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Article

The Digitalization Boost of the Covid-19 Pandemic and Changes in Job Quality

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Abstract
The Covid-19 pandemic caused a digitalization boost, mainly through the rise of telework. Even before the pandemic, advancing digital transformation restructured the way of working and thereby changed the quality of jobs—albeit at a different pace across occupations. With data from the German National Educational Panel Study (NEPS), we examine how job quality and the use of digital technologies changed during the first pandemic year in different occupations. Building on this, we analyze change score models to investigate how increased workplace digitalization connects to changes in selected aspects of employees' subjective job quality. We find only a weak association between the digitalization boost in different occupational fields and the overall decrease in subjective job quality. However, telework—as one aspect of digitalization—is connected to a smaller decrease in work–family reconciliation and conformable working hours. Thus, it may buffer some detrimental pandemic effects on job quality. In addition, telework is connected to increased information overload, creating a new burden for specific employee groups.

Keywords
digitalized workplaces; information overload; job quality; occupations; telework; work autonomy

Issue
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1. Introduction

Employees, firms, and society benefit from good working conditions. High job quality is not only associated with higher engagement, better mental and physical health, and well-being of employees but also with enhanced performance of firms and higher labor market participation (e.g., Arends et al., 2017; Bakker & Demerouti, 2017; Eurofound, 2021; Muñoz de Bustillo et al., 2011). Consequently, improving job quality across countries, sectors, and occupations became a national and international public policy goal to, for example, enhance the labor force in societies with a shortage of skilled workers (BMAS, 2020; Cascales Mira, 2021; Cazes et al., 2016; Kortmann et al., 2022). There are several main drivers for the continuous evolution of the way of working, and digital transformation is one crucial among them (Eurofound, 2021).

In the course of increasing digitalization in the workplace and the mass dissemination of telework, digital communication, and digital collaboration during the Covid-19 pandemic (Adams-Prassl et al., 2022; Bellmann et al., 2021; Hansen et al., 2023; OECD, 2021), the association of digitalization and job quality has received great research interest (Hipp & Krzywdzinski, 2023; Laß et al., 2023; Senik et al., 2022; Wöhrmann & Ebner, 2021). This pandemic-driven digitalization boost provides scholars with the unique opportunity to study the positive and negative effects of rapid workplace digitalization on several aspects of job quality. In particular, daily working conditions—one of the various facets of job quality—such as communication, working time arrangements,

autonomy, or work-life reconciliation changed from one day to another during the pandemic.

Job quality, however, is a broad concept that encompasses multiple objective and subjective features of working and employment conditions (Cascales Mira, 2021; Muñoz de Bustillo et al., 2011; Reimann & Tisch, 2021). The pre-pandemic correlations between digital transformation and objective aspects of job quality, such as job security and earnings, have been extensively investigated. For example, there is empirical evidence that automation and the use of information and communication technologies (ICT) influence earnings or the risk of unemployment (Damioli et al., 2021; Dengler & Gundert, 2021; Kristal, 2020). Moreover, advancing digitalization changes job tasks and skill requirements within occupational profiles (Arntz et al., 2017; Dengler & Matthes, 2018). Thus, the resulting debates revolve around the "disruptive social and economic consequences" (Dengler & Tisch, 2020, p. 428; Müller et al., 2021) of digitalization for developments in the world of work. In addition to the objective aspects of job quality describing bundles of observable job characteristics, a subjective perspective considers employees' assessment of job characteristics and to what extent these characteristics meet individual needs, preferences, and experiences in the job (Kortmann et al., 2022).

