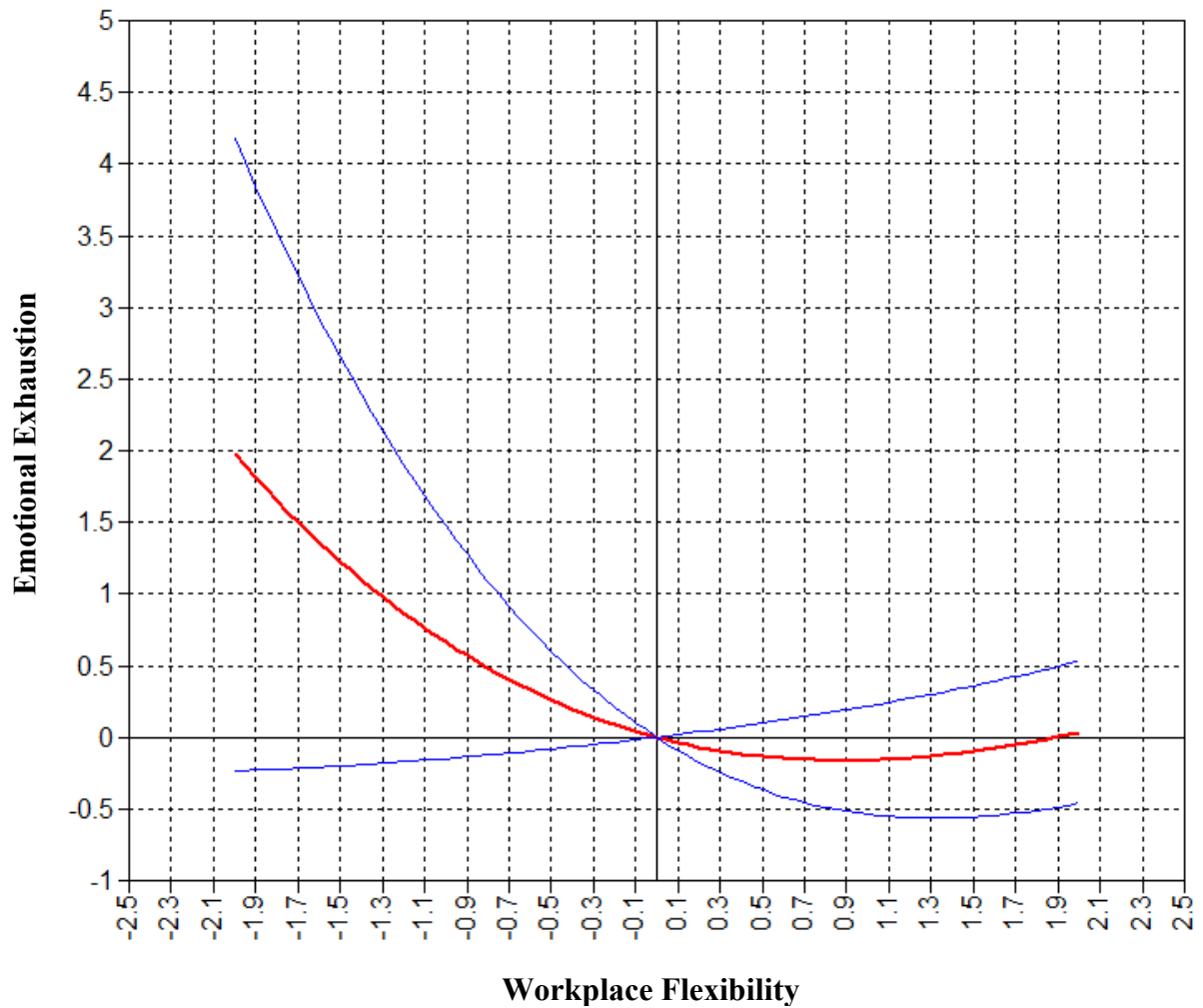


Figure 2.6: Plot (hazard ratios) of the Relationship between Workplace Flexibility and Emotional Exhaustion for Employees with *Mean (average) Task Interdependence* in Class 5 (statistically significant, $p < .05$).

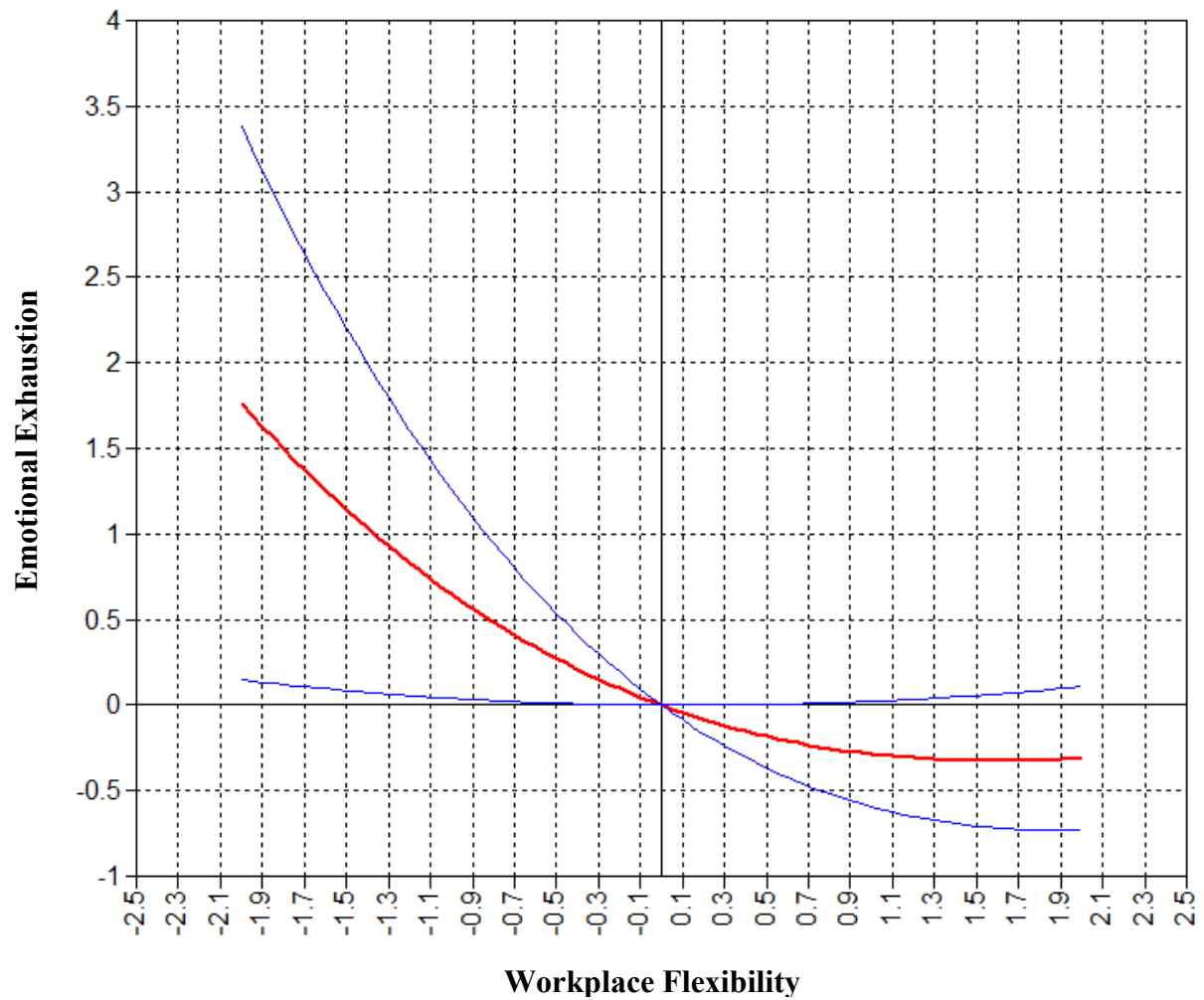


Figure 2.7: Plot (hazard ratios) of the Relationship Between Workplace Flexibility and Emotional Exhaustion for Employees with *High Task Interdependence* in Class 4 (statistically significant, $p < .05$).

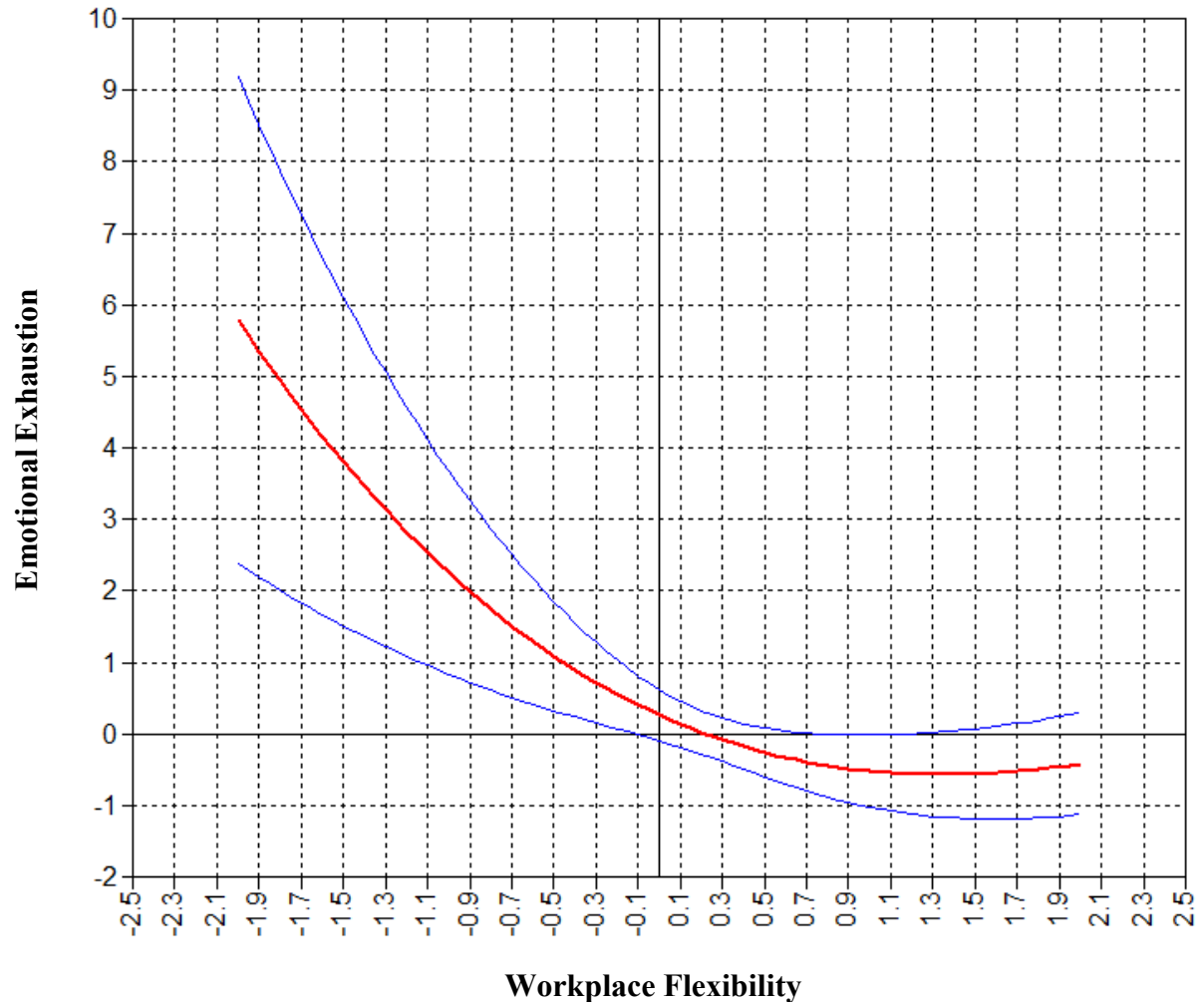
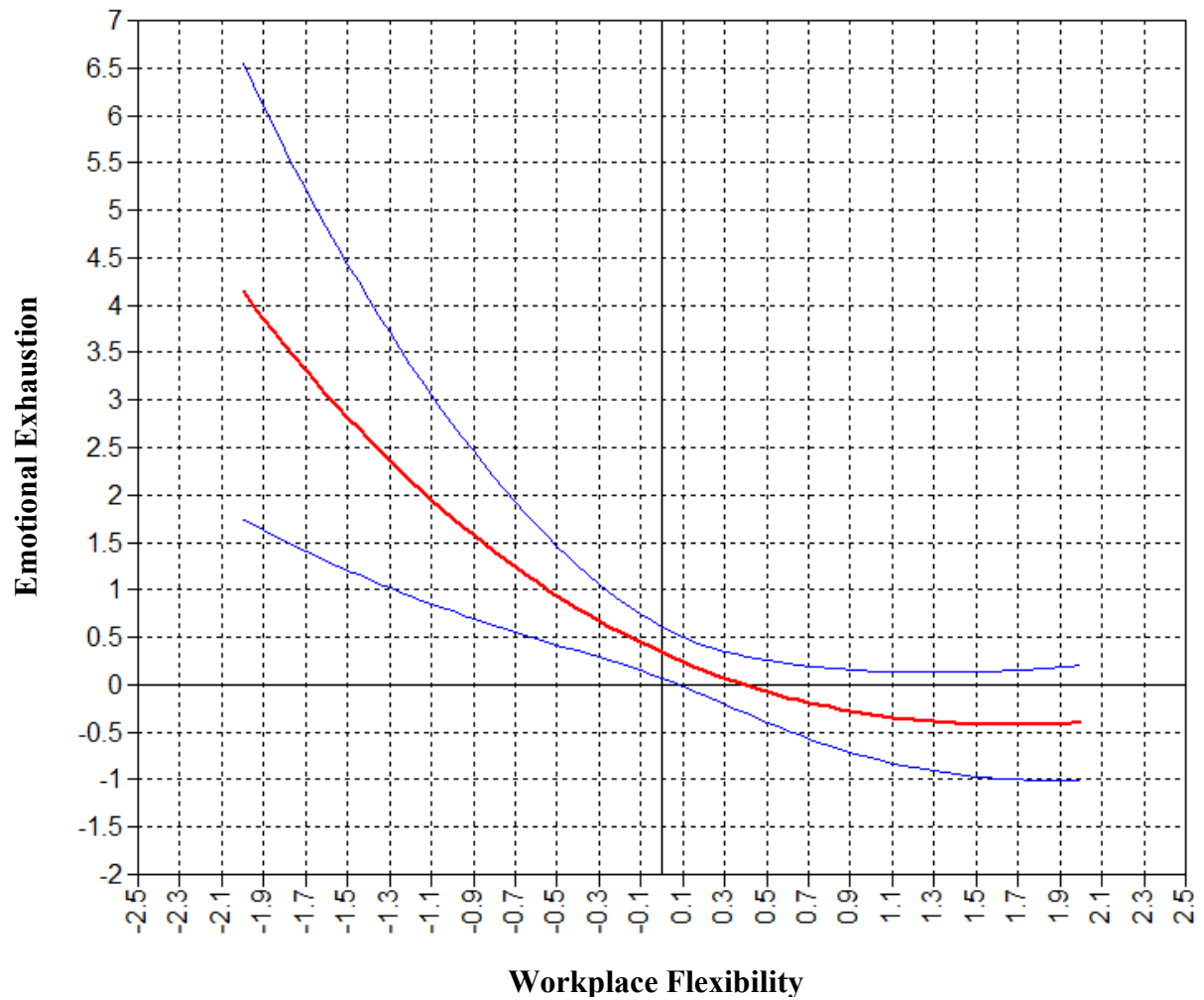


Figure 2.8: Plot (hazard ratios) of the Relationship between Workplace Flexibility and Emotional Exhaustion for Employees with *High Task Interdependence* in *Class 5* (statistically significant, $p < .05$).



2.5 Discussion

Overall, this study explores the role of yet unobserved heterogeneity, i.e., communication patterns and task interdependence, for the relationship between workplace flexibility and health (i.e., emotional exhaustion). In doing so, this exploratory study provides empirical evidence for five different communication patterns being present in the German workforce. They vary in the usage distribution of individual means of communication with one's colleagues. Thus, employees in different classes vary in the use of traditional and virtual communication channels.

Estimation results indicate that the identified virtual communication classes and task interdependence might actually represent dimensions of unobserved heterogeneity in the relation between workplace flexibility and health. This conclusion derives from the observation that no significant relationship is detectable when estimations are run with the full sample. However, incorporating the heterogeneity in the estimation (i.e., running the estimations for each identified communication class) changes the results and conclusions about the relationship. For instance, results indicate a strong negative and cubic relationship between emotional exhaustion and health in the classes with high virtual communication amongst colleagues (i.e., classes 4 and 5, with $N = 254$, $N = 384$, respectively). But no significant relationship is indicated for the class which represents employees that rather focus on traditional means of communication and do not make use of more virtual channels (i.e., class 3 with $N = 2805$). Comparing the sample sizes, just a minority actually uses the variety of modern ICTs available for communication purposes while most employees still rely on the traditional ICTs in the workplace (i.e., class 3). Thus, the pure dominance of the latter employees drives the full sample estimation (see Table 2.9) towards non-significance. Similar effects may be the result of inconsistency across prior studies, that do not incorporate the proposed forms of heterogeneity.

To conclude, results indicate that workplace flexibility is only beneficial (i.e., reduces strain) for employees that are used to communicate virtually with their colleagues across various channels. This relation seems to be particularly valid for employees which work in a task interdependent work setting. Accordingly, the way of communication and task interdependence might actually represent strong boundary conditions for examining the relationship between workplace flexibility and emotional exhaustion.

2.5.1 Limitations and Future Research

Despite methodological strengths such as high statistical power due to a large data sample, this study still has certain methodological limitations. First, the study is an exploratory study, which is cross-sectional in nature and thus leads to associated limitations with regard to causality. For example, high perceptions of emotional exhaustion might be the reason rather than the consequence of high workplace flexibility behavior. Although generating the amount and quality of data at hand is time- and cost-intensive, we encourage future studies to focus on multi-wave study designs, i.e., longitudinal studies, to enable causal interpretations. This would also enable to replicate the latent class analysis and examine whether the latent classes are constant over time.

Second, study data is generated via surveys conducted by a market research institute. By using pre-registered members of an established panel, self-selection bias can arise. The people tending to participate in those surveys regularly might be different from those not participating. The development of data generation procedures, able to minimize self-selection bias, are encouraged.

Third, as this is an exploratory study it just serves to uncover initial indication for important boundary conditions of workplace flexibility, thus being communication patterns and task interdependence. I strongly encourage that future scholars try to replicate and prove the relevance of the boundary conditions in other samples.

2.5.2 Practical Implications

The study results yield recommendations for the management of workplace flexibility efforts in organizations. Hence, results indicate that workplace flexibility behavior can unfold its beneficial effects for employee health only when the respective individuals actually communicate across a diverse set of traditional and modern (virtual) communication channels with their colleagues. However, results also show that just a minority of employees actually shows this behavior. This implies that changing employee behavior from choosing modern forms (e.g., social networks) over traditional means (e.g., e-mail) is not an easy process, although if the employee might know that a new media form might lead to faster results. Therefore, managers must actively start this transformation process towards new communication media use, as the ‘new normal’ world of work will be accompanied by increased levels of workplace flexibility, which demands it.

Thus, organizations must acquire and establish various high-quality communication channels. However, the pure existence of ICTs for communication is not enough. Managers must guide employees towards a sense of acceptance, trust, and positivity towards the new ICTs because, if there is uncertainty associated with the use of the respective technologies, there will be no change at all. Therefore, providing IT support and training for employees is recommended.

Further, the managers must convey that they are positively disposed towards the change and that it is accepted, even appreciated, if the work takes place via different forms of communication. Only when there are no constraints towards the use of various communication media (e.g., no technical constraints, social constraints towards specific channels, or doubts about new media), employees will make full use of the best possible media for the respective work task. And only then, the organization has established an environment in which workplace flexibility can unfold its beneficial effects for employee health. And besides, the more organizations are characterized by task interdependent work structures, the more they need to follow this strategy.

