# THE INFLUENCE OF DIGITIZATION ON THE EMOTIONAL EXHAUSTION OF EMPLOYEES: THE MODERATING ROLE OF TRADITIONAL JOB RESOURCES AND AGE

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## ABSTRACT

Against the background of technological trends, employees are increasingly confronted with digital job demands such as digital hindrance demands (i.e., the introduction of new technologies as well as the associated organizational restructuring) and digital challenge demands (i.e., an increase in task complexity and intensity). Up to now, little is known to what extant these digital demands influence the mental well-being of employees. By drawing on the Job-Demands and Resources (JD-R) model, this research paper assesses the impact of digital hindrances and digital challenges on the emotional exhaustion of employees. Particular attention is paid to the role of age and to the potential buffering effect of traditionally researched job resources (i.e., autonomy, support of leaders and peers). Using hierarchical regression modelling with a sample of 6,855 white collar workers, the results show that digital job demands exert a high and significant positive effect on emotional exhaustion. Whereas traditional job resources and increasing age helped alleviating the effect of digital challenge demands, the emotional exhaustion caused by digital hindrances was unaffected by age and could only limitedly be buffered by traditional resources.

**Keywords:** emotional exhaustion, JD-R model, job demands, job resources, digitization, age, work environment, hierarchical regression

**JEL Classification:** J14, M12, O15, O33

# 1 INTRODUCTION

Digitization is defined as "*the conversion of analogue data and processes into machine-readable format*" (OECD, 2019) and is one of the mega trends of the 21st century. Driving rapid advances in information and communication technologies (ICT), human-machine interaction (Warning & Weber, 2018), and big data analysis (Lenkenhoff et al., 2018), digitization affects our economy as a whole and has a deep impact on the way we do business and on the way we work (BMAS, 2017; Zeike, Choi, Lindert, & Pfaff, 2019).

In Germany, 82 % of employees are affected by digitization processes in their working environment (DGB-Index Gute Arbeit, 2016). Technological developments (i.e., new software, machines, and products) trigger continuous restructuring processes within organizations (Bayo-Moriones, Calleja-Blanco, & Lera-Lopez, 2015) and, therefore, pose hindrances to employees' everyday work (Lindbeck & Snower, 2000).

The implementation of new technologies further results in a shift of job demands, increasing both task complexity and task intensity (Chesley, 2014; Frey & Osborne, 2017). New technologies such as smart algorithms substitute well-defined, structured tasks (Acemoglu & Autor, 2011; Frey & Osborne, 2017), complement high-skilled problem solving tasks (Eisele & Schneider, 2014), and eventually result in more complex job tasks. At the same time, ICT leads to a more flexible working environment by decreasing barriers of space and time for work and communication across departments and countries (Weiß & Wagner, 2017).

Job demands have a high influence on the (mental) well-being of employees (Crawford, LePine, & Rich, 2010). They require employees' continuous physical, cognitive or emotional effort (Bakker, Demerouti, & Verbeke, 2004), might deplete employees' physiological or psychological resources and, therefore, add to the risk of emotional exhaustion (LePine, LePine, & Jackson, 2004). The link between job demands and emotional exhaustion is therefore of particular interest.

Different types of job demands influence emotional exhaustion to varying degrees. With regard to digital job demands, existing research mainly examines the effects of task intensity (Chesley, 2014) or task complexity (Meyer & Hünefeld, 2018) on the mental well-being of employees. They unanimously come to the conclusion that greater time pressure and a broader range of tasks add to emotional strain. In contrast, we know little to what extent the

introduction of new technologies affects the emotional exhaustion of employees. The introduction of new technologies and the related restructuring process disrupt habitual workflows and constitute the immediate outcome of technological change. Their influence should therefore be considered when analyzing medium-term effects such as the shift in task challenges. This paper analyzes the cumulated impact of digitization on employees' emotional exhaustion by aggregating digital job demands into two broad categories: digital hindrances (i.e., introduction of new software, machines, products, organizational restructuring processes) and digital challenges (i.e., increasing task complexity and task intensity) (Crawford et al., 2010). In doing so, this paper strives to assess the influence of digitization as a part of job demands more comprehensively.

Suitable resources are able to buffer the effect of digital job demands on emotional exhaustion. It depends on the nature of job demand which kind of job resource plays a role in reducing the effect on emotional exhaustion (Bakker et al., 2004; Xanthopoulou et al., 2007). In the past, job resources like autonomy (Nahrgang, Morgeson, & Hofmann, 2011; Karasek, 1979) as well as social support from leaders and peers (van den Broeck, de Cuyper, de Witte, & Vansteenkiste, 2010) were found to counteract the impact of non-digital work demands (e.g. work-home interference, etc.). However, due to the progressive digitization of the working environment and the shift towards digital job demands, the necessity to re-examine the effectiveness of these traditional job resources becomes apparent (Gerten, Beckmann, & Bellmann, 2018).

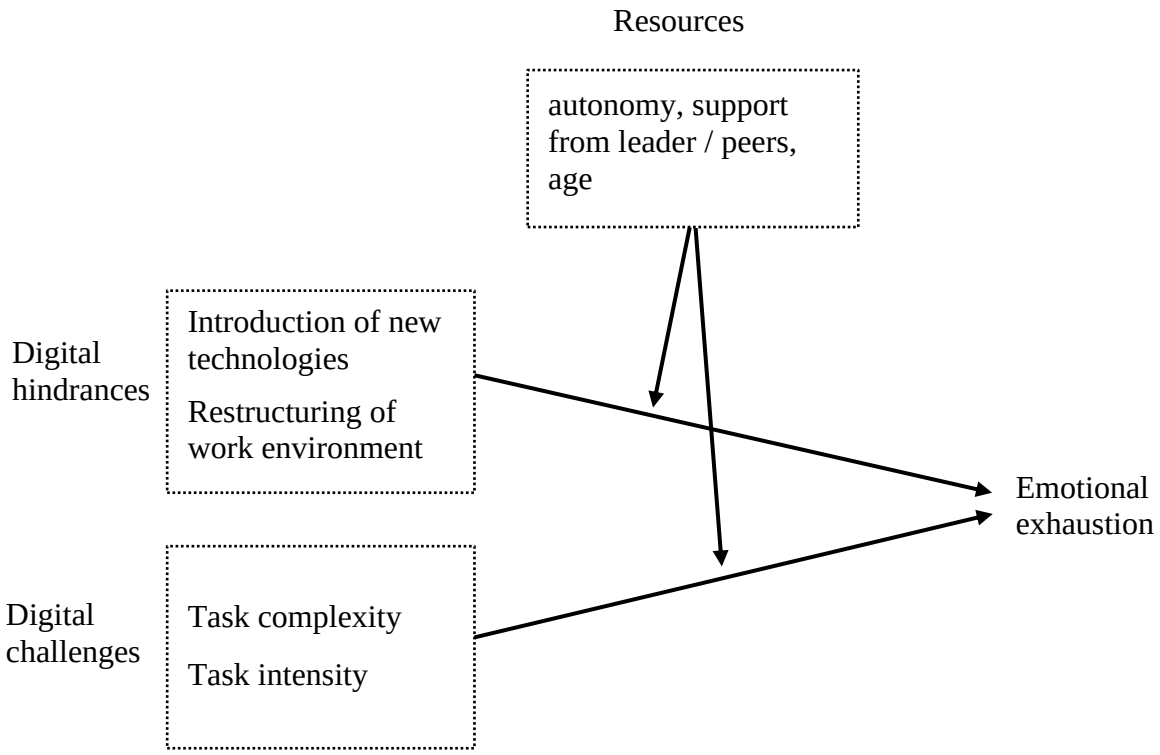
In the light of demographic trends, it is also necessary to examine to what extent the effect of digital job demands differ across age groups (Meyer & Hünefeld, 2018). Age can be a valuable personal resource that has the potential to counteract the effect of job demands on emotional exhaustion (Brewer & Shapard, 2004). However, up to now, there is no satisfactory evidence whether employees' age influences the effect of digital job demands on emotional exhaustion (Meyer & Hünefeld, 2018). Past research has demonstrated competing results showing that age either buffers (Ragu-Nathan, Tarafdar, & Tu, 2008) or does not have an effect on the relationship (Berg-Beckhoff, Nielsen, & Ladekjær Larsen, 2017). Scheibe and Zacher (2013) therefore propose to explicitly examine the effect of age instead of including age as control variable.