The subjective perspective of job quality is far less explored, and more comprehensive evidence is needed on positive and negative experiences and subjective evaluation of working conditions associated with digitalized work environments (Kirchner et al., 2023; Kortmann et al., 2022; Reimann & Tisch, 2021). On the one hand, the technostress literature deals with this relationship, emphasizing the downside of exposure to new technologies, such as work intensification, an increase in time pressure and interruptions, information overload, boundaryless work, or a decrease in mental health (e.g., Borle et al., 2021; Chesley, 2014; Lordan & Stringer, 2022; Meyer et al., 2019; Tarafdar et al., 2015). On the other hand, optimistic perspectives of technological transformation highlight that workplaces also become more flexible in time arrangements, safer, socially inclusive, or physically less demanding (e.g., Andries et al., 2002; Bolli & Pusterla, 2022; Dengler & Tisch, 2020; Dragano & Lunau, 2020; Kirchner, 2015; Pfeiffer, 2012; Reinert, 2016). However, these studies often investigated the association between digitalization and job quality for a specific group of employees, a particular firm, or an industry. For example, Kirchner et al. (2023) find a correlation between digital technologies and decreases in work autonomy ("digital Taylorism") for jobs with production and service tasks and an increase in digital self-determination for jobs with knowledge-related tasks.

Apart from different exposures to digitalization in specific industries or technology-related task-performing groups of employees, there are also considerable variations in the dissemination of digitalization across occupational fields (cf., Dengler & Gundert, 2021; Kortmann et al., 2022). Hence, considering occupations may be crucial to address the heterogeneity of digitalized workplace experiences. Moreover, many studies only proximate workplace digitalization by either the use of computers or ICT (e.g., Andries et al., 2002; Bolli & Pusterla, 2022; Borle et al., 2021; Chesley, 2014; Dragano & Lunau, 2020; Kirchner, 2015; Kirchner et al., 2023; Kristal, 2020), which captures only some aspects of digitalization and thereby excludes most blue-collar jobs, or by occupational substitution potentials (e.g., Dengler & Gundert, 2021; Dengler & Tisch, 2020; Kortmann et al., 2022; Müller et al., 2021), which rather represents an outcome of the digital transformation.

Against this background, we aim to answer the following research questions: (a) Did workplace-related digitalization and subjective job quality change during the Covid-19 pandemic? (b) Is there any association between the level of digital transformation and subjective job quality? Moreover, we assess these two research questions in light of the varying progress of digital transformation in different occupational fields to capture the variance in levels of digital dissemination. By investigating these research questions with an occupational focus, our study contributes to a better understanding of the association between advancing digital transformation and changes in subjective job quality in a heterogeneous labor market. Thus, we extend previous research in multiple ways:

First, we use data from the adult survey of the German National Educational Panel Study (NEPS-SC6), which provides several measures for workplace-related digitalization and job quality and for further individual and employment-related information. Thus, we examine a novel, direct indicator for digitalization that captures the usage of technologies of varying complexity (Friedrich et al., 2021). Although this measure cannot objectively quantify the degree of workplace digitalization, it reflects the extent to which new technologies confront employees.

Second, with this annual panel, we benefit from comparing digitalization and several indicators for subjective job quality over two survey waves. One was collected right before the Covid-19 pandemic, the other one year later after the digitalized communication and telework boost. The data also allow for selecting and monitoring changes in subjective job quality aspects that we assume have been most affected by the pandemic. Thus, we can highlight how workplace well-being has developed during this challenging period. Accordingly, we apply change score models to examine how the intrapersonal change in exposure to workplace digitalization is associated with a change in subjective job quality aspects. Therefore, our study moves beyond previous research mainly based on cross-sectional data.

Third, we include an indicator for telework in our models, which enables us to disentangle the association between experienced changes in working conditions and the broader concept of digitalization on the one hand

and the pandemic-related rapid boost in telework on the other hand. Considering telework discretely from digitalization is particularly interesting in the German context, in which digital transformation was somewhat lagging before the pandemic but where firms massively invested in remote infrastructure during lockdowns when a telework obligation was introduced for all eligible jobs (Adams-Prassl et al., 2022; Bellmann et al., 2021; Hansen et al., 2023). Consequently, there was an almost tenfold rise in telework usage after starting from low numbers (Wöhrmann & Ebner, 2021), and even today, the share of telework is above the European average (Aksoy et al., 2023). However, digital transformation and telework adoption have remained very different across occupations. For this reason, we analyze the association separately for occupational fields—a rough aggregation of similar occupations into nine groups because running analyses for every single occupation would exceed our study—and thus capture the differentiated structure of the German labor market during the pandemic-driven digitalization boost better.