3 Am I outdated? The Role of Strengths Use Support and Friendship Opportunities for Coping with Technological Insecurity

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My responsibilities:	Responsible for the conceptual development, introduction, hypothesis development, statistical computation, discussion of results, as well as the review process.
Presentations	A prior version of this paper was presented at the 79 th Annual Meeting of the Academy of Management in Boston, United States, from 9-13 th August 2019. It was also presented at the Annual Meeting of the HR Division of the German Academic Association for Business Research in Munich, September 2019.
Current Status:	This paper project is published in <i>Computers in Human Behavior</i> . ⁵

Abstract

In the digital era, the prevalent integration of new technologies in work processes gives rise to employees' perceptions of technological insecurity. Such technology-induced strain poses new challenges to occupational health and safety and needs to be better understood in order to be prevented. Based on Conservation of Resources (COR) theory, we investigate to which extent the negative effect of technological insecurity on perceived health depends upon the availability of non-technology-related resources in the workplace. Specifically, we argue that employees who experience two key organizational resources, i.e., organizational support for strengths use and friendship opportunities, are better suited to cope with these modern forms of strain. We hypothesize that those resources reinforce each other in such way that employees' coping

⁵ Goetz, T. M., & Boehm, S. A. (2020). Am I outdated? The role of strengths use support and friendship opportunities for coping with technological insecurity. *Computers in Human Behavior*, 107: 106265.

capabilities rise and health issues decrease. For hypothesis testing, time-lagged hierarchical moderated regression analysis is conducted. The study sample consists of 8'019 German employees. Results support our assumption that accumulating resources create an intensified buffering effect, which surpasses the additive buffering effects of individual resources. Under the condition of high support for strengths use and high friendship opportunities, technological insecurity does no longer show a negative relationship with employee's time-lagged health. By using post-stratification weights, these results apply to 33.3 million employees in Germany having access to Information and Communication Technologies.

Keywords: conservation of resources, technostress, organizational resources, strengths use, workplace friendship, occupational health

3.1 Introduction

Digitization is speeding up and it is accompanied by dramatic changes for the workforce. There is almost no day public press does not report about new technologies and their threats to existing jobs. Forecasts expect growth rates in worldwide spending on Information and Communication Technologies (ICTs) of double that of the global economy; leading to a total market opportunity of approximately \$5.5 trillion by 2020 (Businesswire, 2017). Further studies claim that almost 50% of all jobs are in high danger to be replaced by technological solutions in the future (Frey & Osborne, 2017; 2018).

This development implies that new technologies will continue to change and penetrate work processes in the future. Technological changes will affect current demands in the workplace, cause recurring and reinforcing adaptation efforts for employees, add skill requirements or even turn employees' skills obsolete (Ayyagari et al., 2011; Day et al., 2010; Fuglseth & Sørenbø, 2014; Gekara, & Thanh Nguyen, 2018; Ragu-Nathan et al., 2008; Wang et al., 2008). Most likely, employees will experience increased levels of stress and strain due to increasing ICT demands in the workplace (i.e. "technostress", see Ayyagari et al., 2011; Ragu-Nathan et al., 2008; Weil & Rosen, 1997). Due to those developments, the European Agency for Safety and Health at Work (EU-OSHA, 2018, p.7) highlights that "digit[ization] [...] opens the door to an increase in [occupational safety and health] challenges, in particular of an ergonomic, organi[z]ational and psychosocial nature, that need to be better understood and managed."

In Information Systems (IS) literature, various studies have examined the negative effects of ICT-related stressors, such as on job-related, IS use related and well-being related outcomes (see Ayyagari et al., 2011; D'Arcy et al., 2014; Tarafdar et al., 2007). Other studies focused on the boundary conditions of those relationships, such as technology self-efficacy and competence (Tarafdar et al., 2015), ICT exposure control (Galluch et al., 2015), personality traits (Srivastava et al., 2015), ICT involvement facilitation (Ragu-Nathan et al., 2008), technical support provision (Ragu-Nathan et al., 2008), ICT literacy facilitation (Ragu-Nathan et al., 2008) and training interventions (Soucek & Moser, 2010). Nonetheless, in line with recently published reviews on technostress (e.g., Tarafdar et al., 2017), we argue that the IS literature on technostress is still limited in four important ways: First, prior research does not offer a sound theoretical explanation or framework to explore the effects of technostress on outcomes. Particularly, prior studies did not incorporate established theoretical explanations from outside the IS field, e.g. from psychological stress literature. Second, key stressors in the technostress literature and their respective effects on the health of employees are still understudied. One of those variables is technological insecurity (Tarafdar et al., 2007; Ragu-Nathan et al., 2008). It covers stress and strain associated with feelings of potential job loss due to ICT-related changes in the workplace (Ragu-Nathan et al., 2008). Third, prior research did not yet examine the effects of ICT-related stressors in the presence of supportive, non-technology-related organizational resources. Such resources could help employees to overcome ICT-induced stress and strain by enhancing coping capabilities. Fourth, previous studies mostly rely on rather small and isolated samples to examine the effects of ICT-related stressors which strongly limits their external validity.

To jointly address those research gaps, this study integrates COR theory (Hobfoll, 1989) as one of the most influential psychological stress theories with IS-related work on technostress. Further, we examine how two non-technology-related organizational conditions influence the relationship between employees perceived technological insecurity and their general health perception. To do so, we collected data from 8'019 employees in Germany, which can be statistically weighted to be representative for 33.3 million employees in the respective workforce. Based on COR theory, our central argument is that organizational conditions apart from the IS-related environment can serve as important resources that increase employees' coping capabilities with strain. This reduces the negative effect of technological insecurity on employee health perceptions.

Specifically, we argue that two non-technology-related organizational resources are of particular relevance for employees in insecure and/or unstable working environments because they individually induce feelings of appraisal by and belonging to an organization: (a) organizational support for strengths use (Keenan & Mostert 2013; van Woerkom et al., 2015) and (b) friendship opportunities in the workplace (Morgeson & Humphrey, 2006; Sims et al., 1976). Organizational support for strengths use covers “employees’ beliefs concerning the extent to which their employer actively supports them in applying their personal strengths at work” (van Woerkom et al., 2015, p.142). This increases employees’ actual use of their strengths at work and induces feelings of being valued due to own individual capabilities (Biswas-Diener et al., 2011; van Woerkom et al., 2015).

Next, friendship opportunities in the workplace are a key element for the informal structure of organizations (Barney, 1985), which can increase the actual friendship formation among employees (Richey & Richey, 1980; Tokuno, 1986). Friends enable to provide and receive assistance and emotional support to and from others. This can encourage positive emotions in the workplace such as trust, respect, support, and security (Chiaburu & Harrison, 2008; Colbert et al., 2016; Foote, 1953; Grant, 2008; Spreitzer, 1995). We further argue that support for strengths use and friendship opportunities play together and reinforce each other by accumulating to higher resource levels (Hobfoll, 2011). This interaction of resources further increases one’s coping capabilities and reduces stress and strain caused by technological insecurity.

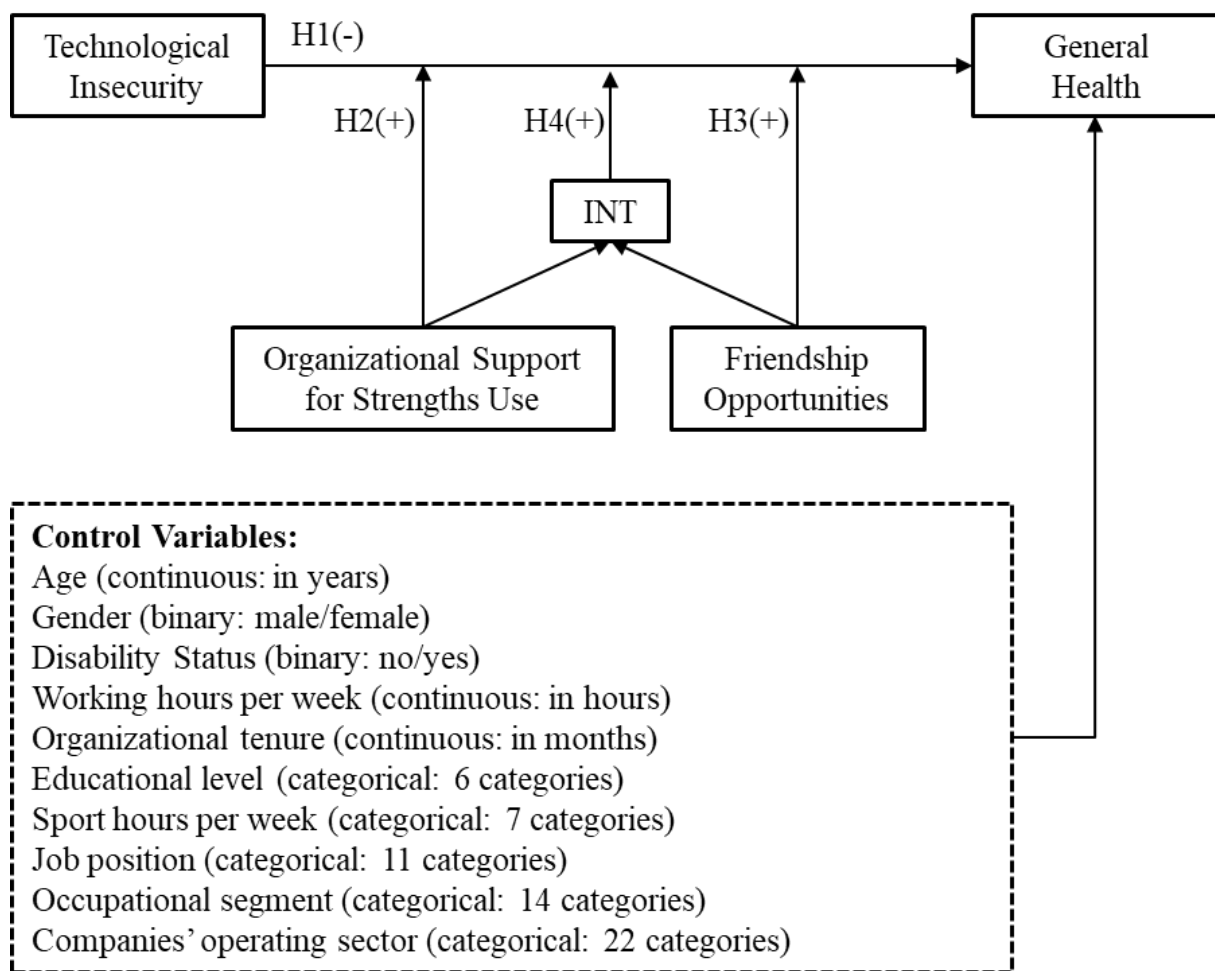
Taken together, this study makes four primary contributions to the literature. First, we follow the call by Tarafdar et al. (2017) and provide a cross-disciplinary contribution by combining IS research on technostress with non-IS research on psychological stress (i.e., COR theory). By doing so, we open up a new research direction to adequately examine the impact of technostress on employees. Second, we provide theoretical and empirical support that technological insecurity is an important, yet understudied variable in the technostress literature that can negatively affect the perceived health of employees across an entire workforce. Third, we show that two non-technology-related organizational resources, i.e., support for strengths use and friendship opportunities, are important for employees in order to successfully cope with ICT-related stressors. This “interdisciplinary lens” on preventing and dealing with technostress broadens the existent research focus which has mainly focused on the role of boundary conditions directly related to ICTs (e.g., Technical support provision, ICT involvement facilitation, ICT equipment or ICT training). And fourth, we argue and empirically demonstrate that

our results have high external validity and are robust with respect to multiple controls. By using post-stratification weights, the results apply to approximately 33.3 million employees in Germany who are 18 years or older and have access to internet-enabled ICTs.

3.2 Theory and Hypotheses

Our central argument is that organizational resources, particularly organizational support for strengths use and friendship opportunities, help to decrease the negative effect of strain caused by technological insecurity concerns, and thus, increase employees' health perceptions. An overview of the hypothesized model is shown in Figure 2.

Figure 3.1: Overview of the Model under Investigation



Note. Categorical controls were coded as dummies.

Conservation of Resources Theory (COR; Hobfoll, 1989) is one of the most influential theories in explaining stress. Resources' are defined as objects (e.g., car, house),

conditions (e.g., marriage, employment), energies (e.g., time, money), and personal characteristics (e.g., key skills, self-esteem) that are centrally valued by humans, are the major focus of the theory (Hobfoll et al., 1996; recommended reading about resources: Halbesleben et al., 2014; Krohne, 2002; ten Brummelhuis & Bakker, 2012). The psychological processes that motivate people to maintain and/or attain those resources explain how people react to everyday stressors in their environment and how this affects their respective well-being.

In its core, COR theory attempts to explain much of human behavior, respectively stress, from an evolutionary approach to resources. For instance, its rationale is largely derived from the notions of an “evolutionary-based built-in and powerful bias [of humans] to overweight resource loss and underweight resource gain [...] [and the] evolutionary need to acquire and conserve resources for survival” (Hobfoll et al., 2018, p.104). Accordingly, COR theory’s basic tenet is that “individuals [...] strive to obtain, retain, foster, and protect resources” (Hobfoll et al., 2018, p.104) and that stress arises when those resources are in danger to be depleted or are depleted (Hobfoll, 2002). Situations or events are perceived as ‘stressful’, i.e., causing strain, when individuals commonly associate those with potential or actual loss of the resources. This, in turn, may have detrimental effects on well-being and health.

COR theory has been constantly debated, applied, and modified since its first publication by Hobfoll (1989). This resulted in a compilation of individual principles and corollaries that together form the basis of today's COR theory (recommended readings for more detail: Halbesleben et al., 2014; Hobfoll et al., 2018; ten Brummelhuis & Bakker, 2012). The applied tenets in this study are explained below.

First, the *primacy of (resource) loss principle* states that the detrimental effects of the loss of resources on individuals are disproportionately greater compared to the beneficial effects of the equivalent gain of resources. This also implies that resource loss “not only is more powerful than resource gain in magnitude but also tends to affect people more rapidly and at increasing speed over time” (Hobfoll et al., 2018, p.105). Second, the *resource investment principle* describes that individuals “must invest resources to protect against resource loss, recover from losses, and gain resources” (Hobfoll et al., 2018, p.105). This suggests that individuals engage in a direct replacement, e.g., replacing lack of income with savings, and indirect investment processes of resources, e.g., using time and money to increase key skills necessary to stay competitive in the workplace environment. Third, the *gain paradox principle* states that the importance of

resource gains increases especially in times when resource loss is very likely or the resources are in high danger of depletion (Hobfoll, 2002; Hobfoll et al., 2018). Fourth, *Corollary 1* states that the possession and the lack of resources are crucial factors in an individual's vulnerability and resilience, mainly assuming that "those with greater resources are less vulnerable to resource loss and more capable of resource gain" (Hobfoll et al., 2018, p.106). The contrary applies to individuals who lack resources.

Applying those rationalities, COR theory must be differentiated from other stress theories, especially Lazarus and Folkman's (1984) stress-appraisal theory. In sum, the stress-appraisal theory postulates that the extent of the effects of stressful situations depends on one's perception, i.e., 'appraisal' of these situations as stressful. It even assumes that there is no such thing as environmentally produced stress without the appraisal of the individual (Lazarus & Folkman, 1984, p.19). In the first place, the stress-appraisal theory implicitly considers the occurrence of stress to solely depend on an individual's appraisal of the situation which might lead to certain problematic conclusions in certain contexts.

For instance, in the context of a criminal act, stress would emerge in response to the victims' perception of the event to be stressful. As such, addressing the situation would be a matter of the victim who would need to adjust his/her appraisals (Hobfoll et al., 2018) rather than the matter of the criminal act itself. As this is only one drawback of former stress theories (for a detailed discussion see Hobfoll, 1989; Hobfoll et al., 2018), Hobfoll (1989) formulated the COR theory to provide a more appropriate and testable understanding of coping and stress.

Although COR theory does not deny subjective appraisal, it puts much more emphasis on the objectivity of stressful events (Hobfoll, 1989; Hobfoll et al., 2018). It follows the notion that stressful events contain objectively stressful elements "that are shared within a culture and have a common level of impact" (Hobfoll et al., 2018, p.104). Although subjective perceptions might have an influence, COR theory states that objective elements will be the determining factors in explaining the effects of stressful events on any outcome.

In this study, we assumed that perceptions of technological insecurity can be regarded as a commonly stressful situation that contains negative objective elements for employees. The rationalities behind this assumption are outlined in the following section.

3.2.1 Technological insecurity and health

One special form of job insecurity that is on the rise is the so-called technological insecurity (Tarafdar et al., 2007). More than 30 years ago, clinical psychologist Craig Brod's (1984) already described, in his book "Technostress: The Human Cost of the Computer Revolution", a term called technostress as "a modern disease of adaptation caused by an inability to cope with the new computer technologies in a healthy manner" (p.16). Weil and Rosen (1997) adjusted this notion by including "any negative impact on attitudes, thoughts, behaviors, or body physiology that is caused either directly or indirectly by technology" (p.5). Since Brod's (1984) book, decades of irresistible enthusiasm to incorporate technologies have passed.

To date, ICTs are the most dominant technologies in the workplace because they provide high efficiency and productivity opportunities for organizations (Srivastava et al., 2015). However, they also change and shape organizational structures, working processes, and interactions between individuals inside and outside of organizations (Ayyagari et al., 2011). According to those persistent change processes, employees constantly need to learn new skills as well as to adapt to new work processes and increased capabilities of ICTs in performing complex tasks. This may lead to doubts about one owns' ability to keep up with the rising workplace demands through ICTs and/or to worries about being replaced in the future (Ayyagari et al., 2011; Day et al., 2008; Fuglseth & Sørenbø, 2014; Ragu-Nathan et al., 2008; Wang et al., 2008). In other words, technological insecurity actually focuses on perceived threat of losing the job due to technologies or also to other people, e.g., colleagues who possess a better knowledge or understanding of those technologies (Fuglseth & Sørenbø, 2014; Ragu-Nathan et al., 2008; Srivastava et al., 2015).

Therefore, technological insecurity links technological reasons with concerns about one's job security. In line with COR theory, this means that when employees face increased technological insecurity, they commonly associate technologies with being a threat to actual resources, i.e., 'job insecurity' or 'employment' (Hobfoll et al. 1996; Krohne, 2002), which may lead to strain (Hobfoll, 1989). For example, an employee (e.g., a project manager) is confronted with continuous and/ or radical changes in the technological environment of the organization. Hence, he/she shows high perceptions of technological insecurity (e.g., fear of being replaced in the future due to technological solutions that make ones' skills obsolete). Thus, individuals commonly associate this

situation with an actual or potential loss of their current job (position), also called ‘job insecurity.’

Job insecurity is generally defined as the subjective perception of being threatened by job loss and concerns about the continued job existence in the future (Klandermans & van Vuuren, 1999; Mohr, 2000). Several studies have shown a link of job insecurity with increased stress and decreased well-being and health (Abildgaard et al., 2018; de Jong et al., 2016; de Witte et al., 2016; Hellgren & Sverke, 2003; Wiezer et al., 2011). In particular, negative effects of job insecurity on both psychological well-being (e.g., depression), somatic health (e.g., high blood pressure), and general self-rated health have been established (Ibrahim et al., 2009; Kim et al., 2008; Kirves et al., 2011; Virtanen et al., 2011). Therefore, job insecurity has been shown to have a major influence on health.