This paper draws on the Job-Demands and Resources (JD-R) model to predict whether and to what extent digital hindrance demands and digital challenge demands affect the emotional

exhaustion of employees. Additional attention is paid to the role of different age cohorts and to the question whether traditional job resources (i.e., autonomy, support from leaders and peers) are able to buffer the positive effect of digital job demands on emotional exhaustion. Figure 1 provides on overview of the proposed research model.

The present study makes three important contributions to existing research: First, this research paper introduces the concept of digital job demands to the JD-R model. In doing so, the mechanisms through which digitization influences the mental well-being of employees is further disclosed. Second, the present study answers to calls to examine the impact of digital job demands across subgroups of employees (Meyer & Hünefeld, 2018) and explicitly across age groups (Berg-Beckhoff et al., 2017). Third, by testing the efficiency of traditionally granted job resources, this research paper offers practical implications to design a (mentally) healthy work environment for a smooth transition into the digital future.

**Figure 1: Theoretical Model**



# 2 THEORETICAL FRAMEWORK

## 2.1 Emotional Exhaustion

Emotional exhaustion is the feeling of extreme physical and psychological fatigue and the result of intense and prolonged physical, affective or cognitive strain (Demerouti, Bakker, Vardakou, & Kantas, 2003; Lee & Ashforth, 1993). It was found to be an important antecedent for a number of negative outputs such as burnout, absenteeism as well as mental and physical (cardiovascular) diseases (Bakker et al., 2004). As the "*central quality of burnout and the most obvious manifestation*" (Maslach, Schaufeli, & Leiter, 2001) emotional exhaustion is described as the state in which an individual suffers from the complete depletion of energy. However, this energy is needed when working on cognitively demanding tasks (LePine et al., 2004) that are related to a digitized working environment (Meyer & Hünefeld, 2018). If individuals do not have the resources to counteract the feeling of emotional exhaustion, it might lead to cynicism, decreased personal accomplishment and eventually to burnout (Bakker, Demerouti, & Euwema, 2005).

## 2.2 A Brief Review of the JD-R Model

Past research provided valuable insights into the influencing factors on employees' emotional exhaustion (Bakker & Demerouti, 2014; Bakker et al., 2004). The demand-control model by Karasek (1979) is one of the most cited and tested theories on the relationship between psychosocial work environment and employee health (Elovainio et al., 2005). Following this theory, emotional exhaustion results from excessive work overloads (e.g., time pressure) in the face of low decision latitude (e.g., autonomy regarding skill usage) (Glaser, Seubert, Hornung, & Herbig, 2015; Karasek, 1979) and little social support (Karasek & Theorell, 1990).

The Job-Demand and Resources Model (JD-R) (Bakker & Demerouti, 2007; Demerouti, Bakker, Nachreiner, & Schaufeli, 2001) extends Karasek's original demand-control model by opening up the narrowly defined categories of demands and resources to further job characteristics (Parker, Morgeson, & Johns, 2017). Job demands are no longer reduced to work overload but can be any "*physical, social, or organizational aspect of a job that requires sustained physical or mental effort and are therefore associated with certain physiological or psychological costs*" (Demerouti et al., 2001, p. 501). Job demands deplete employees' mental resources, either by hindering employees from their everyday work or

by confronting them with challenging work demands (Crawford et al., 2010). Both hindrances (referred to as bad stressors) and challenge demands (good stressors) (Cavanaugh, Boswell, Roehling, & Boudreau, 2000) reduce employees' mental well-being and add to emotional exhaustion (Crawford et al., 2010). The main difference between hindrance and challenge demands is that challenges, besides depleting employees' energy, drive motivation and personal achievement (Bakker & Sanz-Vergel, 2013). In contrast, hindrances are perceived as unnecessary hassles and barriers to personal achievement (Bakker & Sanz-Vergel, 2013) and, thus, solely involve emotional exhaustion (Paskvan & Kubicek, 2017). In the context of digitization, frequently proposed job demands primarily foster mental (in contrast to physical) costs through the restructuring of the immediate working environment (Zeike et al., 2019) as well as through an increased complexity and an intensification of job tasks (Green, 2004b, 2004a; Meyer & Hünefeld, 2018).

Job resources can be any physical, social, or organizational aspect of a job that buffers the strain caused by job demands (McGonagle, Fisher, Barnes-Farrell, & Grosch, 2015). The job resources most commonly examined are autonomy (Bakker & Demerouti, 2007) as well as the support from supervisors and from peers (Nahrgang et al., 2011). These traditional job resources were found to act as a buffer against the impact of non-digital work demands on emotional exhaustion.

An extension to the original JD-R model is the consideration of personal resources as a further potential buffer effect (Bakker & Demerouti, 2014). Personal resources in the original sense are "*positive self-evaluations*" which refer to an employee's perceived capability to control and influence his /her working environment (Bakker & Demerouti, 2014). However, not only personality traits but also demographic factors such as age are of importance when it comes to the effects of digital job demands (Brewer & Shapard, 2004). Age shapes employees' attitudes, values and beliefs (Balkundi et al., 2007) and, thus, influences employees' perception of the working environment as well as their reaction to it (Schaufeli & Taris, 2014).

## 2.3 Digitization and Job Demands

According to the JD-R, digital job demands take their toll on employees' mental well-being and lead to emotional exhaustion. Digitization brings forth new technological bases for collaboration, production, and the organization of businesses worldwide (BMAS, 2017). As a consequence, there is a continuous introduction of new manufacturing technologies,

machines, and software. The constant implementation of new technologies leads to small but frequent restructuring processes within the organization (Bayo-Moriones et al., 2015; Dedrick, Gurbaxani, & Kraemer, 2003). Continuous changes in the working environment disrupt familiar working processes (Bamberger et al., 2012) and pose undesirable constraints for employees (Crawford et al., 2010). As a consequence employees are kept from applying their knowledge and skills efficiently and from attaining their goals (Cavanaugh et al., 2000; LePine et al., 2004). Past research has demonstrated that hindrances at work provoke negative emotions, deplete mental energy resources and lead to emotional exhaustion (Crawford et al., 2010; LePine et al., 2004). Therefore, I hypothesize:

> *Hypothesis 1:* Digital hindrance demands taken together (introduction of new machines / software / products and restructuring processes) are positively associated with emotional exhaustion.

Digital challenge demands such as the increasing task complexity and intensity might also fuel the experienced emotional exhaustion (Green, 2004a; Korunka & Kubicek, 2013; Meyer & Hünefeld, 2018). Digitization threatens job tasks that follow a structured and well-defined procedure because they can be substituted by smart algorithms (Acemoglu & Autor, 2011; Frey & Osborne, 2017). Especially administrative, accounting, and sales activities such as calculating, monitoring but also data analyzing are prone to computerization (Acemoglu & Autor, 2011; Lewandowski, Keister, Hardy, & Górka, 2017). At the same time, digitization complements high-skilled job tasks (Bresnahan, Brynjolfsson, & Hitt, 2002; Gerten et al., 2018) which leads to employees fulfilling more multifaceted, creative, social and strategic tasks (Frey & Osborne, 2017; Humphrey, Nahrgang, & Morgeson, 2007). Examples are abstract reasoning, problem-solving and the coordination of decentralized knowledge and people across departments within an organization (Autor, Katz, & Kearney, 2006; Di Nunzio, Hohnen, Hasle, Torvatn, & Øyum, 2009). These complex job tasks are associated with higher psychological costs (Meyer & Hünefeld, 2018). In their seminal meta-analysis Nahrgang and colleagues (2011) found task complexity to be one of the most important constructs influencing employees' mental well-being.

Digitization also increases task intensity (Chesley, 2014). ICT-based organizations allow for a more efficient design of workflows, for an immediate feedback from colleagues (Green, 2004a) and for multi-tasking (Chesley, 2014; Kubicek, Paškvan, & Korunka, 2015).

As a consequence, work becomes more dense requiring employees to fulfill an increasing number of job tasks in a limited time (Korunka & Kubicek, 2017). The increasing task intensity instills employees with the feeling that they constantly need to work faster (Korunka & Kubicek, 2013). Tough deadlines, multi-tasking, and the decline of idle time results in the feeling of being rushed and, thus, in the further depletion of employees' energy (Green, 2004a; Korunka & Kubicek, 2013; Kubicek et al., 2015). Therefore, I hypothesize:

> *Hypothesis 2:* Digital challenge demands taken together (task complexity, task intensity) are positively associated with emotional exhaustion.