2. Previous Research

2.1. Measuring Subjective Job Quality

Digital transformation entails a permanent change in business organization and restructuring of work processes. On the individual level, this transformation influences aspects of daily working and employment conditions in positive and negative ways. Therefore, policymakers and organizations set it on their agenda to create better jobs (Cascales Mira, 2021; Kortmann et al., 2022). Thus, what makes a good job?

Although scholars disagree on a standard definition of job quality, they describe it as a multidimensional concept that refers to a variety of job attributes, all of which relate to the well-being of employees (e.g., Cascales Mira, 2021; Eurofound, 2021; Muñoz de Bustillo et al., 2011) or their productivity (Arends et al., 2017; Bolli & Pusterla, 2022; Tarafdar et al., 2015). Depending on the framework for measuring job quality, there are observable, objective aspects such as earnings, job security, career prospects, or working time arrangements, and subjective aspects focusing on employees' evaluation of their job's nature (Kortmann et al., 2022; for an overview see Cazes et al., 2016). For measuring job quality, Muñoz de Bustillo et al. (2011) proposed using a composition of indicators that clearly and directly impact employees' well-being beyond the oversimplified measure of job satisfaction. However, while Eurofound (2021) establishes a job quality framework that includes predefined working and employment conditions indicators to monitor trends across European countries, scholars choose individual key indicators for their research (Cascales Mira, 2021).

In our study, we focus on those aspects of subjective job quality that we regard as key at the onset of the Covid-19 pandemic. In Germany, the massive implementation of short-time work—a government-subsidized scheme to temporarily reduce regular working hours—preserved many jobs (Bauer & Weber, 2021), and lockdowns were less strict than in other countries, so one of the most severe changes in daily working life was the obligation to work from home if the nature of the job permitted it (Hipp & Krzywdzinski, 2023). For working parents, telework was often complicated by caring for their children during work due to daycare and school closures (Zoch et al., 2022). Considering these circumstances, we chose four indicators for our study: comfortable working hours, work–family reconciliation, autonomy, and information overload, which we assume are crucial to evaluating subjective job quality. We can subsume all these aspects among working conditions, directly translating into employees' well-being. According to Muñoz de Bustillo et al. (2011), such working conditions are, together with employment conditions, the core dimensions of job quality.

2.2. Subjective Job Quality and Digitalized Workplaces

Previous studies have revealed many benefits and drawbacks of digital transformation for employees' working conditions. For instance, ICT use and digitalization are seen as essential drivers of the flexibilization of working time arrangements, which in turn is found to be positively associated with a good work-life balance and high job satisfaction (Dengler & Tisch, 2020; Kortmann et al., 2022; Reinert, 2016). In our study, we consider a subjective evaluation of the employee's working time, measuring whether they perceive their working hours as comfortable. To our knowledge, there is no literature on how comfortable working hours connect to digitalization. However, in line with the findings for working time arrangements, this indicator should also be positively associated with advancing digitalization. In addition, digitalization is also positively connected with an increase in work-life balance, resulting from more flexible working time. As workplaces are embedded in social contexts, work and family life reconciliation is seen as an essential part of work-life balance that may benefit from digitalization (Muñoz de Bustillo et al., 2011; Pfeiffer, 2012). We assess that these two aspects enhance subjective job quality.