Therefore, as technological insecurity reflects an individuals’ perception of being threatened in ones’ job security or employment due to technologies, it is expected to be a common and objectively perceived stressful situation for employees. Nevertheless, the effect of technological insecurity on individuals’ health has, to our knowledge, never been studied from a psychological stress perspective. Thus, the IS literature runs the risk of neglecting relevant findings of decades of research in the field of psychological stress. Hence, in line with COR theory’s primacy of (resource) loss principle (Hobfoll 1989, Hobfoll et al., 2018), we expect technological insecurity to cause actual strain manifested in a decreased assessment of one’s general health perception. Therefore, we hypothesize:

Hypothesis 1: *Technological Insecurity is negatively related to employees’ perceived general health.*

3.2.2 Moderating Effect of Organizational Support for Strengths Use

As initially outlined, COR theory provides further rationalities about resource processes, which explain the coping of individuals in stressful situations. As stated in *Corollary 1*, people “with greater resources are less vulnerable to resource loss and more capable of resource gain” (Hobfoll et al., 2018, p.105) because they are argued to be better suited for dealing with stressful situations (Hobfoll, 2002). In line with the *resource investment principle* (Hobfoll et al., 2018), a greater set of resources allows them to execute resource replacement processes when being confronted with resource losses, and thus, reduce strain (Hobfoll, 2002). Therefore, this rationality implies that individuals may

actually use existing resources in order to induce coping processes for both actual and potential resource losses. For example, individuals may be able to invest energy resources (e.g., time) in the development of personal resources (e.g., new skills) to protect against potential losses of condition resources (e.g., employment) in the future.

Following the theoretical assumptions of COR theory, organizations may provide or emphasize special environmental conditions (organizational resources), that direct and energize employees' behavior and resources (Gagné, & Deci, 2005) to better cope with stressful conditions. One non-technology-related organizational resource, expected to be of particular relevance in stressful conditions of technological insecurity, is organizational support for strength use (Keenan & Mostert, 2013). It has been shown that if individuals perceive their organizational environment to be supportive in terms of encouraging the use of their individual strengths, they are less likely to be negatively affected by strain experienced by stressful job conditions (van Woerkom et al., 2015). This form of organizational support relies on previous research showing that actual strength use leads to positive effects on the users' stress levels and well-being (Forest et al., 2012; Senf & Liao, 2013). Hence, it is argued that instead of focusing on the identification and correction of particular weaknesses of employees (Buckingham, 2005), organizations should rather enable and support the use of employees' existing strengths at work (Luthans & Youssef, 2007). This organizational support then leads to increased levels of actual strengths use in the workplace. It is argued that enabling employees to perform tasks that capitalize on their individual strengths, these employees experience "higher levels of self-esteem as a result of feeling valued for their unique worth and experiences" (van Woerkom et al., 2015, p.143). This may act as an important counterbalancing resource to the decreased self-confidence in one's worth for the company caused by experienced technological insecurity (Ayyagari et al., 2011). Furthermore, when employees perceive to be supported in doing what they are good at, this inherently covers freedom to behave more in line with their authentic selves and perform at one's personal best according to one's individual habits (Wood et al., 2011). This may further stimulate their personal growth and development (Dollard & Bakker, 2010; Peterson & Seligman, 1995), decrease strain and increase performance and happiness levels (Forest et al., 2013; Govindji & Linley, 2007; Seligman et al., 2005).

Therefore, when being supported to use one's individual strengths, employees experience the appreciation by the organization of one's abilities and thus profit from increased resource levels (e.g. personal resources: self-esteem, etc.). Higher resource levels then further increase one's coping capabilities with strain (e.g. caused by the fear

to loose one's job due to any technological solution). Hence, we argue that organizational support for strengths use acts as valuable resource in the workplace, which increases the coping capabilities of employees according to strain caused by the exposure to technological insecurity concerns. In this manner, in line with COR theory, organizational support for strength use is expected to decrease the negative effects of technological insecurity on one's general health perception. Therefore, we hypothesize the following:

Hypothesis 2: Organizational support for strengths use moderates the relationship between technological insecurity and general health such that the negative relationship between the two is weaker when organizational support for strengths use is higher.

3.2.3 Moderating Effect of Friendship Opportunities

Moreover, friendship opportunities are expected to inhere high relevance in the ICT-related workplace context at hand. Fundamentally, the need to build social ties with others is one of the most central needs of human beings (Hobfoll et al., 2018). Strong social relationships to one another, often termed as friendships, provide several positive functions for the people involved such as, having a listener, someone who understands one's problems, receiving valuable advice, guidance, acceptance, and a sense of belonging to a social group (Richey & Richey, 1980; Tokuno, 1986; Weiss, 1974). Those interpersonal encounters increase peoples' self-esteem and well-being (Hartup & Stevens, 1977). Further, stable friendships enable opportunities to expand one's own social network by getting in closer contact with the people in the social network of a friend, subsequently profiting from aggregated benefits of more friendships (Buote et al., 2007).

Due to the fact, that most people spend a significant amount of time at work, it is not surprising that friendships play a crucial role in the workplace. This notion is supported by several studies showing the positive relation of workplace friendships with, e.g., job satisfaction, involvement, motivation, supportive and innovation climate, and productivity (Berman et al., 2002; Crabtree, 2004; Nielsen et al., 2000; Sias et al., 2004; Solano, 1986; Synder & Smith, 1986). This is in line with recent findings by Colbert et al. (2016) who identify friendships in the workplace to be "the most important predictor of positive emotions at work" (p.1215) and further highlight its importance for the individual and organizations, respectively.

From an organizational point of view, it is valuable that employees build friendships at work in order to capitalize on those benefits. Hence, an organization can design the workplace environment in a way that allows employees to participate in organizational processes and activities. Thus, enabling more social contact and communication with others, and subsequently strengthening the opportunities to develop friendships in the workplace (Ragins & Dutton, 2007; Riordan, & Griffeth, 1995; Song, 2006). Those friendship opportunities (Morgeson & Humphrey 2006; Sims et al., 1976) are examined as an important antecedent for actual workplace friendships (Nielsen et al., 2000; Sias et al., 1998). This implies that the perception of employees about the extent the workplace environment provides adequate friendship opportunities is an important organizational job resource. It increases one's capabilities to lower stress levels by helping employees to cope with demanding situations, which further increases one's health perceptions (Berman et al., 2002; Buote et al., 2007; Ragins & Dutton, 2007).

Hence, in the context of employees facing technological insecurity, providing adequate friendship opportunities (as antecedent for actual friendship formations) may increase employees' resources by helping to share one's individual uncertainty about the job-related future with peers. This subsequently buffers the negative strain effects by mutually received social support among friends. Therefore, friendship opportunities are assumed to increase one's possibilities to receive social support, share honest views with peers about one's uncertainty and perceptions of job threats caused by technology. This makes employees more likely to perceive oneself as an integrated element of the organization that will not be replaced, which ultimately reduces the impact of strain caused by technological insecurity on one's health perception. Hence, we hypothesize:

Hypothesis 3: Friendship opportunities moderates the relationship between technological insecurity and general health such that the negative relationship between the two is weaker when friendship opportunities are higher.

3.2.4 Organizational Resource Reservoirs: Strength Use Support and Friendship Opportunities

As outlined, both organizational resources are individually expected to be valuable in enhancing coping capabilities with strain caused by technological insecurity. This roots mainly on the notion of COR theory's *primacy of (resource) loss principle and Corollary 1* (Hobfoll et al., 2018). Together, they say that higher resource levels make employees less vulnerable to stressful conditions (*Corollary 1*) leading to less actual strain, and that the loss of resources takes place with a disproportionately high (negative)

effect on individuals. Thus, resource losses are more salient than resource gains (Hobfoll 2002, 2018).

Further following these notions, when employees perceive to be provided with more types of resources, those individual resources accumulate to higher resource levels. Higher resource levels then enable to experience less strain caused by stressful conditions, which leads to less resource losses as a result of the coping process. In turn, decreased resource losses and strain leads to a disproportionate reduction of the associated negative impact on the individual, i.e., on one's health assessment. Therefore, we expect the mitigating role of resources to be higher when individuals are in possession of both resources simultaneously, meaning, being able to use both their strengths and develop social ties in form of friendships in the workplace.

Further, following the notion of COR theory's *gain paradox principle*, the effect of resource gains on individuals becomes particularly salient when resources are in danger to be depleted, or actually deplete (Hobfoll, 2002). This implies that higher resources unfold its true potential when employees perceive being confronted with high demanding conditions. Hence, we additionally expect that especially in times of high stressful conditions (e.g., high technological insecurity), when job resources are in great danger of depletion, employees benefit the most from higher accumulated resource reservoirs. This is coherent, because particularly in situations when employees experience high stress caused by technological insecurity (e.g., in form of perceptions of not being able to adequately adapt to ongoing or expected technological changes; having actual fear to be replaced by technologies), employees may request and benefit the most from positive work experiences and feelings of appreciations caused by using their strengths and receiving emotional support from colleagues.

For example, again, imagine an employee (e.g., a project manager) with perceptions of technological insecurity that is confronted with continuous technological changes in the organization and therefore having high perceptions of technological insecurity (e.g., fear of being replaced by technologies that make one's skills obsolete). But, imagine, that the employee is additionally supported by the organization to use and foster the individual strengths (e.g., financial forecasting) and is provided with friendship opportunities in the workplace. By applying his/her individual strengths, this employee will perform tasks with unique value which provides him/her with higher security to not fall into disuse in the future. Additionally, he/she performs routine tasks on a high level with less effort. Thus, using one's strengths encourages higher self-esteem while

performing at one's personal best and feelings of being valued by the organization due to the individual abilities. This leaves the employee with more time, energy and attitude towards work to cope with the demanding situation (e.g., by investing time and energy in improving key skills to foster the employment position). In addition, the employee will be able to exchange thoughts and information on the relevance of technological changes with peers from other organizational areas and from peers in the specific field of financial forecasting. This leaves the employee with feelings of being an integral part of the social/ informal organizational environment, not being confronted with the technological insecurity just on its own. This informal environment allows to receive mutual emotional support amongst peers, which is particularly valuable when feeling insecure. As a result, this decreases the impact of stress caused by perceptions of high technological insecurity on the employee's health perception.

Therefore, employees will experience an accumulated level of organizational resources when being provided with both organizational support for strengths use and friendship opportunities simultaneously. The higher resource levels buffer the impact of stress caused by perceptions of technological insecurity on the employee's health perception at a disproportionally higher level. In addition, the higher resource levels are expected to be particularly valuable when the employee encounters stressful situations. Thus, the employee is encouraged to make the most out of those resources provided in times of high technological insecurity. In this particular situation, the resources show an accumulated buffering effect on the negative effect of technological insecurity on health. Hence, in line with COR theory, we hypothesize:

Hypothesis 4: There is a three-way interaction among technological insecurity, organizational support for strengths use and friendship opportunities in explaining general health. The negative relationship between technological insecurity and general health is weaker when both organizational support for strengths use and friendship opportunities are high and stronger when both organizational support for strengths use and friendship opportunities are low than in any other combination of organizational support for strengths use and friendship opportunities.

3.3 Methods

3.3.1 Data Collection and Sample

To test our hypotheses, we collected a representative data set for the German labor force by instructing a German market research institute with the data collection process. In doing so, we only surveyed participants with an age of 18 years or older, who are currently employed and have access to internet-enabled communication technologies. Hence, all participants of the survey are registered panel members who agreed to participate in online surveys and are rewarded for their participation by points which can be converted into a real currency. To ensure high data quality, the research institute thoroughly checks for and excludes participants who are found to manipulate the survey (e.g., multiple participation or click-through behavior). To reduce single-source bias, two-wave survey data were collected. The survey versions were translated to German by professional translators following a double-blind back-translation procedure to ensure semantic equivalence with the original English items (Schaffer & Riordan, 2003). The two surveys were carried out at a 9-month interval, resulting in 8,019 and 8,004 respondents, respectively. Being able to track each participant by a specific ID enabled us to identify an overlap sample of 4,754 respondents having participated in both survey waves. Therefore, attrition rate is 40.7%.

To take missing values of the model variables into account, we conducted chained multiple imputation by using the *mi impute chained* command in Stata software version 15 (StataCorp. 2017). We chose chained imputation over multi-variate normal imputation (mvn), because variables with missing values are not solely of continuous nature and violate the normality assumption of mvn. All variables in the model are included in the imputation model. We imputed continuous variables using linear regression models, binary variables using logistic regression models, ordinal variables using ordered logistic regression models and categorical variables using multinomial logistic regression models. Although some continuous variables were skewed, they were imputed on the raw scale without transformation, irrespective of their distribution (Lee, & Carlin, 2017; von Hippel, 2013). Hence, we did not constrain the imputation values to a specific range of values (e.g., Likert scale range) - “although this imputation method results in some implausible values, it appears to be the most consistent method with low bias and reliable coverage in repeated sampling of missingness, irrespective of the amount of skewness in the data.” (Rodwell et al., 2014, p.10). To take care of missing values in the dependent variable due to dropout (potential ‘attrition bias’, see Asendorpf

et al., 2014), we also imputed the dependent variable (second survey period) by adding the same variable from the first survey period as an auxiliary variable in the imputation model (Enders, 2010; Johnson & Young, 2011; White et al., 2010). This procedure leads to more accurate and stable estimates when the auxiliary variable is strongly correlated with the dependent variable, e.g. > 0.5 (Enders, 2010; Johnson, & Young, 2011). Herein, the observed correlation is .66, and therefore fits this criterion. In total, 50 datasets were imputed, being in line with the rule of thumb provided by White et al. (2010), as the number of imputed data sets surpasses the maximum percentage of missing cases in one variable (here: 41.3% in outcome variable). All variables were imputed on the item level. In doing so, all observations of the first survey period, 8'019 in total, are used for hypothesis testing.

After multiple imputation, the final study sample consists of 8'019 observations. Herein, the age of the respondents ranged from 18 to 77 years, with an average of 44.3. Hence, the sample consisted of 3'922 women and 4'097 men (i.e., 51.1% were male). Of all respondents, 31.4% hold a university degree, 21.0% a higher education entrance qualification, 39.3% a secondary school leaving certificate, and 8.4% hold a lower vocational background. On average, the contractual working hours of the respondents are 35.1 hours per week and the mean organizational tenure is 11.4 years. Additionally, 11.5% do have an officially labeled disability. By using sample weights, the study sample can be weighted to be representative for 33.3 million employees of at least full age in Germany and having access to internet-enabled ICTs.⁶

3.3.2 Measures

Unless otherwise noted, answers for all measures were provided on a 5-point Likert scale ranging from 1 (*completely disagree*) to 5 (*completely agree*). Means, standard deviations, and standardized factor loadings of measurement items are shown in Table 3.1.

⁶ Structural representativeness is established by comparing the distribution of key demographics in the data sample at hand with the distribution in the statistical population. The participants are weighted so that the weighted data sample has the same distribution as in the statistical population. For this procedure, we acquired access to 'best for planning' (b4p, 2016) data. 'b4p' are statistical population data for the German workforce - regularly collected by the 'Gesellschaft für integrierte Kommunikationsforschung' (GIK). For further information, please contact the authors.

Table 3.1: Means, Standard Deviations, and Standardized Factor Loadings of the Main Study Items

Measurement items of main study variables					
Items	M	SD	N	Load.	Source
<i>Technological insecurity (N = 8019, T1)</i>					
I: "I feel constant threat to my job security due to new technologies."	1.80	.98	8019	<i>fixed</i>	Tarafdar et al. (2007)
II: "I have to constantly update my skills to avoid being replaced."	2.43	1.17	8019	.90	
III: "I am threatened by coworkers with newer technology skills."	1.75	.94	8019	1.09	
IV: "I do not share my knowledge with my coworkers for fear of being replaced."	1.59	.90	8019	.89	
<i>Org. strength use support (N = 7861, T1)</i>					
I: "My organization gives me the opportunity to do what I am good at."	3.71	1.03	7987	<i>fixed</i>	Keenan, and Mostert (2013)
II: "My organization allows me to use my talents."	3.59	1.07	7973	1.02	
III: "My organization ensures that my strengths are aligned with my job tasks."	3.57	1.05	7936	.99	
IV: "My organization allows me to do my job in a manner that best suits my strong points."	3.62	1.03	7965	.99	
<i>Friendship opportunities (N = 7808, T1)</i>					
I: "I have the opportunity to develop close friendships in my job."	3.09	1.15	7917	<i>fixed</i>	Morgeson, and Humphrey (2006), adapted from Sims et al. (1976)
II: "I have the chance in my job to get to know other people."	3.84	1.16	7930	1.08	
III: "I have the opportunity to meet with others in my work."	3.61	1.19	7953	1.37	
<i>General Health (N = 7901, T2)</i>					
"When indicating the best conceivable health condition with 10 points and the worst with 0 points: How would you assess your current health condition?"	7.88	1.81	7901	-	Adapted from Tuomi, et al. (1998)

Note. Means, SDs, and Loadings of items shown for Confirmatory Factor Analyses in the unimputed, original data set with listwise deletion as commands *mi impute* and *sem* are not jointly available in Stata. All items were measured on a 5-point Likert scale with 1 (completely disagree) to 5 (completely agree), except the General Health item, which is measured on a 11-point Likert like scale with 0 (worst possible) to 10 (best possible). All loadings (coefficients) are significant with $p < .01$.

Technological Insecurity. We measured technological insecurity with a scale developed by Tarafdar et al. (2007), including the following items: "I feel constant threat to my job

security due to new technologies”, “I have to constantly update my skills to avoid being replaced”, “I am threatened by coworkers with newer technology skills”, and “I do not share my knowledge with my coworkers for fear of being replaced”. Among others, Raghu-Nathan et al. (2008) validated that the items load on one single factor. Later, Chen (2015) validated the scale in a Chinese context concluding that this measure offers solid ground to further investigate technological stress in a global perspective. We excluded one item from the original five-item scale to shorten the survey.

Organizational Support for Strengths Use. We measured an individuals’ perception about the organizational support for strengths use with a scale developed by Keenan and Mostert (2013). To reduce the burden for the respondents, we excluded 4 items from the original eight-item scale, resulting in the following items: “My organization gives me the opportunity to do what I am good at”, “My organization allows me to use my talents”; “My organization ensures that my strengths are aligned with my job tasks“, and “My organization allows me to do my job in a manner that best suits my strong points”.

Friendship Opportunities. We used three items from the Friendship Opportunity scale validated by Sims et al. (1976) and later adapted and included in the Social Support Scale as part of the The Work Design Questionnaire (WDQ) (Morgeson & Humphrey, 2006; adapted from Sims et al., 1976). The questionnaire was modeled to capture work characteristics for research purposes. Specifically, survey participants were asked about their perception to which extent they think to have the opportunities to establish friendships and receive social contact with others in their workplace. The items used are as follows: “I have the opportunity to develop close friendships in my job”, “I have the chance in my job to get to know other people”, and “I have the opportunity to meet with others in my work.”.

3.3.3 Construct Validity and Measurement Model Comparison

The original latent constructs have been adapted to the German context, which requires respective construct validity testing (Hinkin, 1998). Hence, we statistically tested the validity of the three constructs with both Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA).

First, EFA has been conducted. Table 3.2 summarizes the EFA factor loadings and interitem correlations. Accordingly, the results show high internal consistency reliability for the three measures in this study. All measurement items consistently load on one single factor with no major intercorrelations between factors. The Eigenvalues of the

three factors are higher than 1 (Kaiser criterion), and all factor loadings are surpassing .40 and thus are judged as meaningful (Ford et al., 1986). Further, the interitem correlations show that the items correlate more strongly with items from the same domain compared to items from another domain. The Kaiser-Meyer-Olkin measure for sampling adequacy shows an overall value of .83 with all items being higher than .73, indicating that the items were adequate for EFA (Tabachnick et al., 2007). Further, every single factor shows high internal consistency reliability based on Cronbach's alpha (Price, 1997). Thus, coefficients are .91, .77, and .72 for the factors technological insecurity, organizational support for strengths use and friendship opportunities, respectively, with no value being below the threshold of .70 (Hinkin, 1998). Therefore, the study variables are rated as showing high internal consistency reliability for the study context at hand.

Second, the three latent constructs are validated by executing individual CFA, to test the model fit of the individual latent constructs (see Table 3.3). Results indicate good model fit for technological insecurity ($\chi^2 = 39.55$; $df = 2$; Comparative Fit index [CFI] = .97, Tucker-Lewis Index [TLI] = .99, root mean square error of approximation [RMSEA] = .05) and organizational support for strengths use ($\chi^2 = 30.34$, $df = 2$, CFI = 1.00, TLI = 1.00, RMSEA = .04). Fit indices for friendship opportunities were not able to be estimated, as the model is statistically perfectly identified ($df = 0$). Overall, the computed fit statistics indicate good fit to the data.