## 2.4 Traditional Job Resources

Whereas digital job demands might provoke emotional exhaustion of employees, job resources might buffer the impact (Xanthopoulou et al., 2007). As a consequence, when high digital job demands are counteracted with high resources, employees will experience a low level of emotional exhaustion (Bakker & Demerouti, 2007). Which kind of job resources play a role in reducing the effect on emotional exhaustion depends on the nature of job demand (Bakker et al., 2004).

In the past, autonomy and support from leaders and peers were acknowledged as important job resources across different work environments (Bakker et al., 2005). The role of autonomy has already been stressed in Karasek's original model (1979). Autonomy is the level of discretion an employee has over the task and time constraints at hand (Alarcon, 2011). Bakker and colleagues (2005) found that autonomy helps employees in dealing with job demands because they can decide when and in what way they meet these demands. In addition, social support might also buffer the possible impact of digital hindrance and digital challenge demands. Advice and encouragement are crucial in helping employees deal with increased work intensification (Korunka & Kubicek, 2017). Rigg and colleagues (2013) have demonstrated that social support from advisors reduces students' level of emotional exhaustion in cognitive demanding environments. Furthermore, Bakker et al. (2005) have shown that supervisors provide employees with feedback, help them in perceiving and understanding present hindrances and might also support them in dealing with challenging job demands. Therefore, I hypothesize:

*Hypothesis 3a:* Taken together, traditional job resources (autonomy, support from leader, support from peers) buffer the positive relationship between digital hindrance demands and emotional exhaustion.

*Hypothesis 3b:* Taken together, traditional job resources (autonomy, support from leader, support from peers) buffer the positive relationship between digital challenge demands and emotional exhaustion.

## 2.5 Age as a Personal Resource

The age of employees might be another important influencing factor on the relationship between digital job demands and emotional exhaustion (Abbasi & Bordia, 2019). Employees belonging to different age groups tend to adhere to diverging norms, beliefs and values (Balkundi et al., 2007). Therefore, employees belonging to young (i.e., 15 – 34 years), middle-aged (i.e., 35 – 54 years), and mature age groups (i.e., 55 – 65 years) might perceive their working environment differently and also react differently to it (Balkundi et al., 2007; Schaufeli & Taris, 2014). Past research has demonstrated that the acceptance of technology decreases with age (Hauk, Hüffmeier, & Krumm, 2018) and that mature adults do not adopt new technology as easily as young adults (Czaja et al., 2006). In a meta-analysis covering 144 primary studies Hauk et al. (2018) confirm that the perceived ease of technology use decreases with age. Hence, with increasing age employees need more time and energy to adapt to newly introduced technology and to adapt to the related restructuring process within organizations. Therefore, I hypothesize:

*Hypothesis 4a:* Age intensifies the positive relationship between digital hindrance demands and emotional exhaustion.

In contrast, middle-aged and mature employees are equipped with more years of working experience and, thus, dispose of a larger pool of coping skills (Hauk, Göritz, & Krumm, 2019). Under time pressure, ageing employees can rely on heuristic strategies by accessing existing knowledge rather than reverting to analytical approaches (Sluiter, 2006). As a consequence, they are able to extract solutions faster and tend to feel less stressed when it comes to complex decision-making tasks (Abbasi & Bordia, 2019; Blanchard-Fields, 2007). Giniger and colleagues (1983) have confirmed that mature industrial workers perform better in time-sensitive jobs than their younger co-workers. Therefore, I hypothesize:

*Hypothesis 4b:* Age buffers the positive relationship between digital challenge demands and emotional exhaustion.

# 3 METHODS

## 3.1 Sample

The statistical analysis is based on the 2012 version of the BIBB/BAuA Employment Survey, which is conducted every six years by the Federal Institute for Vocational Education and Training (BIBB) and the German Federal Institute for Occupational Safety and Health (BAuA). With 20,036 participants in 2012, the cross-sectional survey constitutes a representative study of employees in Germany. The survey targets all full-time employees in Germany aged 15 or above who work at least 10 hours per week (Rohrbach-Schmidt & Hall, 2013); apprentices are excluded from the study. In targeting both the topic of "*work and occupation in transition*" and mental strains of employees (Rohrbach-Schmidt & Hall, 2013), the survey is particularly suited for the present research questions. The survey was conducted by TNS Infratest between October 2011 and April 2012 via computer-assisted telephone interviews (CATI) (Rohrbach-Schmidt & Hall, 2013).

Further inclusion criteria were applied to the data. The present analysis included dependently employed white-collar[1] workers up to 65 years[2] who worked full-time (i.e., ≥ 30 hours per week), were employed for at least one year in their current job, and had a working contract with indefinite duration. In order to guarantee that the effects of emotional exhaustion can be traced back to their main employment, individuals with additional part-time jobs were excluded. Finally, this study excluded microenterprises with less than 10 employees since the organizational structure as well as HR practices of microenterprises (e.g., job resources) differ considerably from the structure of bigger firms (Rodwell & Shadur, 1997). The resulting sample consisted of 6,855 observations with 3,338 (48.7 %) male and 3,517 (51.3 %) female employees.

## 3.2 Measures

Responses to the BIBB/BAuA Employment Survey 2012 questions were used to construct the dependent variable emotional exhaustion as well as the explanatory variables digital

[1] Abbasi and Bordia (2019) call for a separate analysis of either white- or blue-collar workers. They argue that different kinds of "cognitive demands" of white- and blue-collar workers prevent the detection of age effects. This study focuses on white- instead of blue collar workers, since IT-enabled organizational change was found to result in more extensive use of high-skilled labor (Bresnahan et al., 2002).

[2] The statutory retirement age in Germany was 65 for the oldest age cohort surveyed in 2012. Individuals working longer than necessary do so for heterogenous reasons. To avoid distorting effects, employees older than 65 years were excluded from the analysis (Meyer & Hünefeld, 2018).

hindrance and digital challenge job demands, the moderating effects of traditional resources and age as well as a number of control variables. A detailed list of the variables, their operationalizations and the respective value ranges is in the appendix (table 4).

*Emotional exhaustion*. The survey included four questions regarding the level of emotional exhaustion. Participants were asked whether they experienced "night-time sleeping disorders", "general tiredness, faintness or fatigue", "nervousness or irritability", and "emotional exhaustion" in the past 12 months in connection with their work. Responses were either "yes" (coded = 1) or "no" (coded = 0)[3]. The answers to the four items were summed up and averaged (Cronbach $\alpha = 0.744$) so that the variable ranged between 0 and 1. The contents of the questions are similar to the 5-items emotional exhaustion subscale of the Maslach Burnout Inventory – General Survey (i.e., "I feel tired in the morning"; "I feel emotionally drained from my job") (Maslach & Jackson, 1981; Schaufeli & Buunk, 1996) which was validated in past studies across nations and occupational groups (Bakker, Demerouti, & Schaufeli, 2002; Toppinen, Kalimo, Schaufeli, & Schutte, 2000).

*Digital hindrance demands.* Participants were asked whether they experienced changes in their immediate working environment, such as "new computer programs", "new manufacturing or process technologies" or "new services". Possible answers were either "yes" (coded = 1) or "no" (coded=0). The answers to the six items were summed up (Cronbach $\alpha = 0.629$)[4] and averaged. Thus, the variable took on values between 0 and 1.

*Digital challenge demands*. The two digital challenge demands task complexity and task intensity were included in the present study and aggregated into one variable. Answers ranged from 1 = "never" to 3 = "often"[5]. *Task complexity* was measured with three items (Cronbach $\alpha = 0.712$). A sample item is "How often is it that you have to react to and solve problems?". *Task intensity* was measured with two items (Cronbach $\alpha = 0.575$). A sample item is "How often does it happen in your occupational activity that you have to work under strong pressure of time or performance?". Owing to the low Cronbach α value, an additional confirmatory factor analysis was performed. Since both factor loadings exceeded 0.5, both

[3] In the original dataset the answer "no" was coded = 2. To ease later interpretation the variable was recoded to 0. All "yes" / "no" variables were recoded accordingly.