The literature on digitalization's effect on job autonomy is more controversial (Kirchner et al., 2023). Higher job autonomy, meaning the freedom to decide when to do what, is associated with less job strain and, thus, well-being (Chesley, 2014). Nevertheless, there is evidence that the link between autonomy and well-being is not uniform. Too much autonomy can lead to work intensification and permanent availability, which is more likely in digitalized workplaces (Gerten et al., 2018). Generally, digital workplaces involve greater job autonomy (Andries et al., 2002; Kirchner, 2015; Meyer et al., 2019). However, again, this association is ambiguous. It depends on the task domain whether job

autonomy increases or decreases with digital transformation (Kirchner et al., 2023).

Finally, as the technostress literature highlights, digitalization is connected to an increase in work intensification, time pressure, interruptions, information overload, and boundaryless work (e.g., Borle et al., 2021; Chesley, 2014; Lordan & Stringer, 2022; Meyer et al., 2019; Tarafdar et al., 2015). This deterioration in working conditions is mainly a result of the acceleration of work and communication processes and raises employees' stress perception (Borle et al., 2021; Meyer & Hünefeld, 2018; Pfeiffer, 2012).

2.3. Subjective Job Quality and Telework

There is not only an ongoing public debate about the impact of digital transformation on employment and working conditions. Additionally, how teleworking influences employees' well-being was the subject of political and scientific debates long before the pandemic (Wöhrmann & Ebner, 2021). Some effects point in the same direction; others contrast digitalization and telework. Scholars have identified increased flexibility in working time and improved work–family reconciliation connected to telework (Pfeiffer, 2012; Sardeshmukh et al., 2012). Although telework seems to enhance job satisfaction, it also involves specific demands, which have become apparent during the widespread use of telework in recent years (Hipp & Krzywdzinski, 2023). These are reduced interactions with coworkers and increased work-life boundarylessness (Wöhrmann & Ebner, 2021), resulting in stress due to constant availability and information overload (Pfeiffer, 2012). Thus, regarding our four selected aspects of job quality, we assume to find a pattern for the associations with telework that is similar to the associations with digitalization: All four indicators that we chose for measuring subjective aspects of job quality—comfortable working hours, work–family reconciliation, autonomy, and information overload—should be positively related with telework because, according to the corresponding literature, they are positively associated with digitalization. In the case of autonomy, jobs eligible for telework are generally associated with digital self-determination and, therefore, higher autonomy.

2.4. Contextualization of Expectations

Our research questions ask whether workplace-related digitalization and subjective job quality changed during the pandemic and whether there is an association between these changes. To capture the context of our observation period, we need to include pandemic circumstances and the occupational structure to embed our assumptions on how each aspect of job quality is associated with digitalization and telework.

Indeed, digital transformation is not the only reason for changing daily working conditions. In addition to demographic and compositional factors (Kortmann et al., 2022), the pandemic impacted job quality. While for example, telework was associated with high job satisfaction before the Covid-19 pandemic, this association turned negative during the pandemic (Laß et al., 2023; Senik et al., 2022). Thus, due to the pandemic circumstances with lockdowns, short-time work, and school and daycare closures, we expect comfortable working hours, work–family reconciliation, and autonomy to decrease. On the other hand, we assume information overload to increase, particularly in telework, where employees were confronted with the rapid introduction of new communication channels such as video conferencing without sufficient technical support.

However, this telework boost spread unevenly across occupations and industries, at least in Germany, and was most dominant in occupational fields with an initial high level of digitalization (Adams-Prassl et al., 2022; Aksoy et al., 2023; Bellmann et al., 2021; Reimann & Tisch, 2021). Nevertheless, considerable variations in the dissemination of digitalization across occupational fields were evidenced even before the pandemic (Dengler & Gundert, 2021; Kortmann et al., 2022). Considering this heterogeneity in the spread and speed of digital transformation, some scholars focus instead on job tasks and requirement levels within occupational profiles rather than on occupations themselves to analyze under what circumstances digitalization substitutes or supplements job activities (Arntz et al., 2017; Dengler & Matthes, 2018; Kirchner et al., 2023). Given that high requirement levels benefit most from new technologies across all occupations in general, in the setting of a digitalization boost, we focus on changes in the levels of digital transformation between occupational fields instead. Moreover, subjective job qualities differ among occupations, each containing typical compositions of positive and negative job features and working conditions. Since we analyze the entire labor market, however, we do not make any assumptions about how and in which occupational field our selected job qualities are compiled. We consider the results of our stratified analyses in the context of the pandemic situation as an open empirical question.