Last, joint CFA with items from all latent constructs was conducted for measurement model comparison (for test results see Table 3.4). Results showed that a three-factor model with technological insecurity, organizational support for strength use and friendship opportunities loading on three separate factors ($\chi^2 = 562.41$; $df = 41$; CFI = .99, TLI = .98, RMSEA = .04) fits significantly better to the data than a two-factor model with organizational support for strengths use and friendship opportunities loading on one factor and technological insecurity on a second factor ($\Delta\chi^2 = 3730.91$, $df = 2$, $p < .001$, CFI = .89, TLI = .86, RMSEA = .11), as well as a model with all three constructs loading on one single factor ($\Delta\chi^2 = 12622.76$, $df = 3$, $p < .001$, CFI = .65, TLI = .57, RMSEA = .19).

Overall, the combined results from EFA and CFA indicate high construct validity of the latent constructs under investigation. Based on those results, we assume that the applied transfer to the German context was appropriate. Thus, the constructs were used as described.

Table 3.2: Exploratory Factor Loadings and Interitem Correlations of the Studied Latent Constructs

Nr	Items	Factor Loadings			Interitem Correlations									
		F1	F2	F3	1	2	3	4	5	6	7	8	9	10
1	Technological insecurity I	.71												
2	Technological insecurity II	.55			.41**									
3	Technological insecurity III	.81			.57**	.44**								
4	Technological insecurity IV	.70			.50**	.35**	.57**							
5	Org. strengths use support I		.87		-.12**	.02	-.07**	-.06**						
6	Org. strengths use support II		.85		-.09**	.06**	-.03**	-.02	.76**					
7	Org. strengths use support III		.86		-.09**	.03**	-.05**	-.04**	.73**	.72**				
8	Org. strengths use support IV		.85		-.10**	.04**	-.05**	-.05**	.74**	.73**	.74**			
9	Friendship opportunities I			.57	.01	.01	.01	.02	.26**	.28**	.25**	.26**		
10	Friendship opportunities II			.63	-.11**	-.04**	-.09**	-.09**	.24**	.25**	.22**	.23**	.39**	
11	Friendship opportunities III			.82	-.08**	.04**	-.04**	-.06**	.26**	.27**	.23**	.26**	.48**	.52**

Note. Factor loadings based on Exploratory Factor Analysis using maximum likelihood estimation with oblique quartimin rotation. Factor loadings with $p < .15$ are not shown for clarity purposes. Interitem correlations based on unimputed data. * $p < .05$, ** $p < .01$.

Table 3.3: Summary of Results From Individual Confirmatory Factor Analysis (CFA) Construct Validation

Nr	Latent Constructs	N	χ^2	df	AIC	BIC	CFI	TLI	RMSEA
1	Technological insecurity	8019	39.55**	2	81593.59	81677.46	.97	.99	.05
2	Org. strength use support	8017	30.34**	2	69561.03	69644.67	1.00	1.00	.04
3	Friendship opportunities	8012	0	0	68857.32	68919.99	.00	1.00	1.00

Note. Model results calculated with maximum likelihood with missing values (mlmv) option. Replication with listwise deletion (sample size as shown in Table 3.1) does not substantially bias estimation results. For listwise deletion, SRMR < .05 in all cases. No model results available for Friendship opportunities, as the model is perfectly identified (df = 0). N = mlmv sample size; χ^2 = Model chi-square; df = Degrees of freedom; AIC = Akaike information criterion; BIC = Bayesian information criterion; CFI = comparative fit index; RMSEA = root mean square error of approximation; * $p < .05$, ** $p < .01$.

Table 3.4: Summary of Results From Joint Confirmatory Factor Analyses (CFA) Measurement Model Comparison

Nr	CFA Model	$\Delta\chi^2$	Δdf	χ^2	df	AIC	BIC	CFI	TLI	RMSEA	90% CI
1	One-Factor Model	12622.76**	3	13185.17	44	233971.35	234202.01	.65	.57	.19	n.a.
2	Two-Factor Model	3730.91**	2	4293.31	43	225081.50	225319.14	.89	.86	.11	.108-.114
3	Three-Factor Model	-	-	562.41	41	221354.59	221606.21	.99	.98	.04	.037-.043

Note. $N = 8'019$. Models calculated using maximum likelihood with missing values (mlmv) option. $\Delta\chi^2$ = Model chi-square difference; Δdf = Degrees of freedom difference (respective difference between three-factor model and compared model); χ^2 = Model chi-square; df = Degrees of freedom; AIC = Akaike information criterion; BIC = Bayesian information criterion; CFI = comparative fit index; RMSEA = root mean square error of approximation; CI = confidence interval; * $p < .05$, ** $p < .01$.

General Health. It was captured by using a single-item measure, generated based on the WAI (i.e., Work Ability Index) first item (i.e., current work ability compared with best) (Tuomi et al., 1998). We asked participants to indicate their current (general) health when being compared to the best possible. The item used was “When indicating the best conceivable health condition with 10 points and the worst with 0 points: How would you assess your current health condition?”. Answers were provided on a 11-point Likert type scale, ranging from 0 (*worst possible*) to 10 (*best possible*). Opposed to all other study variables, data for general health was used from the second study wave to reduce single source bias. The average health status was 7.84 ($SD = 2.03$).

We chose to assess perceived general health using self-reported measures that can provide more accurate health information compared to objectively verifiable health indicators (Burr et al., 2013; de Witte et al., 2016; Wurm et al. 2008). For instance, objective indicators (e.g., cortisol levels) might be misleading because they are a highly isolated health measure and deviations between individuals can likely occur due to genetic differences; thus, they might not be detrimental for ones’ health.

Further, we decided to use a single-item measure because when collecting a vast amount of data across several time points, it is crucial to minimize the burden on respondents which has shown to have negative effects on response rates (Fisher et al., 2015). Alternative multiple-item measures commonly contain many items (e.g., SF-36 scale, see Ware & Gandek, 1998; World Health Organization, 2010) that are very time-consuming to complete and thus result in higher attrition.

In addition, Fisher et al. (2015) pointed out that multiple-item measures within occupational health psychology often omit construct-relevant items and maintain construct-irrelevant ones. This is particularly relevant when “the survey is administered to a wide range of different populations” (Petrescu, 2013, p.113), as item relevance may vary. Due to the high interpretability, face validity, and general lack of repetition of single-item measures (Metz et al., 2007), “they allow testing more holistic or thorough models of relations among constructs” (Fisher et al., 2015, p. 3). This led to the recommendation to assess health using more general single-item measures (Fisher et al., 2015).

Accordingly, in the field of “occupational health psychology [...] single-item measures have attained a degree of respectability [...] [especially when assessing] overall self-rated health” (Fisher et al., 2015, p.4). Ensuring high validity and not overloading respondents who might eventually drop out, single-item measures are

commonly used to assess general health in population-representative surveys (Burr et al., 2013). Hence, we regard the use of our selected measure as appropriate for this study.

Control variables. We included disability status (0 = no; 1 = yes) as control variable, because having a disability by definition directly affects the current health assessment compared to one's best conceivable health condition. Therefore, not incorporating disability status might strongly bias the observed effects on a perceived health outcome (McDowell, 2006; Røysamb et al., 2003). In similar vein, we also account for a sporty or healthy lifestyle by using the average hours of workouts per week as a proxy. Physical activity has shown to be a strong predictor of physical and mental health (Bize et al., 2007; Haskell et al., 2007). Furthermore, the official working hours per week (by contract, in hours) were measured as a proxy of the degree of how much people interact within their work environment. This control captures potential work overload issues and the relevance (and impact) of work (demands) on employees' health ratings (McDowell, 2006; Sluiter et al., 2003). Being exposed to demanding work conditions for a prolonged period of time, employees are more likely to suffer from negative health effects caused by these conditions. Unobservable work-related factors will influence general assessments about life more when spending more time at work.

In addition, based on the sample structure, having participants from many different companies and occupational backgrounds, which is known to have an effect in study designs due to self-selection bias (Antonakis et al., 2010), we also account for those effects. In doing so, we incorporated the operating sector (branch) of the company the participants work for (*i.e.*, 22 categories that cluster the German industry sectors from "Banking, insurance, real estate" to "Government, administration, public services") and the type of occupation the participants perform in their respective company (*i.e.*, 14 categories ranging from "Occupations in business management" to "Occupations in cleaning services"; KldB, 2010) as control variables. We also control for the respective job position of the participants (*i.e.*, 11 categories ranging from different types of self-employment (freelancers, self-employed, etc.), lower-tier to higher-tier employees and civil servants, and several categories of blue-collar workers). Additionally, gender (0 = female; 1 = male), age (in years), organizational tenure (in years) and educational level (*i.e.*, six categories ranging from "still in education or training" to "university degree") are incorporated.

3.3.4 Analysis

To analyze the superior effect of a three-way interaction model, we conducted hierarchical moderated multiple regressions (HMMR) with a time-lagged dependent variable using Stata 15 (StataCorp., 2017). For each latent independent construct in the analysis, a single-indicator factor score was obtained after confirmatory factor analysis within every single imputed dataset. Furthermore, we grand-mean centered all continuous control variables after imputation. Categorical controls were included as dummies. Interaction terms to test for moderating effects were computed by using factor variables of the respective factor scores involved within regression. All models with full data were estimated by using Stata's *mi estimate* command. Hence, Model 1 contains solely the control variables. In Model 2, the main effects of the three independent variables were added to test Hypothesis 1. Following the hierarchical structure, model 3 additionally included the moderation term of technological insecurity and organizational strengths use support to test Hypothesis 2. To test Hypothesis 3, Model 4 included the interaction of technological insecurity and friendship opportunities. Model 5 incorporated the interaction of organizational strength use support and friendship opportunities. Finally, Model 6 incorporated the three-way interaction term to test Hypothesis 4. With multiply imputed data it is not possible to perform incremental F tests of the R^2 changes to test nested models against each other. Therefore, in order to compare the different (nested) models several joint tests by using Stata's *mi test* command were conducted – following the null hypothesis that coefficients on several variables are simultaneously equal to zero (StataCorp., 2017). Finally, we performed a simple slope analysis of the interaction effects one standard deviation above and below the mean of the interacting variables⁷ to illustrate the interaction effects (Aiken & West, 1991). To further illustrate the nature of the three-way interaction, we also followed the approach recommended by Dawson and Richter (2006) for comparing the corresponding slopes amongst each other.⁸

⁷ Standard Deviations of extracted factor scores above and below zero mean: Technological insecurity (.98), organizational support for strength use (.94) and friendship opportunities (.94).

⁸ No observations with 'impossible' values or 'response patterns' were identified in the survey. Also, no responses were able to be classified as outliers due to 'extreme' values. The latter is mainly because of the use of Likert scales for the measurement of the main study variables. Yet, applying the common SD-method ($3\text{-SDs} \pm \text{variable mean}$) for all continuous and Likert-scale variables prior to imputation as a robustness check did not lead to substantially different estimation results. Therefore, we assume that our analysis is not substantially biased due to outliers.

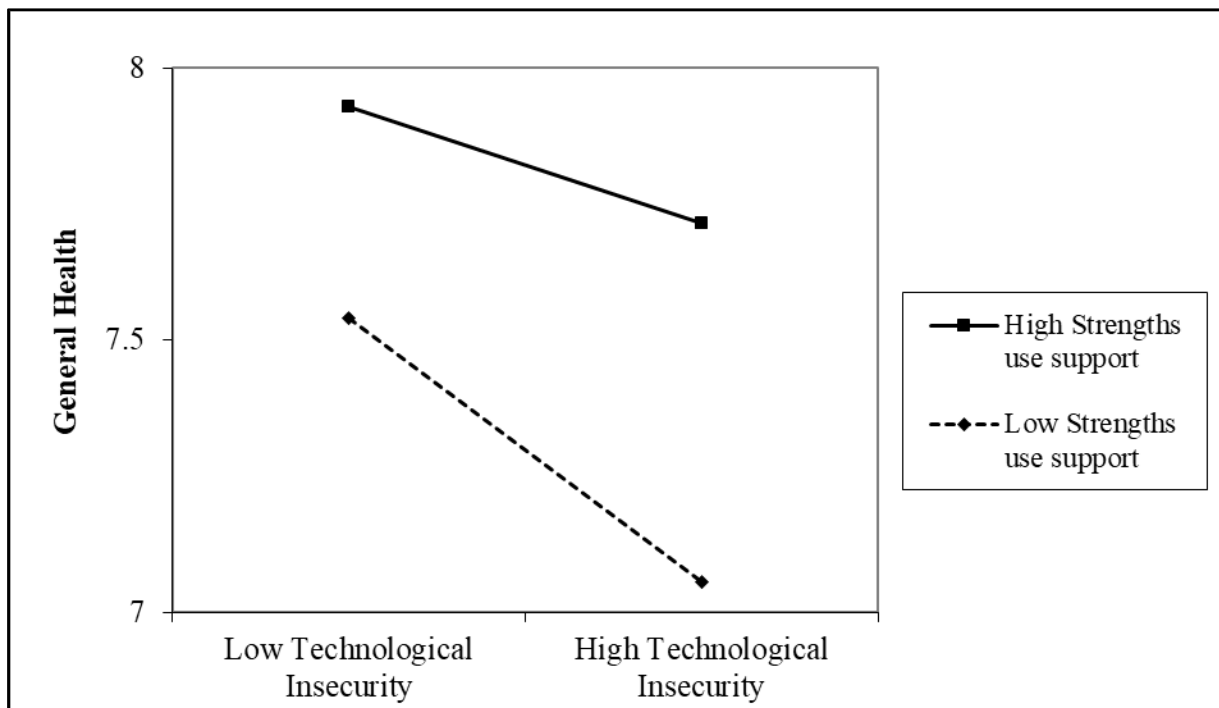
3.4 Results

Table 5 shows the means, standard deviations and the correlations among the study variables. Herein, correlation coefficients were all in the expected direction.

Additionally, results of the conducted hierarchical regression analysis are reported in Table 6. Supporting Hypothesis 1, Model 2 shows a significant direct and negative effect of technological insecurity assessed at time 1 on general health assessed at time 2 ($B = -.27, p < .001; F = 81.47, df = 3, p < .01$).

In support for Hypothesis 2, Model 3 shows the results of general health at time 2 regressed on the interaction term for technological insecurity and organizational support for strength use in time 1, thus indicating a positive relation ($B = .12, p < .01; F = 9.94, df = 1, p < .01$; cf. Figure 3.2). Simple slope tests indicated significant slopes for both employees with low support for strength use ($B = -.38, SE = .05, p < .01$) and the respective high-level condition ($B = -.17, SE = .05, p < .01$). This supports our hypothesis that higher levels of strengths use support buffer the negative effect of technological insecurity on general health over and above all controls.

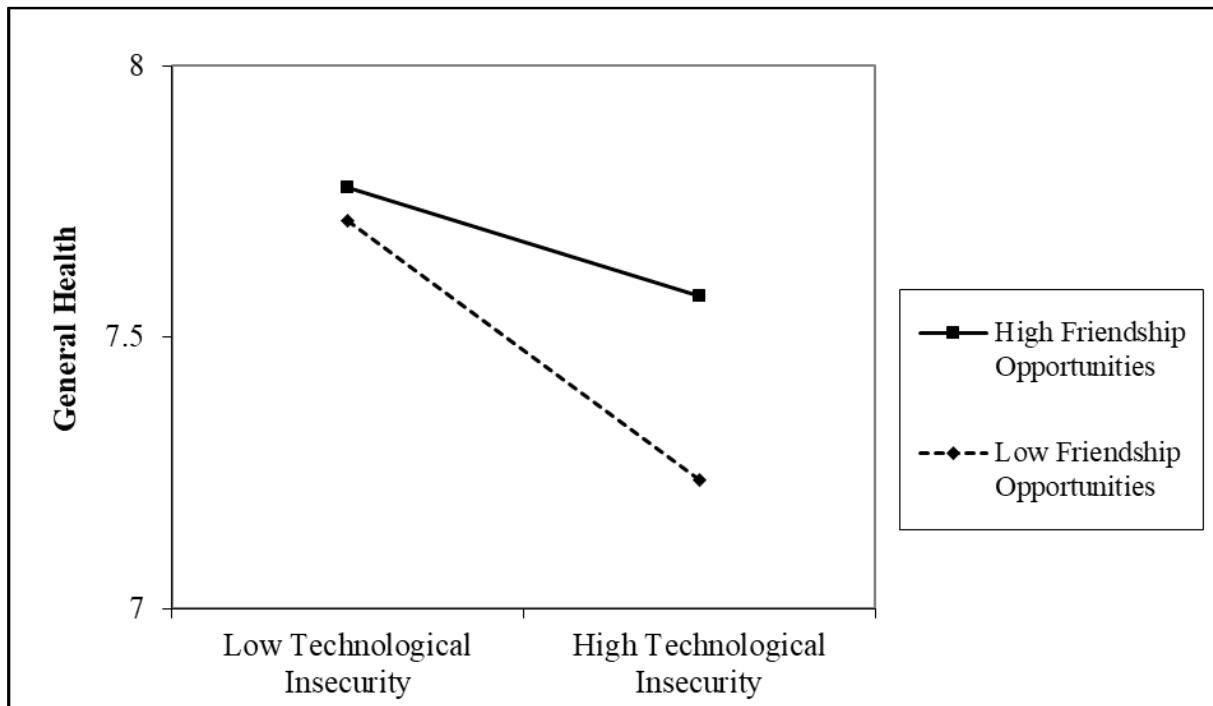
Figure 3.2: Plot of the Two-Way Interaction Effect of Technological Insecurity and Organizational Support for Strengths Use on General Health



In a similar vein, Model 4 shows the interaction effect of technological insecurity and friendship opportunities at time 1 to be positively related to general health at time 2 (B

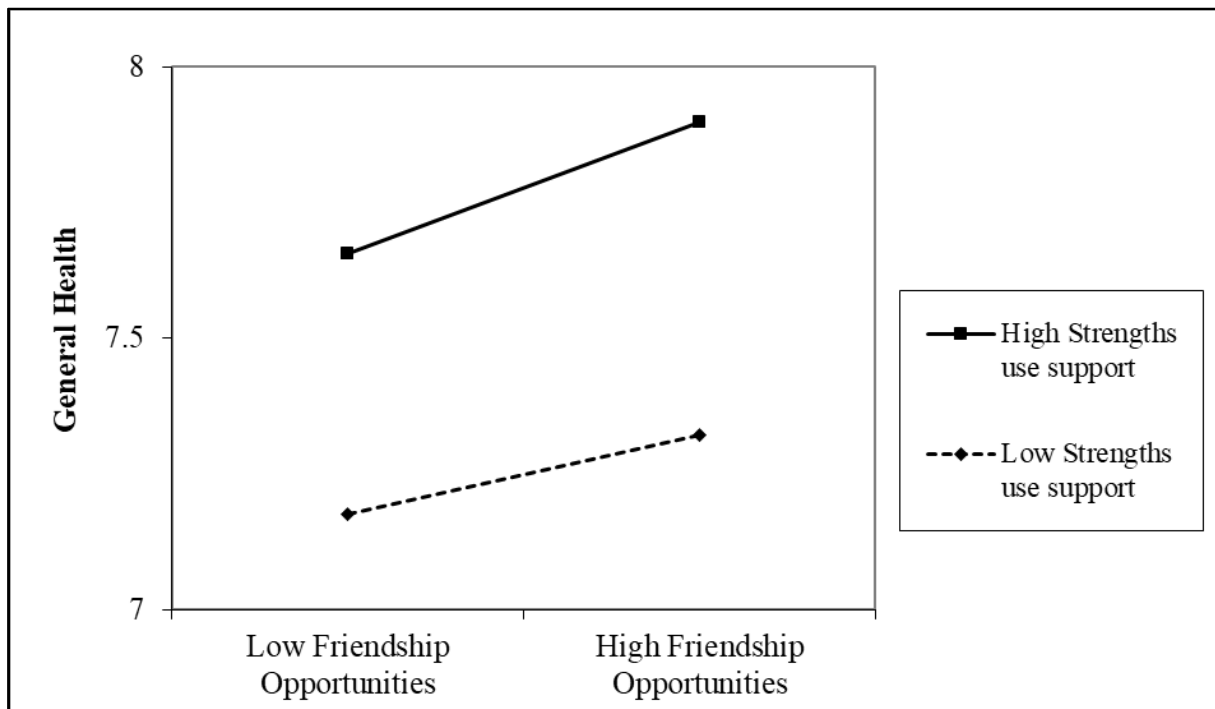
$= .18, p < .01; F = 9.94, df = 1, p < .01$; cf. Figure 3.3). Simple slope tests indicate that the relationship is significant for both low levels ($B = -.38, SE = .05, p < .01$) and high levels ($B = -.16, SE = .05, p < .01$) of friendship opportunities in the workplace, indicating that the negative relationship of technological insecurity on general health is stable under low and high conditions of friendship opportunities, but will be buffered more when friendship opportunities are high. Therefore, Hypothesis 3 found support.