[4] The low Cronbach α value stems from the cross-industry and cross-organizational research sample. Depending on the respective industry or organization different kinds of technological advances might correlate positively or negatively. To catch the technological advance in different industries, I accept the low Cronbach α.

[5] The scale for task intensity was recoded from originally 1 ("never") to 4 ("often") to fit the scale of task complexity. In doing so, the original scale values 2 ("rarely") and 3 ("sometimes") were combined.

items were retained in the calculation of task intensity (Hair, Black, Babin, & Anderson, 2006). The overall variable of digital challenge demands combined task complexity and task intensity and took on values between 1 and 3.

*Traditional job resources.* Three traditional job resources were included in the present study and aggregated into one variable. Every resource was measured with one item, answers ranged from 1 = "never" to 4 = "often". *Autonomy* was measured with the question: "How often does it happen that you can plan and schedule your work on your own?". *Support from the leader* was measured by asking the participants "How often do you receive help and support for your work from your direct supervisor?". *Support from peers* was measured with the question "How often do you consider the collaboration between you and your <colleagues> to be good?". The overall construct of traditional job resources ranged between the values 1 and 4.

*Age.* The participants were divided into three age group (i.e., 15 – 34 years, 35 – 54 years, 55 – 65 years) (cf. Meyer & Hünefeld, 2018) to account for young, middle-aged and mature employees.

*Control variables.* Three types of control variables were included: Four non-digital work-demands, three personal characteristics, and ten industry dummy variables. First, non-digital job demands (i.e., work-home interference, job insecurity, unfavorable work conditions, weekly working hours) were included in the analysis in order to control for their effect on the dependent variable. In addition, the effect sizes of non-digital job demands pose an interpretation aid by providing a well-researched benchmark to rank the impact of digital demands on emotional exhaustion. *Work-home interference* was measured with one item ("How often do you succeed in taking your private interest and the interest of your family into account when planning your working hours?", 1 = "often" – 3 = "never"). *Job insecurity* was measured with one item ("How high do you think is the likelihood that you will be laid off by the firm in the near future?", 1 = "completely unlikely" – 4 = "very high"). *Unfavorable work conditions* was measured with 13 items. A sample item is "How often do you work exposed to noise?" with answers ranging from 1 = "never" to 4 = "often" (Cronbach $\alpha = 0.872$). *Weekly working hours* was measured as a continuous variable in hours.

Second, personal characteristics were controlled since they might influence how the working environment and therefore how digital job demands are perceived (Schaufeli &

Taris, 2014). Therefore, the *gender* of participants ("female" = 1, "male" = 0), four dummy variables for the *highest qualification level* ("no qualification", "firm-/ school-based apprenticeship", "advanced further training", "university or technical college degree") and a dummy variable for whether or not the participant fills a *leadership position* ("yes" / "no") were included in the analysis.

Third, to account for diverging influences of digitization across industries (Bradley, Loucks, Macaulay, Noronha, & Wade, 2015), ten *industry dummies* in accordance with the German Classification of Economic Activities were included.

# 4 RESULTS

## 4.1 Descriptive Statistics

Table 1 shows the means, standard deviations and the correlation coefficients of the focus variables. The total number of participants who fit the inclusion criteria is 6,855 ranging from 19 to 65 years. The mean sample age is 46.7 years. The mean level of emotional exhaustion ($\mu = 0.33$) is moderate, however the level of emotional exhaustion varies widely in the sample (SD = 0.35).

**Table 1: Descriptive Statistics and Correlations**

| Variables | Mean | SD | 1 | 2 | 3 | 4 | 5a | 5b |
|---|---|---|---|---|---|---|---|---|
| 1. Emo. exhaustion | .33 | .35 | | | | | | |
| 2. Digital hindrances | .44 | .32 | .13*** | | | | | |
| 3. Digital challenges | 2.48 | .37 | .19*** | .22*** | | | | |
| 4. Trad. resources | 3.63 | .47 | -.26*** | -.01 | .03* | | | |
| 5. Age | 46.66 | 9.71 | | | | | | |
| *a. 15 – 34 years* | | | -.03* | .03** | .03** | -.02 | | |
| *b. 35 – 54 years* | | | .02† | .03** | .05*** | .03** | -.52*** | |
| *c. 55 – 65 years* | | | .00 | -.07*** | -.08*** | -.02* | -.23*** | -.71*** |

*Notes*: N = 6,855; *** p < .001, ** p < .01, * p < .05, † p < .1

As table 1 shows, emotional exhaustion was significantly and positively correlated with both digital hindrance and digital challenge demands and negatively correlated with traditional job resources. Furthermore, digital hindrance and digital challenge demands were highly positively correlated. Surprisingly, traditional job demands were uncorrelated with digital hindrance demands and only weakly correlated with digital challenge demands. As can be seen in the appendix (table 5), traditional job resources were negatively correlated with non-digital job demands and positively correlated with leadership positions of employees. Finally, table 1 shows that the strength and the direction of the correlation between age and emotional exhaustion as well as the correlations between age and the three main explanatory variables varied across age groups. This justified to take a closer look at the role of age in the subsequent regression analysis.

## 4.2 Approach

To test the hypotheses, I applied a moderated hierarchical regression analysis. The first model only contained the control variables (i.e., non-digital job demands, personal characteristics, industry dummies). In the second model, digital hindrance demands and digital challenge demands were entered. In a third step, traditional job resources and age

were entered into the analysis. Standardized beta coefficients of the main effects were calculated to enable the comparison of effect strength on employees' emotional exhaustion. To test the interaction effects, four separate hierarchical regressions were run. In doing so, the changes in $R^2$ values compared to the model without moderators gave first indications about the explanatory strength of the moderators (Aiken & West, 1991).

## 4.3 Test of the Hypotheses

Table 2 shows the stepwise development of ordinary least square (OLS) estimates for the main effects, the robust standard error in parenthesis, $R^2$ values, changes ($\Delta$) in $R^2$ as well as the standardized beta coefficients for Model 3. Regarding the main effects, both digital hindrance demands ($b = 0.111$, $p < 0.001$) and digital challenge demands ($b = 0.157$, $p < 0.001$) had a highly significant positive effect on emotional exhaustion. These results confirm hypothesis 1 and 2. Digital challenge demands constituted the second highest positive factor in the model ($\beta = 0.166$, $p < 0.001$), only surpassed by work – home interference ($\beta = 0.171$, $p < 0.001$). Furthermore, digital hindrance demands ($\beta = 0.101$, $p < 0.001$) represented the third highest factor that influenced emotional exhaustion.

Traditional job resources had a highly significant negative effect on emotional exhaustion ($b = -0.135$, $p < 0.001$). In contrast, age had a significant and positive influence on emotional exhaustion. Both 35 – 54-year-old employees ($b = 0.034$, $p < 0.01$) as well as 55 – 65-year-old employees ($b = 0.044$, $p < 0.01$) suffer more from emotional exhaustion than the reference group of young adults.

Table 3 summarizes the results of the hierarchical moderator analysis. Hypothesis 3a and 3b examined the moderating effect of traditional resources on digital hindrance and digital challenge demands. As depicted in table 3, the results were (tentatively) consistent with hypothesis 3a. There was a significant interaction between digital hindrance demands and traditional resources ($b = -0.051$, $p < 0.1$; $\Delta R^2 = 0.0004$). As hypothesized, the direction of this interaction buffered the positive relationship between digital hindrance demands and emotional exhaustion. There was also a significant negative main effect of traditional resources on emotional exhaustion ($b = -0.112$, $p < 0.001$). Traditional resources also buffered the relationship between digital challenge demands and emotional exhaustion. ($b = -0.062$, $p < 0.01$; $\Delta R^2 = 0.001$), thus confirming hypothesis 3b. Having introduced the digital challenge demands x traditional resources interaction into the model, the main effect of traditional resources on emotional exhaustion turned insignificant.

Hypothesis 4a has to be rejected. Age did not significantly moderate the relationship between digital hindrance demands and emotional exhaustion. Hypothesis 4b can only partly be confirmed. The age group of 55-65-year-olds buffered the influence of digital hindrance demands on emotional exhaustion ($b$ = - 0.068, $p < 0.05$; $\Delta R^2 = 0.0004$). Notably, with the interaction effect of age becoming significant, the main effect of age on emotional exhaustion increased significantly and exerted a strong positive effect on emotional exhaustion (35-54-year-olds: b = 0.144, p < 0.05; 55-65-year-olds: b = 0.213, p < 0.01).