Figure 3.3: Plot of the Two-Way Interaction Effect of Technological Insecurity and Friendship Opportunities on General Health



Furthermore, Model 5 shows that the combination of both job resources at time 1, strengths use support and friendship opportunities per se, in absence of the stressful job condition technological insecurity, does not have a buffering effect on general health at time 2 beyond the simple direct effects caused by the individual resources ($B = .05, p > .05; F = 1.45, df = 1, p > .05$; cf. Figure 3.4).

Figure 3.4: Plot of the Two-Way Interaction Effect of Organizational Support for Strength Use and Friendship Opportunities on General Health



To test hypothesis 4, model 6 shows a significant three-way interaction in the expected direction ($B = .14$, $p < .01$; $F = 5.42$, $df = 4$, $p < .01$; cf. Figure 3.5). Simple slopes indicate that solely the slope for high organizational support for strength use (I) and high friendship opportunities (II) was not significant ($I\uparrow II\uparrow$: $B = -.06$, $SE = .06$, $p > .05$), while all other slopes are significant ($I\downarrow II\downarrow$: $B = -.42$, $SE = .06$, $p < .01$; $I\uparrow II\downarrow$: $B = -.37$, $SE = .09$, $p < .01$; $I\downarrow II\uparrow$: $B = -.40$, $SE = .10$, $p < .01$, respectively). This means that technological insecurity at time 1 is not negatively related to general health at time 2 under the condition of high organizational support for strength use and high friendship opportunities in the workplace – supporting the thesis of a strong buffering effect, occurring as a total ruling out effect, of organizational job resources when establishing both in high conditions. Additionally, by comparing the three-way interaction slopes among each other (Dawson & Richter, 2006), results show the slope with high organizational strength use support and high friendship opportunities to be significantly different from all other slopes ($p < .01$ w.r.t. all other slopes). Also, all other slopes do not differ significantly from each other ($p > .05$ in all other cases). This result is an additional indication of the superior amelioration effect of the resources organizational support for strength use and friendship opportunities on the technological insecurity – general health link, when being present in high levels.

Figure 3.5: Plot of the Three-Way Interaction Effect of Technological Insecurity, Organizational Support for Strengths Use, and Friendship Opportunities on General Health

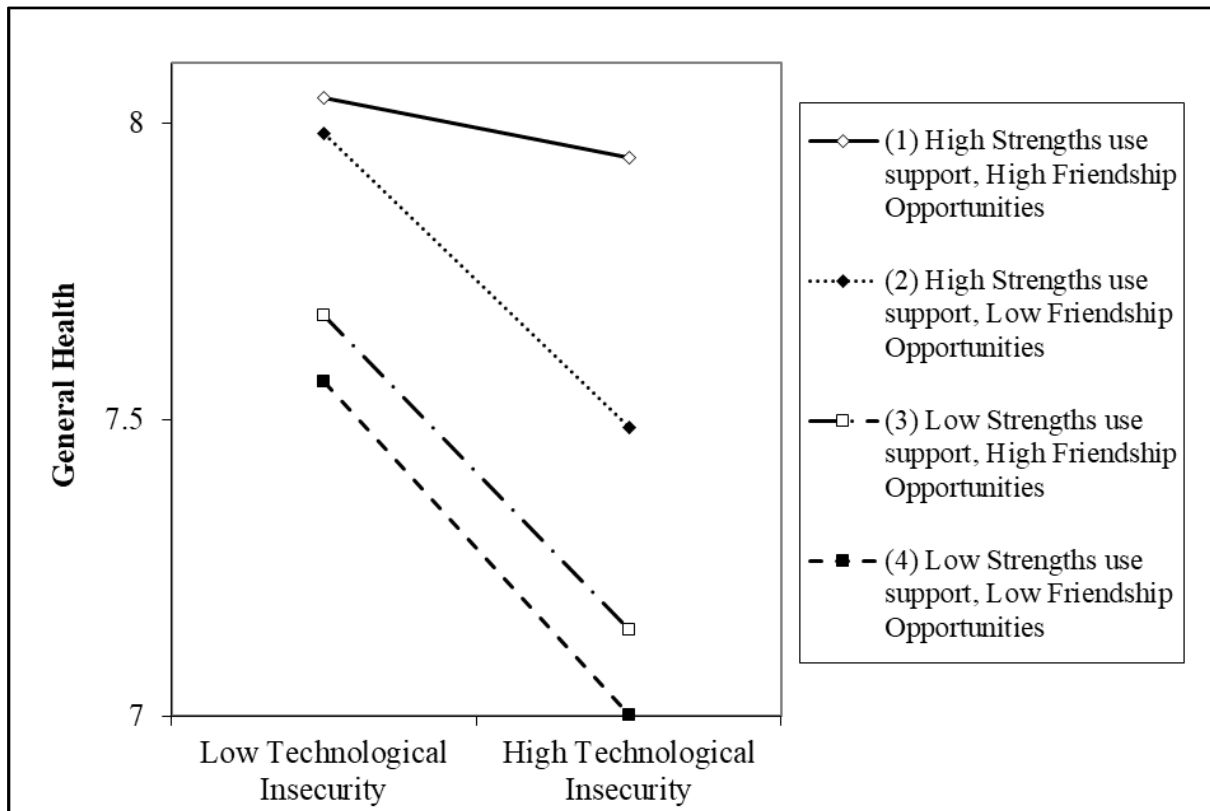


Table 3.5: Means, Standard Deviations, and Correlations between the Study Variables

Nr	Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Gender (0 = <i>female</i> , 1 = <i>male</i>)	.51	.50													
2	Age (in years)	44.3	11.4	.12**												
3	Disability status (0 = <i>no</i> , 1 = <i>yes</i>)	0.12	0.32	.04**	.16**											
4	Educational level ^a	4.75	1.00	-.05**	-.10**	-.11**										
5	Official working hours per week	35.1	8.99	.33**	-.09**	-.05**	.11**									
6	Organizational tenure	11.4	10.3	.15**	-.46**	.10**	-.06**	.10**								
7	Sport hours per week ^b	-	-	-	-	-	-	-	-							
8	Job position ^b	-	-	-	-	-	-	-	-	-						
9	Occupation segment ^b	-	-	-	-	-	-	-	-	-	-					
10	Company operating sector ^b	-	-	-	-	-	-	-	-	-	-	-				
11	Technological insecurity ^c	1.80	0.98	.07**	-.14**	.03**	-.00	.07**	-.03*	-	-	-	-			
12	Org. strengths use support ^c	3.62	0.94	.06**	.05**	-.06**	.09**	.02	-.01	-	-	-	-	-.10**		
13	Friendship opportunities ^c	3.51	0.94	.06**	-.03*	-.06**	.11**	.07**	.01	-	-	-	-	-.11**	-.48**	
14	General health (T2)	7.84	2.03	.01	-.08**	-.26**	.13**	.04*	-.03*	-	-	-	-	-.10**	-.20**	-.16**

Note. $N = 8'019$. Results based on multiply imputed data. Correlations calculated as regression coefficient in a bivariate regression (*mi estimate: regress*) by using standardized variable forms for both independent and dependent variable, respectively.

^a Although educational level is operationalized as categorical variable, the categories follow an internal order. Therefore, an aggregated value and its correlations offer some valuable information and thus, is shown.

^b Correlations with aggregated categorical variables (with no internal order) are not interpretable and therefore not executed.

^c For descriptive purposes, the means and standard deviations derived from an aggregated construct (index) consisting of all respective indicator variables (without centering).

* $p < .05$, ** $p < .01$

Table 3.6: Hierarchical Moderated Regression Analysis Predicting General Health Perception From the Interactions Among Technological Insecurity, Organizational Support for Strength Use, and Friendship Opportunities

Variables (T1)	General Health (T2)											
	1		2		3		4		5		6	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Constant	7.75**	.95	7.53**	.95	7.58**	.96	7.58**	.95	7.52**	.95	7.60**	.96
Gender (0 = <i>female</i> , 1 = <i>male</i>)	.06	.05	.05	.05	.05	.05	.05	.05	.05	.05	.06	.05
Age (in years)	-.00	.00	-.01**	.00	-.01**	.00	-.01**	.00	-.01**	.00	-.01**	.00
Disability status (0 = <i>no</i> , 1 = <i>yes</i>)	-1.41**	.08	-1.33**	.08	-1.33**	.08	-1.33**	.08	-1.33**	.08	-1.33**	.08
Working hours per week	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Organizational tenure	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Educational level	c	c	c	c	c	c	c	c	c	c	c	c
Sport hours per week	c	c	c	c	c	c	c	c	c	c	c	c
Job position	c	c	c	c	c	c	c	c	c	c	c	c
Occupational segment	c	c	c	c	c	c	c	c	c	c	c	c
Companies' operating sector	c	c	c	c	c	c	c	c	c	c	c	c
Technological insecurity (X)			-.27**	.04	-.27**	.04	-.27**	.04	-.27**	.04	-.31**	.04
Org. strength use support (M1)			.30**	.03	.30**	.03	.30**	.03	.31**	.03	.31**	.03
Friendship opportunities (M2)			.15**	.05	.15**	.05	.16**	.05	.16**	.04	.16**	.05
X × M1					.12**	.04					.11*	.05
X × M2							.18**	.05			.13*	.06
M1 × M2									.05	.04	.07	.04
X × M1 × M2											.14**	.05
F-value ^a	11.84**		81.47**		9.94**		10.73**		1.45		6.46** ^b	
R ² (Fisher-z)	.125		.164		.166		.166		.164		.168	

Note. $N = 8'019$. Reported values for each model are estimates of the effect, comparable to unstandardized regression coefficients in standard multiple regression. Results based on multiply imputed data with robust standard errors. Using sample weights and/or excluding the control variables does not lead to substantially different results. ^a Comparisons of nested models was conducted by joint tests of coefficients (*mi test*) – the respective F-values are shown. All coefficients of the first model, except gender, were jointly restricted to be 0, in order to compared the first model to an empty model, with gender as only predictor ($df = 62$). Similar, we compared Model 1 with Model 2: $df = 3$, Model 2 with Model 3: $df = 1$, Model 2 with Model 4: $df = 1$, Model 2 with Model 5: $df = 1$, and Model 2 with Model 6: $df = 4$. ^b Secondly, Model 6 was compared with Model 3 ($F = 4.74, p < .01, df = 3$), Model 4 ($F = 4.65, p < .01, df = 3$), and Model 5 ($F = 8.27, p < .01, df = 3$). ^c Categorical variables were included as dummies within regression. For reasons of clarity, results for those categorical controls are excluded in results table. * $p < .05$, ** $p < .01$.

3.5 Discussion

The results from the time-lagged regression analysis indicate that perceptions of technological insecurity influences employees' perceived health over time. Specifically, we observe that the perceptions of technological insecurity negatively affect employees' health perception nine months later. Furthermore, we find this relationship to become weaker when employees perceive to be supported by the organization in using their individual strengths in the workplace and/or their work enables them to build friendships. When employees perceive those two aspects to be highly present, we no longer find a time-lagged effect of technological insecurity on ones' general health perception. The examined relationships are derived and in line with COR theory, one of the dominant theories in psychological stress literature to theorize individual stress.

More theoretically, the study shows that the impact of technostress creators (e.g., technological insecurity) on individuals is context specific. Even more, derived from COR theory it is the first study to show that non-technology-related organizational resources (organizational support for strength use $\times$ friendship opportunities) play a crucial role in determining the extent to which individuals are affected by ICTs. Thus, adapting organizational resources may act as a buffering strategy to deal with rising technological insecurity concerns in the digital era. Although there is research about the negative effects and consequences of technostress (Ayyagari et al., 2011; Ragu-Nathan et al., 2008; Srivastava et al., 2015), previous research still lacks on strategies on how to effectively and adequately cope with those new forms of stress from a non-technology-related organizational environment perspective. Hence, the findings at hand are particularly important because they provide initial support for the high value of this research direction.

Moreover, our results indicate that applying established theories from other disciplines in the context of IS research is valuable. More specifically, relying on COR theory (Hobfoll, 2001, 2011) from psychological stress literature to analyze the effects of technostress constructs on individuals allows to uncover more complex relationships. Doing so, the study provides initial support for the emphasis of Tarafdar et al. (2017), who claimed the need for IS literature to combine research of technostress (constructs) with non-IS research on (psychological) stress and organizational behavior. This enables to gain valuable theoretical insights on how to cope with uprising stressor(s) in times of inevitable technological change.

By using structural weights, we draw on representative data for approximately 33.3 million employees in Germany, being of full age and having access to internet-enabled ICTs. This strengthens both the internal and external validity of the results.

3.5.1 Limitations and Future Research

Despite methodological strengths such as high statistical power, representative data, time-lagged data, and the related absence of single-source bias (Podsakoff et al., 2003), this study still has certain methodological limitations. First, the study is cross-sectional in nature, which leads to associated limitations with regard to causality. For example, low perceptions of one's general health might be the reason rather than the consequence of high technological insecurity. Although generating the amount and quality of data at hand is time and cost-intensive, we encourage future studies to focus on longitudinal study designs to enable causal interpretations.

Second, our study provides findings based on a study sample representative for respective employees in Germany. This makes the generalizability to employees in other countries questionable. Replication studies with data from other countries are thus encouraged to validate the study results.

Third, study data is generated via surveys conducted by a market research institute. As common practice, by using participants being pre-registered in the institutes' survey panels, we cannot rule out self-selection bias of the people tending to participate in those surveys regularly. The development of data generation procedures, able to minimize self-selection bias, is encouraged.

Fourth, although the use of self-reported single-item measures of perceived health is regarded as adequate for the study at hand, we acknowledge that the use of other measures might lead to slightly different results. Thereof, with rising statistical computation possibilities we also encourage to examine relationships jointly from different health perspectives, i.e., by using both subjective and objective measures (e.g., cortisol levels) or the use of more holistic measures of health, i.e., full workability index (Tuomi et al., 1998).

At last, by providing initial support for both the relevance of theories outside the IS research stream and the context-specificity of technostress effects (i.e., technological insecurity), we strongly encourage future scholars to further integrate existing theories in IS literature.

3.5.2 Practical Implications

By showing strong indication for an accumulative buffering effect of organizational resources, the study at hand provides a clear toolbox for reducing the impact of highly stressful conditions on employees' health perceptions in times of technological change. Our findings suggest that organizational support for strength use and friendship opportunities are of high value for employees to cope with technological insecurity perceptions.

According to those findings, strengths use support can be established by providing training for employees and supervisors that focus on the superior positive effects to use individual strengths at work rather than compensating deficits. Additionally, organizations may introduce platforms for employees to mention their personal interests and strengths. This may facilitate their integration in future decisions by the supervisor. With regard to friendship opportunities, organizations may increase the possibilities for employees to participate in activities with their colleagues by offering teambuilding events or organizational wide festivities. Also, it may be advisable to increase work and break flexibility. This may enhance the opportunities for employees to interact with colleagues they want to while not being restricted to formal work conditions (e.g., flexible working times, flexible break sequences). Further, sophisticated public socialization zones, such as cafés, in which employees may have private conversations amongst each other during breaks may increase the likelihood to build up social ties. Doing so may facilitate friendship opportunities in the workplace.

To bring both components together, possibilities in which employees can communicate their personal interests and strengths with their direct colleagues may be valuable. Colleagues can profit from this knowledge when being confronted with difficult tasks. In the future they know whom to ask for support. On the one hand this may lead to increased feelings of individual value and socialization of the supporter due to its requested personal strengths. On the other hand, it may cause decreased stress levels for the colleagues who received the requested support. Overall, our results suggest that adapting the organizational environment may reduce the impact of ICT-related psychological stress, and thus, contribute to employee health in times of enhanced digitization.

4 Effect Direction between Work-Family Conflict and Psychological Strain: A Replication and Extension Study

- Authors:** Goetz, T. M., Brzykcy, A. Z., & Boehm, S. A.
- My responsibilities:** Responsible for the paper coordination between the authors, conceptual development, first paper draft, the statistical computation, and contributed to the introduction and discussion of results.
- Presentations** This paper was presented virtually at the 80th Annual Meeting of the Academy of Management in Vancouver, Canada, from August 7th-11th, 2020.⁹ It was also accepted for a presentation at the Annual Meeting of the HR Division of the German Academic Association for Business Research in Düsseldorf, September 2020.
- Current Status:** An updated paper version is being prepared for a journal submission.

Abstract

Research on the relationship between work-family conflict (WFC) and employee health (i.e., psychological strain) provides largely inconsistent results about the direction of this effect. To identify a source of this variation, we review modeling approaches used in 15 studies derived from the only meta-analytical test of the direction of this effect (Nohe et al., 2015), and 51 newer studies not yet included in this test. We find that none of these studies accounts for the confounding effect of unmeasured, trait-like between-person differences, for example, by adding random intercepts (RIs) to the structural model. Instead, they apply approaches that combine the within-person variance and the between-person variance (e.g., Crossed-Lagged Panel Model, CLPM), thereby leading

⁹ Goetz, T. M., Brzykcy, A., & Boehm, S. A. (2020). Effect Direction Between Work-Family Conflict and Psychological Strain: A Replication and Extension. In *Academy of Management Proceedings* (Vol. 2020, No. 1: 19321). Briarcliff Manor, NY 10510: Academy of Management.

to biased effect estimates. Recent methodological reviews have thus urged scholars to apply the RI-CLPM to solve this problem. Following these calls, our study replicates and extends prior research by modeling the effect of interest using the CLPM and the RI-CLPM. We seek to examine whether Nohe et al.'s (2015) result holds once the RI-CLPM is applied. We collected three-wave survey data from 12'241 working adults living in Germany. The data are representative of the German workforce and were collected annually from 2016 until 2018. The RI-CLPM yields a significantly better model fit than the CLPM. Whereas the results from our CLPM replicate the meta-analytical finding (i.e., WFC and psychological strain affect each other reciprocally), the RI-CLPM yields a different result: WFC leads to greater psychological strain and not vice versa. Implications for theory development and practice are discussed.

Keywords: cross-lagged panel model (CLPM), random intercept cross-lagged panel model (RI-CLPM), work-family conflict, emotional exhaustion, psychological strain

4.1 Introduction

Few readers will be unfamiliar with prior research relating employee conflict between work and family obligations and psychological strain.¹⁰ This topic has been the subject of a number of meta-analytical reviews of both cross-sectional and longitudinal studies (e.g., Allen et al., 2000; Eby et al., 2005; Amstad et al., 2011; Nohe et al., 2015). However, while this discourse is multi-faceted, the core question has not yet been fully addressed empirically: what is the direction of causality between work-family conflict (WFC) and psychological strain? Do these variables influence each other, or, if not, which of these variables is causally dominant?