## 4.4 Robustness Check

As a robustness check on the results with aggregate variables (i.e., digital hindrance demands, digital challenge demands, and traditional resources), the regression analyses were also run with the single variables (e.g., introduction of new software / machines / products, task complexity, task intensity, etc.). Also taken separately, every variable consented with the previously hypothesized direction of effects. Whereas every digital job demand had a highly significant positive effect on emotional exhaustion, traditional job resources, taken separately, had a negative effect. The one exception was the effect size of autonomy. Although resulting in the previously hypothesized negative direction, the effect of autonomy on emotional exhaustion was not significant. In contrast, support from the leader had the highest negative (standardized) effect on emotional exhaustion and was therefore the most effective resource for employees. Task intensity had the highest positive effect on emotional exhaustion. See appendix (table 6) for the detailed regression results.

Furthermore, the VIF was calculated to check for multicollinearity. The mean VIF value was 1.93 and therefore below the cutoff value of 10 (Chatterjee, Hadi, & Price, 2000; Cohen, Cohen, West, & Aiken, 2003). The results of this analysis were therefore not affected by multicollinearity.

**Table 2: Hierarchical Regression**

| DV: Emotional Exhaustion | Model 1 | | Model 2 | | Model 3 | | Model 3 Beta |
|---|---|---|---|---|---|---|---|
| **Control variables** | | | | | | | |
| **Non-digital job demands** | | | | | | | |
| Work-home interference | .133*** | (.007) | .125*** | (.007) | .101*** | (.007) | .171 |
| Job insecurity | .070*** | (.007) | .063*** | (.007) | .052*** | (.007) | .089 |
| Unfavorable physical work conditions | .072*** | (.007) | .059*** | (.007) | .051*** | (.007) | .094 |
| Working hours (week) | .001 | (.001) | -.001 | (.001) | -.001 | (.001) | -.011 |
| **Personal characteristics** | | | | | | | |
| Gender | .097*** | (.009) | .094*** | (.009) | .091*** | (.009) | .130 |
| Leadership position | -.025*** | (.008) | -.052*** | (.008) | -.043*** | (.008) | -.060 |
| Highest qualification | | | | | | | |
| *Apprenticeship* | .009 | (.022) | -.008 | (.021) | .007 | (.022) | .010 |
| *Advanced training* | .024 | (.024) | -.006 | (.024) | .013 | (.024) | .012 |
| *University* | .018 | (.023) | -.020 | (.022) | .003 | (.022) | .004 |
| **Industry sectors** | | | | | | | |
| Agriculture / etc. | -.075** | (.024) | -.070** | (.023) | -.063** | (.023) | -.031 |
| Other manufacturing | -.066*** | (.017) | -.059*** | (.016) | -.053** | (.016) | -.047 |
| Metal- & electrical ind. | -.059*** | (.015) | -.062*** | (.015) | -.052*** | (.015) | -.054 |
| Construction | -.121*** | (.021) | -.095*** | (.021) | -.081*** | (.020) | -.044 |
| Retail | -.063*** | (.018) | -.046** | (.017) | -.045** | (.017) | -.035 |
| Private service sector | -.025 | (.016) | -.016 | (.016) | -.014 | (.016) | -.013 |
| Banking and insurance | -.001 | (.020) | -.008 | (.020) | -.003 | (.019) | -.002 |
| Business-related services | -.033 | (.021) | -.023 | (.020) | -.016 | (.020) | -.011 |
| Public service | .019 | (.015) | .032* | (.015) | .030* | (.014) | .031 |
| **Main explanatory variables** | | | | | | | |
| **Digital demands** | | | | | | | |
| Digital hindrances | | | .111*** | (.013) | .111*** | (.013) | .101 |
| Digital challenges | | | .149*** | (.011) | .157*** | (.011) | .166 |
| **Resources** | | | | | | | |
| Trad. job resources | | | | | -.135*** | (.010) | -.172 |
| Age | | | | | | | |
| *35 – 54 years* | | | | | .034** | (.011) | .047 |
| *55 – 65 years* | | | | | .044** | (.013) | .054 |
| Constant | -.221*** | (.042) | -.495*** | (.045) | .007 | (.061) | |
| $R^2$ | .1290 | | .1654 | | .1930 | | |
| $\Delta R^2$ (vs. Model 1) | - | | .0364 | | .0276 | | |

*Notes*. Robust standard errors in parentheses; reference industry = health and social services; reference qualification level = no qualification; reference age = 15 - 34 years; *** p < .001, ** p < .01, * p < .05, † p < .1

**Table 3: Moderator Analysis**

| DV: Emotional Exhaustion | Model 3 | | Model 4a | | Model 4b | | Model 4c | | Model 4d | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Main explanatory variables** | | | | | | | | | | |
| **Digital job demands** | | | | | | | | | | |
| Digital hindrance demands | .111*** | (.013) | .299** | (.107) | .111*** | (.013) | .128*** | (.032) | .111*** | (.013) |
| Digital challenge demands | .157*** | (.011) | .157*** | (.011) | .379*** | (.081) | .157*** | (.011) | .202*** | (.027) |
| **Resources** | | | | | | | | | | |
| Traditional job resources | -.135*** | (.010) | -.112*** | (.016) | .017 | (.053) | -.135*** | (.010) | -.135*** | (.010) |
| Age | | | | | | | | | | |
| *35 – 54 years* | .034** | (.011) | .033** | (.011) | .033** | (.011) | .042* | (.020) | .144* | (.074) |
| *55 – 65 years* | .044** | (.013) | .043** | (.013) | .043** | (.013) | .054* | (.022) | .213** | (.081) |
| **Moderating effects** | | | | | | | | | | |
| Trad. resources x dig. hindrances | | | -.051† | (.029) | | | | | | |
| Trad. resources x dig. challenges | | | | | -.062** | (.022) | | | | |
| 15 - 34 years x dig. hindrances | | | | | | | .000 | (.000) | | |
| 35 - 54 years x dig. hindrances | | | | | | | -.019 | (.036) | | |
| 55 - 65 years x dig. hindrances | | | | | | | -.023 | (.040) | | |
| 15 - 34 years x dig. challenges | | | | | | | | | .000 | (.000) |
| 35 - 54 years x dig. challenges | | | | | | | | | -.044 | (.030) |
| 55 - 65 years x dig. challenges | | | | | | | | | -.068* | (.033) |
| Constant | .007 | (.061) | -.084 | (.074) | -0.547*** | (.199) | -.014 | (.062) | -.119 | (.086) |
| $R^2$ | .1930 | | .1934 | | .1940 | | .1930 | | .1934 | |
| $\Delta R^2$ (vs. Model 3) | - | | .0004 | | .0010 | | .0000 | | .0004 | |

*Notes.* Robust standard errors in parentheses; reference industry = health and social services; reference qualification level = no qualification; reference age = 15 - 34 years; *** p < .001, **p < .01, * p < .05, † p < .1

# 5 DISCUSSION

## 5.1 Theoretical Implications

The focus of this research paper is to understand the effect of digitization on the emotional exhaustion of employees. By introducing the concept of digital job demands, I have used the Job-Demands and Resources (JD-R) model as a tool to assess the effect of digital hindrances and digital challenges on emotional exhaustion (Bakker et al., 2004). In addition, this paper examines the buffering effect of traditionally granted resources and answers to calls to reveal differences of perceived strain across age groups (Berg-Beckhoff et al., 2017).

The analysis of 6,855 white collar workers in Germany shows that digital hindrances and digital challenges have a high impact on emotional exhaustion among the factors considered in this study. Traditional resources (i.e., autonomy, the support of leaders and of peers) and increasing age helps alleviating the effect of digital challenge demands. In contrast, emotional exhaustion caused by digital hindrances is unaffected by age and can only limitedly be buffered by traditional resources.

Digitization plays a significant role in the potential development of emotional exhaustion. In this respect, the comparison to well-substantiated effect sizes of non-digital job demands provides a benchmark to interpret the effect strength of digital job demands. Previous studies have demonstrated that work-home interference correlates the highest with emotional exhaustion (Bakker et al., 2005). In this paper, digital hindrances and digital challenges taken together surpass the effect of work-home interference by far. The comparison therefore underlines the strength of digital job demands further and highlights the necessity to carefully consider their negative impact on employees' mental well-being.

Considering digital hindrances and challenges separately, the impact of digital challenge demands on emotional exhaustion is slightly below the level of work-home interference. This shows that digital challenges alone play an essential part in employees' mental well-being. In the digital future, employees need to fulfill more multifaceted tasks, including social, creative and strategic elements (Frey & Osborne, 2017; Humphrey et al., 2007) and do so at a faster pace (Korunka & Kubicek, 2017). The results of this paper indicate that these task and time challenges are related to significantly higher psychological costs (Meyer & Hünefeld, 2018).

Digital hindrance demands exerted the third highest impact on emotional exhaustion. Therefore, this paper confirms results of past research that found organizational hindrances to be a threat to employees' mental well-being (Bamberger et al., 2012; de Jong et al., 2016) and validates these results for digital hindrances. Restructuring processes within organizations interrupt everyday work and keep employees from applying their skills effectively and, thus, from achieving their goals (Cavanaugh et al., 2000; LePine et al., 2004). Since digitization brings forth new technologies at a growing speed, employees are confronted regularly with small technological restructuring processes and with changes in their direct work environment (Bamberger et al., 2012). The more frequently these small technological changes occur, the more they will turn into a hassle for employees, which have to be overcome at an additional psychological cost.

If not buffered by suitable resources, employees might feel exhausted or suffer from burnout in the long run (Bakker et al., 2005). An important result of this study is however, that traditionally granted resources might not be implemented where needed. Traditional resources were uncorrelated with digital hindrance demands and only weakly correlated with digital challenge demands. The results of the detailed correlation table in the appendix (table 5) indicate further that resources are primarily granted according to the employees' position (i.e., leadership position) within the organization. However, a shift in task complexity and intensity is not constrained to employees on the managerial level. It is therefore necessary to base the decision for the provision of resources on the demands the employees face in contrast to their hierarchical position. The restricted access of mid-level employees to autonomy might be one reason for the insignificant effect of autonomy on emotional exhaustion. Another possible explanation might be that autonomy per se is not beneficial for employees (Kubicek, Paškvan, & Bunner, 2017; Warr, 2011). In contrast to Karasek's original demand-control model (1979), Warr (1994; 1990) claims that some job characteristics such as autonomy can have a detrimental effect on employees' mental well-being when provided in excess. Due to digitization the extent of autonomy is increasing (Bresnahan et al., 2002). Among other things, modern ICT grants employees access to a wide range of knowledge via online channels and enables them to work independently of fixed schedules and locations (Demerouti, Derks, & Lieke, 2014). The additional increase of autonomy for high-skilled workers might lead to blurring boundaries between work and free time (Demerouti et al., 2014), to stress, task insecurity, and burnout (Wieland, Klemens, Scherrer, & Timm, 2004).

When considering the potential buffering effect of traditionally granted resources taken together (i.e., autonomy, support from leaders and peers), the positive effect of digital hindrance demands on emotional exhaustion could only limitedly be counteracted. This is a surprising result, considering that social support from colleagues and supervisors in particular (Swanson & Power, 2001) were found to help employees after (non-digital) organizational restructuring processes. One explanation for the weak buffering effect might be that the items of the variable "traditional resources" had a strong focus on instrumental support. Social support per se, however, consists of both instrumental and emotional support. This might indicate that instrumental and emotional support have to be considered separately. The items included in this study queried task-based support, thus excluding the emotional aspect. However, emotional support might play a key role in reducing emotional exhaustion in the face of hindrances. Zorn (2003) even claims the emotional experience during ICT implementation to be essential to its success. Hindrances cannot be pro-actively tackled. As a consequence, the caring and understanding of colleagues and supervisors as well as the opportunity of emotional venting if feeling frustrated might be effective in reducing emotional exhaustion (Zorn, 2003).

In contrast to their weak buffering effect in case of digital hindrances, traditional resources alleviated the positive effect of digital challenge demands on emotional exhaustion. The moderating effect reported the highest change in variance explained by the regression model ($\Delta R^2 = 0.001$). This confirms the long established role of support by supervisors and peers (van den Broeck et al., 2010) as key resources for employees' mental well-being. In contrast to hindrances, digital challenges can be tackled pro-actively with instrumental help. Instrumental support from supervisors provide employees with the right information on how to deal with digital challenges such as increased task complexity and intensity (Bakker & Demerouti, 2007). Furthermore, it is more important than ever to trust on the cooperation and instrumental help of co-workers. Due to digitization employees have to coordinate decentralized knowledge and people across departments in order to succeed (Di Nunzio et al., 2009). By knowing that co-workers provide instrumental support, employees feel less stressed when facing challenging tasks.

Not only traditional resources but also age within the 55 – 65-years-cohort successfully buffered the negative effect of digital challenge demands on emotional exhaustion. In other words, mature employees are not as easily stressed by digital challenges as their younger colleagues (Ragu-Nathan et al., 2008). Especially if 55 – 65-years-old employees have built

a substantial knowledge base over their working years, they are able to apply existing knowledge to find suitable solutions to complex job demands in a faster way and without feeling emotionally exhausted (Abbasi & Bordia, 2019). The prerequisite is that the employees built such a knowledge base by having been confronted with complex problems throughout their career. This aspect is also mirrored in the moderator analysis. With the introduction of the interaction effect of age on the relationship between digital challenges and emotional exhaustion, the first-order effect of age on emotional exhaustion increases significantly. In other words, if not confronted with challenging demands, ageing exerts a strong positive effect on emotional exhaustion. This result confirms the "*use-it-or-lose-it*"-theory, showing that cognitively complex job tasks are related to high cognitive abilities of employees in their 60s (Fisher, Chaffee, Tetrick, Davalos, & Potter, 2017). In this respect, Bielak and colleagues (2007) have found that the engagement in cognitively demanding and in particular the processing of new information prevents a decline in cognitive abilities.

In contrast to digital challenges, the effect of digital hindrance demands does not vary across age groups. Therefore, the implementation of new technologies and the related restructuring processes within organizations do neither stress middle-aged nor mature employees more than their younger colleagues. Although ageing employees might need more time to adapt to new technologies, this does not mean that this slower adoption is related to a higher level of stress. Therefore, ageing employees do not encounter technological change with higher computer anxiety (Hudiburg & Necessary, 1996; Rosen & Maguire, 1990) and are able to handle such hindrances as much as their younger counterparts do (Ragu-Nathan et al., 2008).

## 5.2 Practical Implications

Demographic changes turn the retention of employees into a frequently discussed issue by practitioners (Fisher, Chaffee, & Sonnega, 2016). In order to prevent labor shortage in the digital future, companies are interested in navigating their employees safely through the inevitable digitization process. In doing so, it is essential to implement adequate resources to minimize negative effects on employees' mental well-being.

Digital hindrance demands should be in the focus of new work design. Although digital challenge demands have a higher impact on emotional exhaustion, they can be proactively counteracted with traditional resources and are alleviated with increasing age. In contrast, digital hindrances cannot be alleviated by age and only limitedly be alleviated by autonomy

and / or support from leaders and peers. Furthermore, if employees lose valuable resources in trying to deal with digital implementation processes, their mental resources might already be depleted when they are facing more challenging job demands in the long run.

Therefore, it is important to design the implementation processes of new technology as smooth as possible. In this respect, Ragu-Nathan and colleagues (2008) underline the importance of practical support mechanisms such as the provision of technical support and the involvement of employees in the rationales and motivations for implementing new technologies, software, and machines. Emotional support might also help employees when feeling exhausted by the continuous introduction of new machines and software as well as the related change in working environment and processes. In this respect, past research recommends regular discussion meetings that encourage the exchange of experience and knowledge regarding newly implemented technologies (Ragu-Nathan et al., 2008). During these meetings employees learn how to use new technologies faster and with a reduced level of emotional exhaustion (Ragu-Nathan et al., 2008) and at the same time have the opportunity to vent frustrations about misgivings (Zorn, 2003). In allowing for enhanced discussion during implementation, Zorn (2003) underlines the necessity of supervisors to guide their employees, in particular key users, emotionally. If key users communicate positive experience with new technologies during exchange sessions, their emotion towards and experience with new technologies tend to influence the perception of their colleagues (Zorn, 2003).