Toward that end, Nohe et al. (2015), conducted a meta-analysis of longitudinal studies on the relationship between WFC and psychological strain. To our best knowledge, this review is the only meta-analytical test of the causal direction of this effect. More specifically, having reviewed longitudinal studies published until 2013, Nohe and colleagues (2015) have identified three potential directions of this effect. These include studies claiming to demonstrate unidirectional (i.e., WFC leads to increased psychological strain), reverse (i.e., psychological strain results in greater WFC), or

¹⁰ The latter is defined as psychological and/or physiological reactions to environmental stressors including, for example, burnout, emotional exhaustion, physical complaints (Nohe et al., 2015).

reciprocal causality (i.e., WFC and psychological strain predict one another). Moreover, some of these studies yield a non-significant longitudinal relationship between these variables. Yet, the results of meta-analytical path analyses indicate that WFC and psychological strain are reciprocally related to one another (Nohe et al., 2015).

To bring Nohe et al.'s (2015) review up to date, we have reviewed longitudinal studies that were published between 2013 (end point of Nohe et al.'s keyword search) and 2019. Similarly, our search yielded three directions of this effect (i.e., unidirectional, reverse, reciprocal), and identified further studies showing non-significant longitudinal relationship between the variables of interest (exact search procedure and results are described in detail in a later section). Moreover, going beyond Nohe et al.'s (2015) meta-analysis, our review has placed a special focus on the methodology used in prior studies of interest. These include journal articles that were included in Nohe et al.'s (2015) meta-analysis and more recent studies that were published between 2013 and 2019. Here, our goal was to summarize what data and analytical strategy have been used for making claims about the causal direction of the effect between WFC and psychological strain.

Concretely, we have sought to verify which approaches were chosen to model longitudinal (also referred to as hierarchical or multilevel) data. Here, we focus on the differentiation between modeling approaches that partial out the effect of unmeasured, time-invariant differences between study participants (e.g., IQ, personality traits), and those that do not remove this portion of variance while estimating effect parameters. Consequently, the latter approach provides effect parameters that combine two sources of variance (i.e., between-person differences, and within-persons changes over time), thereby resulting in biased effect estimates (Hamaker et al., 2015; Mund, & Nestler, 2019).

In brief, we find none of the longitudinal studies to partial out the effect of the time-invariant, trait-like between-person differences. This result is particularly troublesome given recent recommendations of how to appropriately estimate models for hierarchical data (e.g., Antonakis et al., 2019; Hamaker, 2012; Hamaker et al., 2015; Usami et al., 2019; Zyphur et al., 2020a, 2020b). As described in more detail in a later section and elsewhere (e.g., Antonakis et al., 2019; Wooldridge, 2016), studies that fail to explicitly model time-invariant between-person differences run the risk of providing biased effect estimates (Antonakis et al., 2010; 2019; Wooldridge, 2016).

Because of this limitation, the cross-lagged panel model (CLPM), a modeling approach that is widely used in applied research for studying causality in longitudinal correlational data, has been subjected to an increasingly harsh critique among methodology scholars (e.g., Antonakis et al., 2019; Hamaker et al., 2015; Zyphur et al., 2020a, 2020b). Specifically, recent simulation studies demonstrate that the inclusion of autoregressive paths in the CLPM does not fully account for the stability of variables, which in turn leads to biased crossed-lagged regression coefficients. In contrast, the random intercept cross-lagged panel model (RI-CLPM) overcomes this shortcoming through the inclusion of random intercepts (RI), thereby controlling for the stability of variables under study (i.e., both the temporal and time-invariant stability) (Antonakis et al., 2019; Hamaker et al., 2015; Usami et al., 2019). From this follows that the inconsistent results regarding the longitudinal relationship between WFC and psychological strain are in large part due to an inappropriate modeling of hierarchical data.

Thus, given that the empirical basis for Nohe et al.'s (2015) claims is entirely based on studies that fail to separate the within-person process from the trait-like between-person differences, the results of their meta-analytical path analyses are also likely to be biased. This inevitably leads to the conclusion that the question regarding the direction of the causality between WFC and psychological strain still needs further clarification.

To help fill this gap, our paper examines whether Nohe et al.'s meta-analytical finding holds once the RI-CLPM is applied. More specifically, we first conduct a replication study using three-wave survey data from a total of 12'241 observations that are representative of the German workforce. Here, our focus lies on the examination of longitudinal relationships between WFC and psychological strain (operationalized as emotional exhaustion, EE). The latter is defined as the extent to which one feels emotionally overextended and exhausted by work (Maslach et al., 1986). Second, and beyond the scope of prior research linking WFC and psychological strain, we provide results on these longitudinal relationships from both the CLPM and the RI-CLPM. Here, our goal is to explore whether, and if so, how the results obtained through these two different modelling approaches differ from one another. More specifically, given the major shortcomings of the CLPM outlined above, we consider it likely that our CLPM will replicate Nohe et al.'s (2015) findings (i.e., WFC and emotional exhaustion are reciprocally related), whereas the RI-CLPM will be more likely to yield results supporting one of the three other potential scenarios: unidirectional causality (i.e., WFC affects emotional exhaustion), reverse causality (i.e., emotional exhaustion affects WFC), or non-significant relationship over time.

4.2 Modeling Approaches: Cross-Lagged Panel Model (CLPM) Versus Random-Intercept Cross-Lagged Panel Model (RI-CLPM)

The CLPM is a modeling approach that is popular among management and applied psychology scholars for studying causality in longitudinal data. It is often used to determine which variable has a stronger causal effect on the other. For example, Eby and colleagues (2015) applied the CLPM to examine causal direction of the effect between mentoring received from supervisors and employee organizational citizenship behavior (OCB). They concluded that it is the mentoring that affects OCB, and not vice versa.

Nonetheless, whereas the CLPM enjoys a great popularity, there is a growing evidence demonstrating serious shortcomings of this modeling approach (e.g., Antonakis et al., 2019; Hamaker et al., 2015; Zyphur et al., 2020a, 2020b). These include CLPM's failure to explicitly model unmeasured, trait-like differences between persons (Antonakis et al., 2019; Hamaker et al., 2015). Thus, although the CLPM is typically considered to control for the stability of constructs through the inclusion of autoregressive paths, recent simulation studies demonstrate that this modeling approach accounts merely for the temporal stability of constructs and does not separate the within-person process from the stable between-person differences (Hamaker et al., 2015; Usami et al., 2019).

Furthermore, it is crucial to differentiate between the within-person variance and the between-person variance as they provide a fundamentally different piece of information. For instance, a meaningful construct variation at the between-person level implies that persons differ from one another in terms of their level of a variable (e.g., some persons structurally have higher WFC than others). Moreover, a significant (positive) relationship between constructs at the between-person level indicates that (higher) levels of one variable are related to (higher) levels of another variable, and vice versa. For example, a positive effect of WFC in T1 on WFC in T2 at the between-person level (also commonly referred to as autoregression) contains two information: 1) persons vary in their levels of WFC and 2) persons with high (low) WFC in T1 are likely to show similarly high (low) WFC during the subsequent point of data collection (T2).

Foremost, a significant (positive) relationship between variables at the within-person level implies that, for one respective person, a (positive) change in one variable is related to a (positive) change in the persons' other variable, and vice versa. Following the same example, a positive effect of WFC in T1 on WFC in T2 on the within-person level means

that a (positive) change in WFC in T1, around the person-specific level of WFC in T1, is related to a (positive) change in WFC in T2, around same persons level of WFC in T2. Thus, within-person relationships are over and above the effect of observed person-specific levels of the respective variables over time, and thus, unrelated to time-invariant trait-like between-person differences.

As noted, the failure to separate the between-person variance from the within-person variance has significant consequences for the estimation of the predictive validity of the variables of interest: the effect estimates obtained through the CLPM are not free of the endogeneity problem (i.e., omitted causes such as trait-like between-person differences are correlated with model predictor variables) (Antonakis et al., 2010; 2019). For example, personality traits have been shown to influence behavioral coping strategies, which, in turn, affect WFC (Baltes et al., 2011). Hence, failing to control for personality traits when examining the effect of WFC would imply an omitted variable problem and lead to biased effect estimates. In such a case, a CLPM would yield biased effect estimates as it does not partial out the effect of these time-invariant, trait-like characteristics. Here, the random effects assumption does not hold: unmodelled causes (e.g., personality traits that are part of the model error term) are correlated with model predictor variables. The effect estimates are thus biased and cannot be retained (Antonakis et al., 2019; Wooldridge, 2016).

In such a case, the results obtained through the CLPM lead scholars to draw different conclusions as they would have when the trait-like characteristics were controlled for (Hamaker et al., 2015). For example, the CLPM may 1) provide support for a significant relationship when there is none, 2) support claims for a reciprocal relationship when in reality there is an unidirectional effect, 3) identify the wrong variable as causally dominant, or 4) find a negative relation when it is in fact positive (Antonakis et al., 2019; Hamaker et al., 2015; Hoffman, & Stawski, 2009).

The RI-CLPM builds upon the CLPM. In plain terms, the CLPM is extended by adding random intercepts (RIs) that capture unmeasured, trait-like between person differences. This implies that between-person variance is explicitly modeled, that is, accounted for in the analyses. Consequently, the effect estimates obtained through the RI-CLPM are free of the unmeasured, trait-like between-person variance and should be interpreted as within-person effects (Baltes et al., 2011; Zyphur et al., 2020a, 2020b).

Thus, given that the CLPM is nested under the RI-CLPM (Hamaker et al., 2015), a comparison of these two models constitutes the test of the random effects assumption

(Antonakis et al., 2019; Wooldridge, 2016). A significant nested chi-square test (Bollen, 1989; Bryant, & Satorra, 2012) indicates that the effect estimates obtained through the CLPM differ significantly from the RI-CLPM estimates, and thus the latter should be retained. Here, the unmodeled causes such as, for example, time-invariant personality traits, are likely to be correlated with model predictor variables. On the contrary, in case the chi-square test yields a non-significant result, the RI-CLPM and CLPM effect estimates are not significantly different. Nonetheless, the RIs should be specified whenever possible as adding these to the model does not bias the effect estimates in the absence of significant trait-like between-person differences (Hamaker et al., 2015). In doing so, one ensures a consistent estimation of the effect of interest.

Taken together, prior research examining the relationship between WFC and psychological strain yielded conflicting findings, ranging from unidirectional, reciprocal or non-significant relationships. We believe that variations in the modeling approach (e.g., hierarchical time-lagged regression, CLPM) are source of these conflicting results. Specifically, past studies differ in terms of disentangling the within-person variation and the trait-like between-person differences. The CLPM, the modeling approach most frequently used in past studies, fails to partial out the effect of the trait-like differences between persons, thereby leading to biased effect estimates. In contrast, the RI-CLPM overcomes this limitation and can thus provide a stronger basis to infer the causal direction of the effect of interest. Needless to say, given the differences between these two modeling approaches, they are likely to yield different results and thus lead to different conclusions in terms of the causal dominance of the variables under study. Thus, given that prior research on the direction of the effect between WFC and psychological strain is based entirely on modeling approaches that do not account for the effect of unmeasured, trait-like between-person differences, the question rises whether Nohe et al.'s (2015) meta-analytical result would be replicated when the RI-CLPM was applied. Formally stated:

RQ: Will the meta-analytical result about the reciprocal effects between WFC and psychological strain hold once the RI-CLPM is applied?

4.3 Part I: Extended Review

4.3.1 Systematic Review of Longitudinal Studies of the Relationship between Work-Family Conflict and Psychological Strain

As noted, we have reviewed longitudinal¹¹ studies of the relationship between WFC and psychological strain with regard to data and estimation strategy they applied. This refers to studies that 1) were included in Nohe et al.'s (2015) meta-analysis, and 2) newer studies published between April 2013 (end of Nohe et al.'s keyword search) and November 2019, that were identified through the search procedure described in detail below. To ensure the comparability of the search results, we have followed the search procedure adopted by Nohe and colleagues (2015).

4.3.2 Inclusion Criteria

We have used six criteria to verify the study eligibility. First, it had to be a quantitative study published in a peer-reviewed journal. Second, it assessed WFC as a focal predictor or outcome variable. Studies that combined WFC and family-work conflict (FWC) to one score and did not report the results separately for these two constructs were excluded. Third, the study included a measure of psychological strain as a focal predictor or outcome variable (e.g., emotional exhaustion, burnout, depressive symptoms). Fourth, the study assessed the effect of interest over time using a time-lagged or longitudinal study design. That is, WFC and psychological strain were measured during at least two waves of data collection. Fifth, the study used a non-experimental study design. Sixth, there was the same referent for both measures (i.e., the same subject provided data on his/her WFC and psychological strain on at least two occasions). Finally, we examined how many of the studies included in the Nohe et al.'s (2015) meta-analysis were published until November 2019. Only articles that were published until then were included in our review.

4.3.3 Search Procedure

We conducted an electronic literature search using three databases: PsycINFO, Web of Science and PubMed. We used the same keywords for WFC and FWC as Nohe and colleagues (2015). These included: *work-family interference*, *family-work interference*,

¹¹ We are aware of the fact that studies are regarded as longitudinal when they show at least three waves of data collection. However, in line with Nohe et al. (2015), we refer to studies with two-wave data as longitudinal studies.

work-family conflict, family-work conflict, work-to-family conflict, family-to-work conflict, work-life conflict, life-work conflict, work-home interference, home-work interference, work interfering with family, family interfering with work. To restrict our search to multi-wave studies only, we have included the following keywords: *longitudinal, lagged, panel.* We searched each database for peer-reviewed journal articles. Furthermore, we sent emails via the list servers hosted by the Academy of Management (i.e., Organizational Behavior and Occupational Health Psychology) to encourage scholars to share their research on the longitudinal relationships between WFC and psychological strain. Here, we asked scholars to share forthcoming studies or studies published between April 2013 and November 2019.

Our keyword search yielded a total of 334 studies. All articles were coded by the first two authors according to the inclusion criteria outlined above. All deviating assessments were discussed. In case of uncertainty, the study was coded again by both authors. This process resulted in the total of 265 articles being excluded. The total of 66 studies (i.e., 15 articles derived from the Nohe et al.'s meta-analysis, 51 articles identified through our keyword search) were then part of a further coding procedure.

4.3.4 Coding

We have included multiple codes, such as: sample size, share of women in the study sample, country of data collection, measurement of the focal predictor or outcome variable (i.e., WFC, psychological strain), measurement scale, direction of causality (i.e., WFC affects psychological strain, psychological strain affects WFC, reciprocal relationship, non-significant relationship), sign of the effect (i.e., positive or negative), number of data collection points, duration of the time interval between the data collection points, estimation strategy, test and application of random effects, intra-class correlation, measurement invariance testing and specification, missing data treatment, estimation program.

Again, the first two authors were involved in this coding phase. The coding scheme was discussed prior to coding to ensure a mutual understanding of the codes. In case of differing coding results, the article was coded once again by both authors.

4.3.5 Features of the Analyzed Studies

As can be seen in Table 4.1, 41 of the 66 studies used self-collected data, whereas 24 studies relied on already existing data sets. We find one study to use both such data

sources. There were 17 studies with data from the United States, 32 from Europe, and 16 from elsewhere. One study did not indicate the country of data collection. The share of women varies across the study samples, ranging from 9% (study participants were police officers) to 100% (study sample consisting of female health care professionals). A total of 40 studies used two-wave survey data (i.e., data on the predictor and criterion variables were obtained at both time points) or introduced a temporal separation of the measurement of these variables (i.e., data on the predictor variables were obtained on time 1, whereas data on the outcome variable were obtained at time 2). There are 15 studies that collected data on three waves and 11 studies with four or more measurement waves.

Table 4.1: Time-Lagged and Longitudinal Studies on Work-Family Conflict and Strain

	Total	Number of waves				
		2	3	4	5	> 5
<i>Number of studies</i>	66	40	15	2	2	7
<i>Estimation: Result (Direction)^a</i>						
WFC → Strain (Directed)	24	14	6	1	1	2
Positive	21	13	4	1	1	2
Negative	5	2	2	1	0	0
WFC ← Strain (Directed)	12	6	4	0	0	2
Positive	12	6	4	0	0	1
Negative	0	0	0	0	0	0
WFC ↔ Strain (Reciprocal)	19	14	4	0	1	0
Positive	18	13	4	0	1	0
Negative	3	2	1	0	0	0
WFC ~ Strain (Unrelated)	17	11	1	1	0	4
<i>Estimation: Unidirectional</i>						
(Hierarchical) Time-lagged Regression	30	22	7	0	0	1
Fixed Effects Regression	4	0	0	1	1	2
Latent Growth Curve Modeling	2	0	0	1	0	1
<i>Estimation: Multidirectional</i>						
CLPM	25	17	7	0	0	1
RI-CLPM	0	0	0	0	0	0
<i>Other Estimations</i>	5	1	1	0	1	2
<i>Random effects (RE)</i>						
RE Specification	3	0	1	0	1	1
Test of RE Assumption	3	0	1	0	1	1
<i>Time lag in months</i>						
Mean	17	20	13	3	18	9
lag < 1	7	0	3	1	0	4
1 ≤ lag < 2	4	0	4	0	0	0
2 ≤ lag < 3	1	1	0	0	0	0
3 ≤ lag < 6	7	6	1	0	0	0
6 ≤ lag < 12	8	4	2	1	0	0
12 ≤ lag < 24	23	18	2	0	1	2
24 ≤ lag	16	11	3	0	1	1
<i>Information & Specifications</i>						
LV in Estimation	-	-	-	-	-	-
MI Testing and Specification	7	4	3	0	0	0
Intra-Class Correlations	5	0	2	0	0	3
Standard Error Specification	16	10	3	1	0	2
<i>Data Collection</i>						
Existing Data Set	25	15	3	2	1	4
Data Collection	42	26	12	0	1	3

Note. $k = 66$. Results derived from the extended literature review. ^a Sums may vary from overall number of studies as more data sets and/or several hypotheses are used in one single study. See appendices A and B for a list of studies included (A) or excluded (B) from the review.

4.3.6 Preliminary Results

In line with Nohe et al. (2015), our results yield support for three optional directions of the effect of interest: 24 studies claim that WFC affects psychological strain, 12 studies provide support for the opposite unidirectional effect (i.e., psychological strain leads to WFC and not vice versa). 19 of these studies conclude that WFC and psychological strain are in a reciprocal relationship. Furthermore, there are 17 studies that find non-significant relationship between these variables.

We find a high variation in modeling approaches across studies. More specifically, from the total of 66 studies, 30 studies applied (hierarchical) time-lagged regression analyses, 25 applied the CLPM, and 11 studies applied other estimation approaches. The latter includes, for example, Generalized Estimating Equations Time-Lag Model or Multivariate Analyses of Variance (refer to Table 4.1 for a detailed overview of all modeling approaches applied).

4.3.7 Preliminary Discussion

None of the studies included in our extended review specifies the RIs. On the contrary, we find these studies to apply other modeling approaches (e.g., CLPM; time-lagged regression) that fail to account for the trait-like differences between persons, and are therefore likely to yield biased effect estimates (e.g., Antonakis et al., 2019; Hamaker et al., 2015; Wooldrige, 2016). This alarming result corroborates the findings of recent methodological reviews. For example, Antonakis et al., (2019) demonstrate that merely 106 of the 206 articles randomly drawn from macro and micro organizational science deal with hierarchical data appropriately. This shortcoming has far-reaching consequences: The results obtained through these modeling approaches are likely to produce erroneous results, thereby hindering theory development and planning of effective interventions.

4.4 Part II: Quantitative Replication and Extension

The goal of this second section is two-fold. First, we seek to examine whether Nohe et al.'s (2015) meta-analytical finding (i.e., WFC and psychological strain affect each other) will be replicated in our large data using the CLPM. Second, we extend prior longitudinal research linking WFC and psychological strain by providing results on this relationship from the RI-CLPM.

4.4.1 Data Collection and Sample

Data representative of the German workforce were collected via an online survey that was distributed by a German market research institute. These data are of hierarchical nature: they were collected at three points in time (level 1), and are nested in persons (level 2). Survey participants are registered panel members who are 18 years old or more, employed in the primary labor market in Germany, and have access to an internet-enabled communication technology at their workplace. The initial survey was conducted in July 2016 (T1), the second nine months later in April 2017 (T2), followed by the third 12 months later in April 2018 (T3), resulting in 8'019, 8'004, and 8'046 respondents, respectively. In total, 14'137 persons participated in our online survey. There were 4'754 persons who participated in both T1 and T2 survey, whereas there were 4'386 persons who participated in the T2 and T3 survey. A total of 3.150 persons participated in all three surveys.