Following the "*use-it-or-lose-it*" hypothesis (Hultsch, Hertzog, Small, & Dixon, 1999) employees have to be continuously confronted with intellectually stimulating tasks over their lifespan. In doing so, employees have the opportunity to build a solid knowledge base during their working life which acts as a buffer against cognitive decline in old age and which helps them deal with digital challenges. In this regard, job rotation, tasks with diverging level of requirements, and systematic training of cognitive abilities can help mature employees to master digital challenges (Falkenstein, 2017).

Age diverse teams might further support the smooth adoption of new technologies within companies. Ageing employees are able to apply existing knowledge to find suitable solutions to complex tasks without feeling emotionally exhausted (Abbasi & Bordia, 2019). Therefore, they can share their insights, their experience, and their coping strategies with

their younger colleagues (Hauk, 2018). In exchange, younger workers might support ageing colleagues in handling new technologies at a faster pace.

## 5.3 Limitations and Future Research

There are three limitations to the findings in this research paper: First, the cross-sectional data of the study does not allow causal conclusions. It is not possible to judge whether time would change the relationship among the variables. The statements in this paper regarding causal relationships are therefore deducted from well-researched theory.

Second, all variables in this study were obtained from the subjective assessments of survey participants. If both dependent and independent variables stem from the same source, common method bias might arise (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). However, past research has found that common method variance does not lead to overestimation in the case of moderating analysis (Barling, Rogers, & Kelloway, 1995) but exerts a weakening effect on the statistical results (Conway & Briner, 2002).

Third, the variables of task complexity and task intensity were attributed to the process of digitization. However, complexity and intensity are not solely caused by digitization. Higher-level managers had to deal with task complexity and intensity previous to the process of digitization. Still, I argue that digitization causes a shift in both complexity and intensity. This proposition is supported by past research (Green, 2004a; Korunka & Kubicek, 2013; Meyer & Hünefeld, 2018; Weiß & Wagner, 2017). Furthermore, the significant and positive correlation between digital hindrance demands and digital challenge demands indicates that job complexity and intensity is related to the introduction of new technologies within the organization (table 1).

Apart from these limitations, this study is the first attempt to measure the impact of digitization as a part of job demands more comprehensively. In order to confirm the findings of this study, it is essential for future research to be based on a longitudinal research design. Since the BIBB / BAuA employment survey is conducted every six years, it constitutes a suitable point of departure. When analyzing buffering effects of digitization on emotional exhaustion, it is also advisable to have a closer look at the role of social support. Social support in the past included both emotional (e.g., caring) and instrumental support (i.e., give feedback) (Karasek & Theorell, 1990; Morgeson & Humphrey, 2008). This paper demonstrates that it is worthwhile to analyze potential buffering effects of the two

subcategories separately. Not only social support but also the role of autonomy might need to be re-examined. With the simultaneous decrease in routine and increase in autonomy especially non-managerial employees have the potential to feel exhausted. Therefore, future research should concentrate on the role of autonomy in a digitized working environment. In doing so, particular attention should be paid to differences according to the employees' hierarchical level within the organization.

Furthermore, the variables included in this study are not exhaustive. When it comes to emotional support the experience exchange regarding technological hindrance might be extended to peers outside the organization. Thus broadening the social environment of employees, the external communication might also help buffering the effect of job hindrances on emotional exhaustion (Morgeson & Humphrey, 2008). Also, aside from age the testing of further personal characteristics such as openness-to-change or intrinsic work motivation might be a fruitful avenue for future research.

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# 7 APPENDIX

**Table 4: Operationalizations**

| Variable | Questions, items | Value range | Mean | SD |
|---|---|---|---|---|
| **Emotional Exhaustion** | Please tell me whether you have had the following health complaints during work or on working days in the last 12 months. We are interested in the frequently occurring ailments. | 0 = no, 1 = yes | .332 | .350 |
| | • Night-time sleeping disorders | | | |
| | • General tiredness, faintness or fatigue | | | |
| | • Nervousness or irritability | | | |
| | • Emotional exhaustion | | | |
| **Digital hindrances** | | 0 = no, 1 = yes | .444 | .319 |
| Introduction of new technology | Please tell me now whether the following changes were undertaken in your immediate working environment in the last two years. In the last two years, have… | | | |
| | ...new manufacturing or process technologies been introduced? | | | |
| | ...new computer programs been introduced? We are not talking about new release versions of existing programs here. | | | |
| | ...new machines or equipment been introduced? | | | |
| | ...new or significantly changed products or materials been employed? | | | |
| | ...new or significantly changed services been provided? | | | |
| Restructuring processes | In the last two years, have… | | | |
| | ...there been significant restructurings or reorganisation pertaining to your immediate working environment? | | | |
| **Digital challenges** | | 1 never – 3 often | 2.484 | .370 |
| Task complexity | How often does it happen in your occupational activity ... | | | |
| | ...that you have to react to and solve problems? Does this occur often, sometimes or never? | | | |
| | ...that you have to take difficult decisions autonomously? | | | |

| | | | | |
|---|---|---|---|---|
| | ...that you have to convince other people and negotiate compromises? | | | |
| Task intensity | How often does it happen in your occupational activity ... | | | |
| | ...that you have to work under strong pressure of time or performance? | | | |
| | ...that you have to work very quickly? | | | |
| **Traditional resources** | | 1 never – 4 often | 3.632 | .470 |
| Support from peers | How often do you consider the collaboration between you and your <colleagues> to be good? | | | |
| Support from leader | And how often do you receive help and support for your work from your direct supervisor if you require it? | | | |
| Autonomy | How often does it happen that you can plan and schedule your work on your own? | | | |
| Age groups | 15 - 34 years | Dummy-coded | | |
| | 35 - 54 years | | | |
| | 55 - 65 years | | | |
| Work-home interference | How often do you succeed in taking your private interest and the interest of your family into account when planning your working hours? | 1 never – 3 often | 1.467 | .595 |
| Job insecurity | How high do you think is the likelihood that you will be laid off by the firm in the near future? | 1 completely unlikely - 4 very high | 1.530 | .602 |
| Unfavorable working conditions | Tell me for each one of the following working conditions whether they occur often, sometimes, rarely or never in your work as [insert job title]. | 1 never – 4 often | 2.710 | .646 |
| | • Working on your feet. | | | |
| | • Lifting and carrying loads of more than < for male TP insert: 20 kg, for female TP: 10 kg > | | | |
| | • Working exposed to fumes, dusts or gases, vapours | | | |
| | • Working exposed to cold, heat, moisture, humidity or draughts | | | |
| | • Working with oil, grease, dirt, grime | | | |
| | • Working in a bent, squatting, kneeling or recumbent position, working overhead | | | |

| | | | | |
|---|---|---|---|---|
| | • Working exposed to powerful shocks, jolts and vibrations that can be felt physically | | | |
| | • Working under harsh light or in light conditions that are poor or too low | | | |
| | • Handling of hazardous substances | | | |
| | • Wearing protective clothing or equipment | | | |
| | • Working exposed to noise | | | |
| | • Dealing with microorganisms like pathogens, bacteria, moulds or viruses | | | |
| Weekly working hours | | 30 - 100 hours | 42.251 | 7.302 |
| Gender | | 0 = male, 1 = female | .507 | .500 |
| Highest qualification level | No qualification | Dummy-coded | | |
| | Firm-/ school-based apprenticeship | | | |
| | Advanced further training | | | |
| | University or technical college degree | | | |
| Leadership position | Do you have colleagues to whom you are the immediate supervisor? | 0 = no, 1 = yes | .385 | .487 |
| Industry sector | Agriculture/ mining / energy / water | Dummy-coded | | |
| | Other manufacturing | | | |
| | Metal and electrical industry | | | |
| | Construction | | | |
| | Commerce | | | |
| | Private service sector | | | |
| | Banking | | | |
| | Business-related services | | | |
| | Public services | | | |
| | Health and social services | | | |