To ensure data of high quality, we excluded observations with an inconclusive response pattern. This includes 417 persons who indicated a lower school-leaving qualification at T2 or T3 than T1, and 27 persons who indicated to be of lower age at T2 or T3 than T1. Furthermore, we have excluded persons with significant changes in their work situation (e.g., promotion to or downgrading from a leadership position) which is otherwise likely to introduce an omitted variable problem to our analyses. Specifically, we have excluded 551 persons who reported a lower company tenure at T2 or T3 than T1 (indication of leaving the organization between 2016 and 2018), 411 persons who changed from working full-time to part-time or vice-versa, 490 persons who reported to be holding a leadership position at T1 and not at T2 or T3 or vice versa.

Furthermore, six persons who did not provide any data on variables under study were excluded from the analyses. Additionally, we have excluded observations with missing values on WFC (total of 7, 8 and 20 missing observations at T1, T2, and T3, respectively) and EE (total of 58, 25 and 30 missing observations at T1, T2, and T3, respectively)¹². Thus, the final usable sample included 12'241 working adults.

¹² However, given that the proportion of missingness is below .01% for both constructs, we do not consider these missing data to be of concern to our study results. Nonetheless, to account for missing data, we applied Full Information Maximum Likelihood (FIML) with robust standard errors. Relative to other methods available, the FIML has been shown to be more efficient as it analyzes all available data using maximum likelihood estimation, and to provide more reliable results (Little & Rubin, 2002; Newman, 2003).

At T1 (T2) [T3], the final wave-specific sample size is 6'722 (6'548) [6'567]. It consists of 3'307 (2'992) [2'975] men and 3'415 (3'556) [3'592] women (i.e., 50.8% (45.3%) [54.7%] are women). Respondents' age ranges from 18 to 76 (18 to 77) [18 to 86] years, with an average of 44.4 (44.0) [43.9]. Of all participants, 30.9% (34.6%) [34.6%] hold a university degree, 20.5% (20.5%) [22.0%] a higher education entrance qualification, 40.0% (38.3%) [38.0%] a secondary school leaving certificate, 8.4% (6.4%) [5.4%] a lower vocational background, and 0.3% (0.1%) [0.1%] indicate to have no vocational background.

4.4.2 Data Attrition

A series of logistic regressions were performed using Stata 15.1 (StataCorp., 2017) in order to examine whether data attrition (dummy coded: 1 = *dropout*, 0 = *no dropout*) is related to demographics and other study variables. The results show significant differences between persons who participated in both the T1 and the T2 survey ($N = 4'754$) and those who participated in the T1 and not in the T2 survey ($N = 3.265$) in terms of age $\chi^2(1, N = 6'722, p < .01) = 165.68$, and gender $\chi^2(1, N = 6'722, p < .01) = 16.73$. Here, older participants and women were more likely to drop out. Furthermore, we find persons with complete data at T1 and T2 to differ from those who provided no data at T1 and T2 in terms of WFC $\chi^2(1, N = 6'722, p < .05) = 4.40$, and EE $\chi^2(1, N = 6'722, p < .05) = 3.91$. We find observations with complete data at T2 and T3 to differ from those with no data at T2 and T3 in terms of age $\chi^2(1, N = 6'548, p < .01) = 291.39$, and gender $\chi^2(1, N = 6'548, p < .01) = 43.12$. Finally, persons with complete data at T2 differ significantly from those with no data at T3 with respect to WFC and emotional exhaustion.

Similar to prior studies (e.g., Miklikowska, 2016; 2018), we rely on the logistic regression pseudo R^2 (i.e., Nagelkerke R^2) to evaluate the extent to which the non-responses are explained by the study variables. The results of all our logistic regression analyses yield values of the Nagelkerke R^2 close to .00 (ranging from .00 to .06)¹³, thereby indicating that the significant differences outlined above are unlikely to influence the results of our analyses (Borooah, 2001).

¹³ In interest of parsimony, we do not report the Nagelkerke R^2 values separately for each of logistic regression analyses outlined above. These values are available from the corresponding author upon request.

4.4.3 Measures

Work-Family Conflict was measured with three items developed by Netemeyer et al. (1996). The items were “The demands of my work interfere with my home and family life”, “The amount of time my job takes up makes it difficult to fulfill family responsibilities”, and “Things I want to do at home do not get done because of the demands my job puts on me”. They were assessed using a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

Emotional Exhaustion. Survey participants rated three items “During my work, I often feel emotionally drained”, “After my work, I usually feel worn out and weary”, and “There are days when I feel tired before I arrive at work”. The reference items derived from exhaustion scale in The Oldenburg Burnout Inventory developed by Demerouti et al. (2010). They were rated on a 5-point Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*).

4.4.4 Confirmatory Factor Analyses

To examine the distinctiveness of each of our measured constructs over time, we have conducted a series of confirmatory factor analyses. The results show that the two-factor model with the items of WFC and EE loading on two separate factors within each wave provides a better fit than the one-factor model (i.e., all items load on one factor). Refer to Table 4.2 for an overview of the fit indices and chi square difference tests between alternative measurement models in each measurement wave.

Table 4.2: Summary of the Results From Confirmatory Factor Analyses (CFA) Measurement Model Comparison

	CFA Model	$\Delta\chi^2_{sb}$	Δdf	χ^2	df	AIC	BIC	CFI	TLI	RMSEA	SRMR	p
Time 1												
1	One-Factor Model	8966.82**	1	4998.51	9	110077.75	110200.38	.68	.46	-	.12	.000
2	Two-Factor Model	-	-	121.48	8	104647.80	104777.25	.99	.99	.05	.02	-
Time 2												
1	One-Factor Model	2871.00**	1	3092.89	9	103896.14	104018.29	.79	.65	.23	.09	.000
2	Two-Factor Model	-	-	84.96	8	99976.24	100105.18	.96	.99	.04	.01	-
Time 3												
1	One-Factor Model	3389.34**	1	3600.77	9	109004.82	109127.03	.74	.57	.25	.11	.000
2	Two-Factor Model	-	-	89.33	8	104576.16	104705.15	.99	.99	.04	.02	-

Note. $N = 12'241$. Models calculated using robust maximum likelihood estimation (MLR). $\Delta\chi^2_{sb}$ = Model chi-square difference using Satorra-Bentler scaling correction; Δdf = Degrees of freedom difference (respective difference between three-factor model and compared model); χ^2 = Model chi-square; df = Degrees of freedom; AIC = Akaike information criterion; BIC = Bayesian information criterion; CFI = Comparative fit index; RMSEA = Root mean square error of approximation; SRMR = Standardized root mean squared residual; p = p-value of nested chi square model test. * $p < .05$, ** $p < .01$.

4.4.5 Analytical Strategy

We have conducted path analyses using Mplus 8 (Muthén & Muthén, 1998-2017) to examine whether, and if so, how WFC and EE are related to one another over time. Specifically, we have first estimated the CLPM (see Figure 4.1). Here, we have specified 1) autoregressive paths for the two study variables, 2) cross-lagged effects from WFC to EE and from EE to WFC, 3) within-time residual correlations of the latent constructs in T1, T2, and T3, 4) within-person correlations of manifest indicator variables for WFC and EE over time.

Second, to estimate the RI-CLPM, we have extended the CLPM by adding two latent Random-Intercept (RI) factors (i.e., one for WFC and one for EE, see Figure 4.2). Next, the RI specified for WFC (RIWF, see Figure 4.2) was regressed on WFC at T1, WFC at T2, and WFC at T3. The RIWF path coefficients were all constrained to 1. The same procedure was applied with the RI specified for EE. The RI residuals were allowed to freely covary.

As series of confirmatory factor analyses (CFA) were computed to assess weak measurement invariance of our two latent constructs over time (i.e., WFC and EE). Here, we sought to determine whether WFC and EE item loadings are equal across time, that is, are understood similarly by study participants at each of the three waves of data collection. In case the weak measurement invariance is established in our data, we use the measurement model with constrained factor loadings in further analyses (i.e., factor loadings are constrained to be equal across the three waves of data collection for WFC and EE).

To assess the model fit, we have relied on multiple fit indices including chi-square (χ^2), root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), comparative fit index (CFI), and Tucker-Lewis index (TLI). Following propositions from simulation studies, we set the cutoff value for the CFI and TLI to .95 (Meyers et al., 2006; Schreiber et al., 2006), for the RMSEA and SRMR to < .08 (Browne & Cudeck, 1993; Hu & Bentler, 1999; Loehlin, 2004; Schreiber et al., 2006). Additionally, we refer to Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC) and Sample-Size Adjusted Bayesian Information Criterion (BIC_{adj}). Here, the model with the lowest value is preferred (Enders & Tofighi, 2008; Schreiber et al., 2006; Schwarz, 1978).

Finally, we have calculated the intraclass correlations (ICCs) in order to examine how much of the variances is due to inter- and intra-individual data fluctuation (i.e., variation due to between-person differences, variation due to within-person variation, respectively) (Bartko, 1966; Weir, 2005).

4.5 Results

Means, SDs, and correlations of the study variables are shown in Table 4.3. WFC and EE are significantly related to one another at all three points in time ($r = .59$, $r = .67$, $r = .62$, for T1, T2 and T3, respectively). We observe high ICCs for WFC and EE. They are, respectively, .70 and .73. These results imply that 70% of the variance in WFC and 73% of the variance in EE is due to differences between persons (e.g., personality traits, IQ). Needless to say, 30% of the variance in WFC and 27% of the variance in EE is attributable to changes within individuals over time (e.g., mood fluctuations due to seasonal influences).

Table 4.3: Means, Standard Deviations, and Correlations between the Latent Study Variables

Nr	Variables	M	SD	1	2	3	4	5	6
1	Work-Family Conflict T1	0	1.02	-					
2	Work-Family Conflict T2	0	1.01	.74	-				
3	Work-Family Conflict T3	0	1.05	.72	.75	-			
4	Emotional Exhaustion T1	0	1.03	.59	.51	.49	-		
5	Emotional Exhaustion T2	0	.96	.55	.67	.55	.80	-	
6	Emotional Exhaustion T3	0	1.03	.49	.55	.62	.76	.82	-

Note. $N = 12'241$. Latent Variable Correlations represent the Correlation Matrix as result of the Joint Measurement Model Estimation using Mplus with TECH4 output command, allowing all latent constructs to covary per default. All correlations significant on 5% significance level with $p < .01$.

4.5.1 Cross-Lagged Panel Model (CLPM)

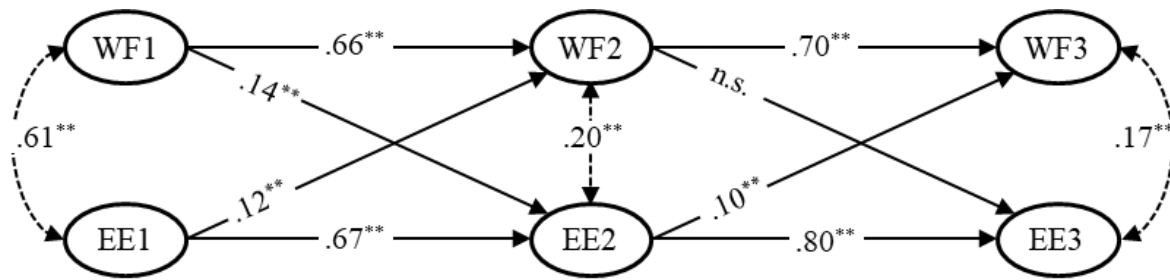
We check for the validity of weak measurement invariance over time to ensure that the path coefficients of the final CLPM are not biased due to changes in the measurement itself over time. Hence, we test an unconstrained measurement model, i.e., freely estimated item loadings in each time point ($\chi^2(120) = 2281.46, p < .01$; RMSEA = .04, SRMR = .03, CFI = .96, TLI = .95, AIC = 301376.81, BIC = 301888.28), against a constrained measurement model with weak measurement invariance, i.e., with equal item loadings across time points ($\chi^2(128) = 2334.66, p < .01$; RMSEA = .04, SRMR = .03, CFI = .96, TLI = .95, AIC = 301372.99, BIC = 301825.16). The chi-square test yields a non-significant result ($\Delta\chi^2_{SB}(8) = 14.06, p > .05$)¹⁴, thereby indicating that both models fit equally well. This result allows assuming measurement invariance for further analyses (van de Schoot et al., 2012).¹⁵

The final CLPM yields good model fit ($\chi^2(114) = 659.66, p < .01$, RMSEA = .02, SRMR = .03, CFI = .99, TLI = .99, AIC = 299392.70, BIC = 299948.64). The results show that individuals who report high WFC at T1 show also a high level of EE at T1. The effects sizes are moderate ($r = .61, p < .01$). We find correlated residuals for WFC and EE at T2 and T3 ($r = .20, p < .01$; $r = .17, p < .01$, for T2 and T3, respectively). Moreover, the results show that both WFC ($r = .66, p < .01$; $r = .70, p < .01$) and EE ($r = .67, p < .01$; $r = .80, p < .01$) yield stable autoregressive paths over time. We find positive cross-lagged effects between WFC at T1 and EE at T2 ($\beta = .14, p < .01$). The path between WFC at T2 and EE at T3 is not significant ($p > .05$). Furthermore, there are significant crossed-lagged effects for both from EE at T1 to WFC at T2, and EE at T2 to WFC at T3 ($\beta = .12, p < .01$; $\beta = .10, p < .01$, respectively).

To sum up, as can be seen in Figure 4.1, the CLPM shows reciprocal effects between WFC and EE over time.

¹⁴ The use of Maximum-Likelihood with robust errors requires use of the Satorra-Bentler adjusted chi-square values ($\Delta\chi^2_{SB}$) when comparing nested models.

¹⁵ We also tested the model with weak measurement invariance against a model with strong measurement invariance. The results indicate that strong invariance cannot be assumed ($\Delta\chi^2_{SB}(8) = 38.48, p < .01$).

Figure 4.1: ‘Standard’ Cross-Lagged Panel Model (CLPM)

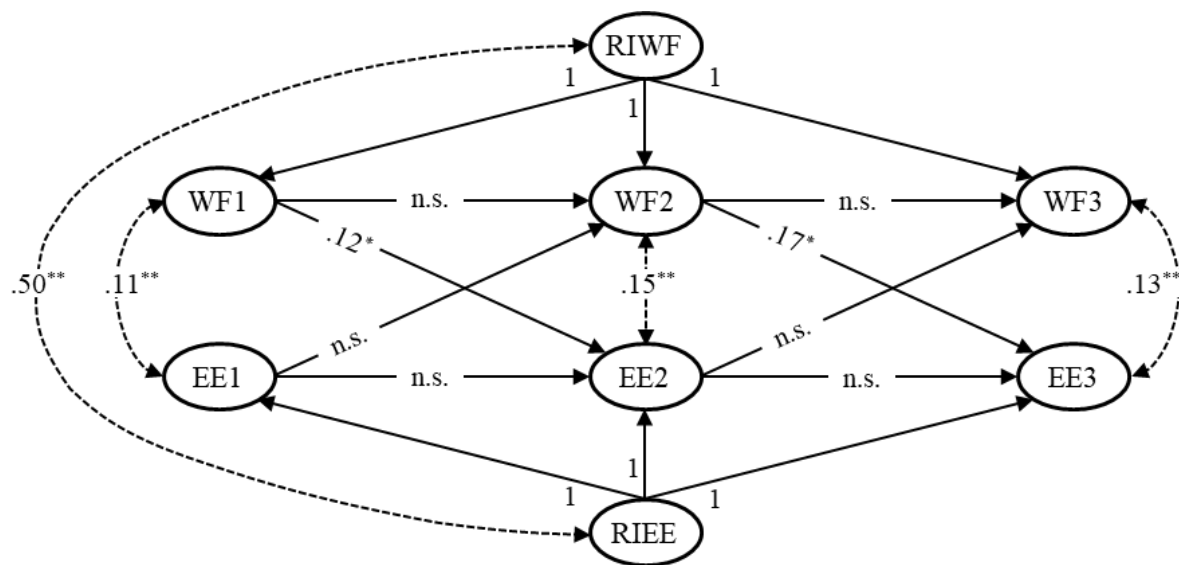
Note. Link of work-family conflict and emotional exhaustion, aggregating between- and within-person variance. WF = work-family conflict; EE = emotional exhaustion; Solid line = lagged paths; Dotted line = correlations of error terms. Circles illustrate latent constructs; measurement model with indicator variables and correlations amongst indicators of same latent construct over time are not shown due to reasons of clarity. Standardized effects (β) of significant paths are specified and constitute indicators of effect size. ** $p < .01$. * $p < .05$. n.s. $p > .05$.

4.5.2 Random Intercept Cross-Lagged Panel Model (RI-CLPM)

The RI-CLPM yields a good model fit ($\chi^2(111) = 434.04$, $p < .01$, RMSEA = .15, SRMR = .02, CFI = .99, TLI = .99, AIC = 299127.87, BIC = 299706.05). Moreover, we find the RI-CLPM to show a significantly better model fit than the CLPM ($\Delta\chi^2_{SB}(3) = 187.77$, $p < .01$).

There is a significant correlation between WFC and EE at the between-person level ($r = .50$, $p < .01$). This implies that participants who reported high WFC at each of the three points of data collection reported also a high level of EE throughout the study period, and vice versa. We find a significant, unidirectional effect of WFC on EE at the within-person level, keeping the effect of between-person differences constant. Specifically, within-person change in WFC during one time period (T) predicts within-person changes in EE at the subsequent time point (T+1) ($\beta = .12$, $p < .05$; $\beta = .17$, $p < .05$, for EE at T2 and T3, respectively) but not vice versa ($\beta = .07$, $p > .05$; $\beta = .18$, $p > .05$, respectively).

There is a significant correlation between WFC at T1 and EEC at T1 ($r = .11$, $p < .01$). We find correlated residuals at T2 and T3 ($r = .15$, $p < .01$; $r = .13$, $p < .01$, respectively). Furthermore, no significant autoregressive paths from T1 to T2 and T2 to T3 were found for both study variables ($r = .01$, $p > .05$; $r = .02$, $p > .05$; $r = .05$, $p > .05$; $r = .05$, $p > .05$; for WFC and EE, respectively).

Figure 4.2: Random-Intercept Cross-Lagged Panel Model (RI-CLPM)

Note. Link of work-family conflict and emotional exhaustion, differentiating between- and within-person variance. Latent constructs capturing within-person variance: WF = work-family conflict; EE = emotional exhaustion; Latent Constructs capturing between-person variance: RIWF = random intercept of work-family conflict; RIEE = random intercept of emotional exhaustion; Solid line = lagged paths; Dotted line = correlations of error terms. Measurement model of latent factors WF and EE is not shown due to reasons of clarity. Standardized effects (β) of significant paths are specified and constitute indicators of effect size. ** $p < .01$. * $p < .05$. n.s. $p > .05$.

Taken together, the CLPM replicates Nohe et al.'s (2015) meta-analytical finding about the reciprocal effects between WFC and psychological strain over time. However, the RI-CLPM shows a significantly better model fit than the CLPM, and provides different results. First, we observe a positive effect of WFC on EE at the between person-level. Second, the results demonstrate that WFC predicts positive within-person changes in EE, but not vice versa. Thus, whereas the CLPM concludes that WFC and EE are reciprocally related to one another over time, the results of the RI-CLPM point to another causal direction of this effect: It is the WFC then affects EE and not vice versa.

4.6 Discussion

The present research sought to identify a source of variation in the results of prior studies linking WFC and psychological strain. Here, we mean the conflicting results regarding the causal direction of the effect between these two variables (i.e., claims about unidirectional, reverse, or reciprocal causality, non-significant relationship). Our central argument is that this variation in results is due to an inappropriate modeling of longitudinal data. To help verify this argument, the present paper offers results from a

systematic literature review, and a three-wave data from 12'241 individuals. Whereas the former summarizes modeling approaches used in prior studies, the latter extends prior research by providing insights on the direction of the effect of interest from two different modeling approaches, that is, the CLPM and the RI-CLPM.

First, the results of our systematic review show that none of the 66 studies model longitudinal data appropriately (i.e., 15 studies derived from Nohe et al.'s meta-analysis, 51 newer studies). Specifically, they apply modeling approaches such as, for example, hierarchical time-lagged regression or the CLPM, that fail to account for the trait-like between-person differences. This, in turn, has been demonstrated to result in biased effect estimates (e.g., Antonakis et al., 2019; Hamaker et al., 2015). Our result corroborates findings of recent methodological reviews that sharply criticize the use of the CLPM because of this failure, and therefore urge scholars to rely on alternative modeling approaches including, for example, the RI-CLPM (e.g., Antonakis et al., 2019; Hamaker et al., 2015; Zyphur et al., 2020a, 2020b). In contrast to the CLPM, the RI-CLPM partials out the effect of potential confounding factors (i.e., unmeasured, trait-like between-person differences), thereby proving a stronger empirical basis to infer causality (Usami et al., 2019).

Second, we have conducted a replication study in order to examine whether the CLPM and the RI-CLPM lead to different estimation results, and thus to different conclusions about the direction of the effect between WFC and psychological strain (operationalized as emotional exhaustion). We find the RI-CLPM to yield a significantly better model fit than the CLPM. This result demonstrates that there is a significant portion of the between-person variance that needs to be taken into account while estimating effect parameters. As expected, the results of the CLPM replicate Nohe et al.'s (2015) meta-analytical finding such that WFC and emotional exhaustion affect each other reciprocally. In contrast, the RI-CLPM yields support for unidirectional causality: WFC leads to greater psychological strain and not vice versa.

We consider the results outlined above to support our argument that the inconsistent results regarding the direction of the effect between WFC and psychological strain are due to inappropriate data modeling. Given the different ways of dealing with the within-person variance and the between-person variance in the CLPM and the RI-CLPM, the results of the RI-CLPM are likely to contradict those obtained through the CLPM. Our study is among the few examples that illustrate how the results obtained through these two modeling approaches differ from one another. Given RI-CLPM's empirical

superiority, and the fact that prior studies largely rely on the CLPM alone, our results question the explanatory power and the ultimate value of these prior studies to the field. Consequently, theories may need to be reconsidered in the light of the results obtained through modeling approaches that control for unmeasured, trait-like between-person differences.

4.6.1 Limitations and Future Research

While the present study has several methodological strengths such as large, population representative data or longitudinal research design, there are certain limitations then need to be considered when interpreting our findings.

First, it is unclear whether we would find the same differences between the RI-CLPM and the CLPM in other cultural contexts. It is because the trait-like between-person differences in WFC and emotional exhaustion might be different for working adults living in other cultural and employment contexts outside of Germany (potential differences in work-life balance policies across countries). Thus, future research linking WFC and emotional exhaustion would benefit from insights on this longitudinal relationship from other cultural and employment contexts.

In addition, our study participants are registered panel members who agreed to participate in online surveys distributed by a market research institute. We can thus not totally rule out the possibility of participant's self-selection into such panels, thereby introducing potential unobserved bias to our data. However, to generate this vast amount of longitudinal data over time researchers have often no choice but to rely on such pre-existing panels of study participants.

Finally, we encourage scholars who plan longitudinal studies to collect more than two waves of data. In doing so, they will be able to model the RI-CLPM and test the random effects assumption (i.e., compare the CLPM against the RI-CLPM). This test is crucial to understand the role of the time-invariant differences between subjects for the study results, and thus leads to an informed choice of the appropriate modeling approach for the data at hand.

4.6.2 Practical Implications

The development of interventions is primarily based on the empirical evidence regarding the causal relationships between the antecedents and outcomes of the construct under investigation. Regarding the study context at hand, human resource departments usually

consider the link between WFC and psychological strain as a central lever for interventions to promote employee health and satisfaction in the corporate environment. However, when assuming a reciprocal relationship as claimed by Nohe et al. (2015) between both components it is difficult to argue for a directed intervention specifically reducing work-family conflict for employees. The results might also rationalize to develop and apply interventions to reduce general psychological strain as this then also leads to reduced work-family conflict perceptions.

However, the updated evidence for a unidirectional relationship from work-family conflict towards emotional exhaustion leads to the notion that work-family conflict cannot be addressed indirectly by reducing strain. Instead, interventions must be designed to directly reduce work-family conflict for employees, e.g., by increasing work flexibility (Byron, 2005). Therefore, the updated evidence disproves the notion that work-family conflict might (partially) be a manifestation of general strain perceptions. This supports HR departments in their decisions to acquire and allocate resources to interventions that directly address reductions of work-family conflict in the workplace.

5 Discussion

The digital era poses a challenge for employees and organizations as the multifold and complex changes in the nature of work causes uncertainty in how to manage the transition to a ‘new normal’ (EU-OSHA, 2018). For instance, the accelerated integration of ICTs induces change to the boundary conditions in which work-tasks are executed (i.e., increased flexibility, such as workplace flexibility), the individual evaluation of ones meaning for the working role (i.e., new forms of stress, such as technological insecurity) as well as the more holistic question of how far work becomes part of everyday life (i.e., increased boundary permeability, accompanied by work-family conflict) (EU-OSHA, 2018, 2019; Haddon & Silverstone, 2000; Lewis & Cooper, 1999; Parker & Grote, 2019; Valcour & Hunter, 2005; Wang et al., 2020). Because of the high speed and complexity of the overall change, there is still limited empirical (i.e., lack of empirical studies), theoretical (e.g., lack of integration of stress theories, such as COR theory) and methodological knowledge (e.g., lack of exploratory and causality methods, such as LCA and RI-CLPM). However, this knowledge is relevant to understand for whom, how and under which circumstances employee health is affected in the digital era. In fact, this understanding is the prerequisite to guide employees into the ‘new normal’ in good health. The present dissertation helps to fill the identified research gaps and provides insights on the aforementioned dimensions of ICT-induced change and its relationships with employees’ health perceptions.

5.1 Key Contributions

5.1.1 Theoretical Implications

Study 1 and Study 2 add to the literatures of workplace flexibility and technostress and their respective relationship with employee health (i.e., emotional exhaustion and general health, respectively). More specifically, the studies examine yet unexamined boundary conditions by building on the theoretical rationalities of COR theory (Hobfoll, 1989). Hence, Study 1 derives from COR theory and shows that high (virtual) communication media use for the interaction with ones’ colleagues can serve as a counterbalancing job resource for employees performing workplace flexibility. Hence, enabling the latter to unfold beneficial health effects. This is, as the virtual communication opportunities provide employees with resource promoting attributes (e.g., social resources, such as virtual workplace involvement and virtual socialization opportunities; and energy resources, such as technical regulation of work and private

life) that are being threatened by pure workplace flexibility behavior. This relation becomes more salient, as employees work spatially dispersed while being embedded in task interdependent work structures. Therefore, on the one hand, Study 1 theoretically adds knowledge to the literature of workplace flexibility and health by identifying the role of two, yet neglected boundary conditions, and further emphasizes the integrative role of COR theory. On the other hand, Study 2 adds to prior research that the role of technostress (i.e., technological insecurity) for employee health is context specific. Specifically, it is the first study that follows a cross-literature approach by integrating psychological stress theory (i.e., COR theory) into technostress examinations (i.e., field in IS literature). Results show that non-technology-related environmental resources (i.e., support for strengths use and friendship opportunities) are contextual factors that determine the extent to which ICT-induced stress affects individuals. Therefore, both studies propose the COR theory as potential theoretical model to rationalize the role of ICT-induced changes for employee health under consideration of contextual boundary conditions.

Although Study 3 is rather methodological, its results contribute to the psychological stress literature in a more holistic and overarching manner. With regard to the established literature on work-family conflict and employee health, the study challenges the adequacy of prior theory building in this field. More specifically, present theories do not take mandatory methodological depth into account, which makes them rather untestable or at least flawed. As the results show, magnitude and direction of effects between work-family conflict and employee health can strongly differ with regard to the level of observation (i.e., within-person or between-person level). This indicates the possibility, that highly different psychological processes take place on these different levels of observation. However, most established theories come up with rather general assumptions and corollaries and do not address these methodological details in their theories. Hence, Study 3 adds knowledge to the psychological stress literature by emphasizing to refine existing psychological theories in a way that they distinguish, or at least consider, potentially different theoretical processes on both the within-person and between-person level.

5.1.2 Methodological and Empirical Contributions

All three studies contribute differently in terms of methodology and empiricism. To begin with, Study 1 is the first to explore boundary conditions for role of workplace flexibility and health by applying a latent class analyses with an arbitrary secondary

structural equation model (Asparouhov & Muthén, 2014). Specifically, this approach allows to identify hidden patterns across variables within the observed study sample (i.e., latent classes) and makes this information available for further analyses in another freely specified model. Although being almost neglected in this use-case, the LCA analysis is highly relevant in making use of compositional variables. This class encompasses variables that are considered jointly but are not entirely independent from each other (i.e., variables that represent partial shares of one overall sum score that adds up to 100%). This characteristic would actually exclude variables for use in ordinary regression analyses, as they violate the basic assumption that estimation coefficients represent a numerical interpretation of the relationship between variables when the predictor is increased by one unit and ‘while keeping everything else equal’ (i.e., independence assumption). Transferred to the respective variable in the study at hand (i.e., communication media usage, with a mean of 100% amongst all participants) one cannot increase the use of one single communication media (e.g., by the unit of 1), while holding the usage of all other media at the same level. This would represent a communication media usage of 101%, which is an impossible case. Hence, the LCA analysis is introduced as a valid methodology to analyze these compositional variables in form of specific patterns (here: usage patterns, represented by a categorical class variable) identified in the data at hand. Extending this approach by an arbitrary secondary model enables to make full use of the identified classes in other models (e.g., structural equation models). Hence, applying this method represents a methodological contribution to the field of workplace flexibility, as it adequately shows the relevance of communication media (i.e., without violating the independence assumption) as contextual condition for the relationship between workplace flexibility and health. This also contributes to other fields of research which seek to analyze compositional variables.

In addition, Study 2 is first to analyze the relationship between technostress (i.e., technological insecurity) and health with statistically weighted data that are representative for an entire workforce (i.e., 33.3 million employees in Germany). Specifically, it hypothesizes and supports that perceptions of technological insecurity can have detrimental effects for employees’ health perceptions. Moreover, it also shows that this relationship can be mitigated by organizational factors that act as resources. Hence, this study contributes empirically to the field of technostress by providing estimation results with high external validity.

Next, Study 3 is the first applied study that shows the superiority of the Random-Intercept Cross-Lagged Panel Model (Hamaker et al., 2015) over the commonly applied standard cross-lagged panel model for examining the causal relationship (i.e., direction of the effect) between work-family conflict and employee health (i.e., emotional exhaustion). In doing so, the results challenge and update the existing notion of a reciprocal relationship by providing empirical evidence that work-family conflict has a negative, unidirectional effect on employee health, and not vice versa. Examining this relationship on the basis of unique, annually collected longitudinal survey data from 12'241 German employees over the course of three years represents a strong empirical contribution to the respective field of research. However, providing empirical evidence on the superiority of the RI-CLPM over the CLPM not only represents a methodological and empirical contribution to the research stream of work-family conflict and employee health, but constitutes a rather general contribution to examinations of causality with longitudinal data structures.

5.2 Limitations and Future Research

Study 1 and Study 2 show specific limitations with regard to causality of the effect estimations, although varying in severity. In addition, there are limitations that affect all studies equally. Accordingly, recommendations for future research are given.

Study 1 explores and shows that the positive relationship between workplace flexibility and employee health depends on the interaction with two contextual boundary conditions, i.e., communication media use to communicate with colleagues and task interdependence. However, the study is designed as an exploratory LCA study, which is cross-sectional in nature. Therefore, the relationship results are associated with strong limitations towards the causality of the relationship (i.e., the cause-and-effect dimensions are theoretically guided, not empirically proven). This being said, it is recommended to update the applied methods (i.e., LCA with an arbitrary secondary model) to be used in settings of multi-wave data (e.g., longitudinal data) in order to test, replicate, and verify the presented study results.

Study 2 examines and explains the relationship between technological insecurity and employee health and the mechanism behind organizational boundary conditions, i.e., organizational support for strengths use and friendship opportunities. To test the hypothesis, this explanatory study relies on time-lagged regression analysis on the basis of two-wave data. This separates the predictor variable (wave 1) from the dependent

variable (wave 2) and sets them in a ‘cause-and-effect’-like relation with regard to its time of measurement. Although this is superior to a single-measurement procedure, the time-lag cannot show causality. Hence, the limitations and recommendations for future research outlined for Study 1 also apply to Study 2, although in reduced severity.

Although Study 3 is rather free from the causality limitations due to the sophisticated longitudinal study design, there are several aspects that apply to all three studies equally: At first, it must be stated that the data for all studies has been collected via surveys with support from a market research institute panel. Relying on established panels can induce self-selection bias to the analyses at hand, as assigned panel members might differ from non-panel members in society. Hence, it is encouraged to make use of other data sources which are less affected from self-selection (e.g., administrative company data), and to use the advanced capabilities of ICTs and develop new applications for data collection (within the legal framework).

Second, data was only collected from employees in Germany. As employee health is a highly complex and subjective perception, it might (well) be that replication studies with employees from other cultural and employment settings lead to different results and conclusions. Replication studies that both support or question the results of the present work are positive, as they increase scholarly discussion about the similarities or differences, which is positive for the entire field of research. Hence, it is strongly encouraged for future studies to replicate or update the results at hand in any possible way.

And third, all three studies are treated as individual examinations of different research streams. However, similarities can be drawn from the studies for future research. For instance, the ICT-induced changes do not appear in isolation, but simultaneously in the workplace. Thus, employees might at the same time execute workplace flexibility behaviors, experience forms of technostress and are confronted with new situations that facilitate work-family conflict. The same applies to the identified contextual conditions communication with colleagues, task interdependence, organizational support and friendship opportunities. As COR theory applies to all studies as an adequate theory to rationalize relationships amongst the variables, I encourage future research to test the interrelations between all of those work characteristics and experiences. This might lead to new insights about the complex nature of ICT-induced changes in the workplace and its role for employee health.

5.3 Practical Implications

The three studies of this dissertation come with practical implications for employees and organizations. So, Study 1 indicates that the workplace flexibility only shows a positive relation with employee health for employees that interact extensively with their colleagues across many different (virtual) communication channels. This relationship becomes more salient with an increase in task interdependence amongst employees. This implies for organizations that workplace flexibility initiatives must be accompanied by additional investment in a diverse set of high-quality ICTs (e.g., texting/messaging, internal/public social networks, videocall/-conferencing all together) that enable spatially dispersed employees to communicate with each other in multiple ways. However, as the implementation of various communication media alone is mandatory, all employees must also be trained and used to rely on the available channels for communication purposes amongst colleagues.

Further, Study 2 implies that organizations can design their organizational environment in a way that supports employees to better cope with modern forms of stress (i.e., technological insecurity). Specifically, employees are not affected by the detrimental health effects of technostress in organizations that actively support employees in using their individual strengths at work, and that design work structures to facilitate socialization at work. Hence, in the digital era, organizations must abandon the common practice in HR development to compensate skill deficits and rather focus on making use of the individual strengths. In addition, employers need to establish virtual socialization events and other practices to foster private relationships amongst the employees. This is essentially critical in times of enhanced workplace flexibility behavior, as the spatial dispersion reduces the possibility to meet colleagues during working hours. Being able to use one's personal strengths in the workplace and exchanging experiences about challenging work situations with friends in the workplace enables employees to better orientate in the 'new normal'.

At last, Study 3 implies that work-family conflict and employee health (i.e., psychological strain) do not influence each other. On the within-person level, it is work-family conflict that causes negative effects on employee health, and not vice versa. Hence, it challenges and updates the prevailing notion about the causal relationship between both dimensions, which assumed a reciprocal effect (Nohe et al., 2015). Updating this notion implies practical implications for managerial practice and the development of health interventions at work. For instance, assuming a reciprocal

relationship as claimed by Nohe et al. (2015), makes it difficult to argue for a directed intervention that particularly intends to reduce work-family conflict. The prevailing notion of causal reciprocity (i.e., $WFC \leftrightarrow EE$) might also rationalize the development of interventions that directly reduce psychological strain, as this would subsequently reduce work-family conflict. Hence, showing that the causal relationship between both domains is of unidirectional nature from work-family conflict on psychological strain implies the necessity to develop interventions that specifically focus on the reduction of the quantity and severity of work-family conflict situations in the modern workplace. Indeed, this subsequently causes an increase in employee health (i.e., reduced emotional exhaustion).

Taken together, all three studies offer practical implications for the management of certain ICT-induced changes in the workplace and the development of focus interventions to foster employee health in the digital era.

5.4 Conclusion

To shed more light on the role of ICT-induced changes in the workplace for employee health, Study 1 explores the role of workplace flexibility. It identifies that workplace flexibility can be beneficial for employees, although the relationship highly depends on contextual work conditions (i.e., communication pattern and task interdependence). The results from the latent class analysis with an arbitrary secondary structural equation model support the notion that workplace flexibility poses a chance for employees when being properly managed.

Further, Study 2 examines the role of technostress (i.e., technological insecurity) for employee health. On the one side, the results from the explanatory time-lagged regression analysis show that technological insecurity (i.e., job insecurity due to technologies) threatens employee health. On the other side, it also shows that this negative relationship can be actively managed by the organization. Specifically, it explains that contextual organizational conditions (i.e., organizational support for strengths use and friendship opportunities) may act as resources that support employees in coping with these new forms of stress. These results suggest that organizations should focus on deploying employees more in line with their individual strengths instead of using workshops to weaken skill deficits and fostering work structures that enable employees to socialize and build friendships amongst colleagues.

Study 3 investigates the role of work-family conflict for employees' health perception. Using longitudinal data from 12'241 employees, the results from the random-intercept cross-lagged panel model identify a unidirectional negative causal effect from work-family conflict on psychological strain (i.e., emotional exhaustion) on the within-person level. This result is particularly important for the development of workplace interventions which intend to foster employee health. In fact, this argues for organizations to develop interventions that specifically focus on decreasing work-family conflict for employees in the digital era. Subsequently, this leads to beneficial effects for employee health.

To conclude, this dissertation implies that the complex changes to the nature of work in the digital era are challenging but manageable. Thus, scientific research is an adequate venue to address the present uncertainty, as it is capable to provide evidence-based insights and guidance on the ICT-induced processes, mechanisms and effects that influence employees' health perceptions in the 'new normal' of the 21st century.

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Appendices

Appendix A: Studies Included in the Extended Literature Review

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Appendix B: Studies Considered but Excluded from the Extended Literature Review due to Misfit with Inclusion Criteria

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Curriculum Vitae

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2016 - 2016	Ateneo de Manila University, Manila, PH M.Sc. in Business Administration, Exchange Student
2011 - 2015	University of Erlangen-Nuremberg, Nuremberg, GER B.A. in Business Administration
2011	Kepler-Gymnasium Weiden, Weiden i.d.OPf., GER Higher Education Entrance Qualification (A-levels)

WORK EXPERIENCE

Since 2017	University of St.Gallen, St. Gallen, CH Research Associate, Institute for Leadership and Human Resource Management (Prof. Bruch), Center for Disability and Integration (Prof. Böhm)
2017	Continental AG, Ingolstadt, GER Working Student, ADAS Business Unit
2016	University of Eichstätt-Ingolstadt, Ingolstadt, GER Research Assistant, Chair for Business Administration, Distribution Management and Marketing (Prof. Büschken)
2015 - 2016	Siemens AG, Munich, GER Working Student, Venture Analyst, Siemens Technology Accelerator GmbH
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- 2014 - 2015 **IP Enterprises GmbH, Munich, GER**
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