**Table 5: Detailed Correlation Table**

| Variables | 1 | 2 | 3 | 4 | 5a | 5b | 5c | 6 | 7 | 8 | 9 | 10a | 10b | 10c | 10d | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Emotional exhaustion | | | | | | | | | | | | | | | | |
| 2. Digital hindrances | .13*** | | | | | | | | | | | | | | | |
| 3. Digital challenges | .19*** | .22*** | | | | | | | | | | | | | | |
| 4. Trad. resources | -.26*** | -.01 | .03* | | | | | | | | | | | | | |
| 5. Age | | | | | | | | | | | | | | | | |
| *a. 15 – 34 years* | -.03* | .03** | .03** | -.02 | | | | | | | | | | | | |
| *b. 35 – 54 years* | .02† | .03** | .05*** | .03** | -.52*** | | | | | | | | | | | |
| *c. 55 – 65 years* | .00 | -.07*** | -.08*** | -.02* | -.23*** | -.71*** | | | | | | | | | | |
| 6. Work-home interfer. | .26*** | .02** | .14*** | -.25*** | -.02 | -.00 | .02 | | | | | | | | | |
| 7. Risk of unemployment | .14*** | .07*** | .04*** | -.13*** | -.05*** | .13*** | -.10*** | .09*** | | | | | | | | |
| 8. Unfav. phys. condition | .15*** | .10*** | .09*** | -.15*** | .07*** | .02 | -.08*** | .14*** | .03* | | | | | | | |
| 9. Weekly working hours | .01 | .09*** | .21*** | .00 | .02† | .03** | -.05*** | .20*** | .01 | .06*** | | | | | | |
| 10. Highest qualification | | | | | | | | | | | | | | | | |
| *a. No qualification* | -.00 | -.01 | -.08*** | -.07*** | .00 | -.02† | .02* | .03* | -.02 | .02 | -.01 | | | | | |
| *b. Apprenticeship* | .04** | -.04*** | -.13*** | -.10*** | .05*** | -.02† | -.02 | .02† | -.03** | .18*** | -.15*** | -.21*** | | | | |
| *c. Advanced training* | -.03** | .04*** | .03*** | .04*** | -.02 | .03** | -.02 | -.03** | .02 | .02† | .03* | -.07*** | -.40*** | | | |
| *d. University* | -.02 | .02† | .15*** | .11*** | -.04*** | .01 | .02† | -.01 | .03* | -.22*** | .15*** | -.13*** | -.73*** | -.23*** | | |
| 11. Leadership position | -.03** | .08*** | .25*** | .09*** | -.03** | .03** | -.01 | .07*** | -.06*** | .10*** | .20*** | -.02* | -.08*** | .09*** | .04** | |
| 12. Industry | | | | | | | | | | | | | | | | |
| *a. Agriculture* | -.04** | .02 | -.01 | .01 | .02† | .01 | -.02† | -.03** | .04*** | -.02† | .02 | -.01 | -.03** | .05*** | .01 | -.01 |
| *b. Other manufact.* | -.03** | .04** | -.02 | -.00 | .00 | .03** | -.04*** | -.01 | .04** | .05*** | .03* | .01 | .02† | .05*** | -.06*** | .01 |
| *c. Metal-/electr. ind.* | -.06*** | .09*** | .03** | .06*** | .00 | .01 | -.01 | -.00 | .03* | -.03* | .05*** | -.02 | -.08*** | .11*** | .02† | .03** |
| *d. Construction* | -.05*** | -.06*** | -.01 | .02† | .03* | -.01 | -.01 | -.00 | .01 | .08*** | .06*** | .01 | -.00 | .03* | -.02 | .03* |
| *e. Commerce* | -.02 | -.04** | -.04*** | -.04*** | .04** | -.01 | -.02† | .03** | .02 | .01 | -.02 | .01 | .10*** | -.02 | -.11*** | .03** |
| *f. Private service sector* | -.01 | -.01 | -.00 | -.02 | .04** | .01 | -.05*** | .01 | .00 | -.07*** | .10*** | .06*** | -.02† | -.04*** | .03** | -.02 |
| *g. Banking* | -.01 | .02 | -.02 | .04** | -.02 | .02 | -.01 | -.04*** | .01 | -.21*** | -.00 | -.00 | -.04** | .04** | .02 | -.04** |
| *h. Business services* | -.01 | -.03* | .00 | .01 | .04*** | -.01 | -.02† | -.00 | .01 | -.08*** | .03* | .01 | -.02* | -.03* | .04*** | .02 |
| *i. Public services* | .05*** | -.06*** | -.06*** | .01 | -.08*** | -.04** | .11*** | -.04** | -.11*** | -.10*** | -.10*** | -.02 | -.05*** | -.08*** | .11*** | -.08*** |
| *j. Health & social serv.* | .12*** | .00 | .08*** | -.06*** | -.03* | -.00 | .02* | .06*** | -.03* | .29*** | -.11*** | -.03* | .12*** | -.07*** | -.07*** | .04** |

*Notes.* N=6,855; *** p < .001, ** p < .01, * p < .05, † p < .1

**Table 6: Hierarchical Regression with Non-Aggregated Variables**

| DV: Emotional Exhaustion | Model 1 | | Model 2 | | Model 3 | | Model 3 Beta |
|---|---|---|---|---|---|---|---|
| **Non-digital job demands** | | | | | | | |
| Work-home interference | .133*** | (.007) | .121*** | (.007) | .099*** | (.007) | .168 |
| Job insecurity | .070*** | (.007) | .059*** | (.007) | .048*** | (.007) | .082 |
| Unfav. phys. work cond. | .072*** | (.007) | .062*** | (.007) | .057*** | (.007) | .106 |
| Hours worked per week | .001 | (.001) | -.001 | (.001) | -.001 | (.001) | -.012 |
| **Personal characteristics** | | | | | | | |
| Gender | .097*** | (.009) | .088*** | (.009) | .083*** | (.009) | .118 |
| Leadership position | -.025** | (.008) | -.047*** | (.008) | -.043*** | (.008) | -.060 |
| Highest qualification | | | | | | | |
| *Apprenticeship* | .009 | (.022) | -.004 | (.021) | .011 | (.022) | .016 |
| *Advanced training* | .024 | (.024) | .003 | (.024) | .018 | (.024) | .017 |
| *University* | .018 | (.023) | -.010 | (.022) | .008 | (.023) | .011 |
| **Industry sectors** | | | | | | | |
| Agriculture / etc. | -.075** | (.024) | -.072** | (.024) | -.071** | (.024) | -.036 |
| Other manufacturing | -.066*** | (.017) | -.060*** | (.016) | -.063*** | (.016) | -.055 |
| Metal- & electrical ind. | -.059*** | (.015) | -.062*** | (.015) | -.057*** | (.015) | -.060 |
| Construction | -.121*** | (.021) | -.099*** | (.021) | -.091*** | (.020) | -.049 |
| Retail | -.063*** | (.018) | -.049** | (.017) | -.044** | (.017) | -.034 |
| Private service sector | -.025 | (.016) | -.019 | (.016) | -.015 | (.016) | -.014 |
| Banking and insurance | -.001 | (.020) | -.013 | (.020) | -.011 | (.019) | -.008 |
| Business-related services | -.033 | (.021) | -.028 | (.020) | -.021 | (.020) | -.014 |
| Public service | .019 | (.015) | .030* | (.015) | .019 | (.014) | .010 |
| **Digital demands** | | | | | | | |
| Introduction of new tech. | | | .016 | (.015) | .029* | (.015) | .024 |
| Org. restructuring | | | .070*** | (.008) | .064*** | (.008) | .091 |
| Task complexity | | | .034** | (.010) | .042*** | (.010) | .054 |
| Task intensity | | | .111*** | (.009) | .100*** | (.009) | .135 |
| Autonomy | | | | | -.006 | (.006) | -.013 |
| Support from leader | | | | | -.054*** | (.005) | -.136 |
| Support from peers | | | | | -.086*** | (.011) | -.102 |
| Age | | | | | | | |
| *35 – 54 years* | | | | | .032** | (.011) | .044 |
| *55 – 65 years* | | | | | .041** | (.013) | .050 |
| Constant | -.221*** | (.042) | -.476*** | (.045) | .086* | (.068) | |
| $R^2$ | .129 | | .1704 | | .2048 | | |
| $\Delta R^2$ (vs. Model 1) | - | | .0414 | | .0344 | | |

*Note*s. Robust standard errors in parentheses; reference industry = health and social services; reference qualification level = no qualification; reference age = 15 - 34 years;*** p < .001, ** p < .01, * p < .05, † p < .1