3. Empirical Method

3.1. Data and Sample

Our analyses rely on data from the adult cohort of the German National Educational Panel Study (NEPS-SC6; NEPS Network, 2022). This annual survey has consulted adults in Germany about educational trajectories, returns to education, competence development, further training, and lifelong learning since 2009 (Allmendinger et al., 2019).

Information on workplace digitalization was first collected in the NEPS-SC6 wave from September 2019 to March 2020 (Friedrich et al., 2021)—right before the first

Covid-19 lockdown in Germany. Comparing this information with data from September 2020 to April 2021 enables us to analyze changes in digitalization and the selected aspects of job quality before and during the first year of the pandemic. As we are interested in workplace characteristics, we restricted our sample to all kinds of employees. Additionally, we excluded all respondents who changed occupational fields between the two waves and those who did not provide valid answers for relevant items. This restriction results in a final sample of 3,250 working adults between the ages of 35 and 78 (on average 54 years). In this analysis sample, 61% work full-time and 50% of the sample are men; 4% have no educational degree, 61% have a vocational degree, and 35% have a university degree. Table A1 in the Supplementary File shows statistics for each observed occupational field.

3.2. Measures

Our dependent construct of *subjective job quality* comprises four indicators, which we selected because we regard them as key for analyzing the changes in working conditions during the pandemic. These are comfortable working hours, work–family reconciliation, autonomy, and information overload due to digitalization. The answer scale of the first three variables ranges from 1 (*strongly disagree*) to 5 (*strongly agree*). While these three variables refer to general job quality, information overload refers directly to digitalization. The answers range from 1 (*does not apply at all*) to 5 (*fully applies*). We transformed all indicators into a range of 0–1, with 1 indicating a high value for the corresponding aspect of job quality.

To measure *workplace digitalization*, we exploited the novel digitalization questions in the NEPS (Friedrich et al., 2021), capturing the use of networked digital technologies (NDT) as a Guttman scale. The construct comprises six variables with increasing difficulty levels for technology use at work—searching for information online, creating or editing digital files, exchanging digital files, maintaining websites, creating new websites, and programming algorithms for intelligent systems. We summed all items to generate a Guttman scale ranging from 0–6 and again transformed it to a range of 0–1, with high values indicating a high level of workplace digitalization. To evaluate the goodness of fit of the Guttman scale (i.e., the conformity between expected and observed response patterns), we calculated the reproducibility coefficient (CR). The CR was above the cutoff of 0.90 for both waves (0.97 for wave 2019–2020 and 0.96 for wave 2020–2021). This measure of subjective exposure to workplace digitalization is more comprehensive than just ICT or computer use or the introduction of new technologies from previous studies (e.g., Borle et al., 2021; Chesley, 2014; Dragano & Lunau, 2020; Kirchner et al., 2023; Meyer et al., 2019).

To disentangle the ongoing digital transformation from the pandemic-related digitalization boost, we additionally included an indicator for the frequency of *telework.* Respondents indicated how often they work from home. Their answers were between 0 (*never*), 1 (*once a month or less*), 2 (*several times a month or once a week*), 3 (*several times a week*), and 4 (*almost daily or daily*). Covering the extent of telework instead of just measuring usage creates a more precise indicator (cf., Wöhrmann & Ebner, 2021). Unfortunately, this indicator is only available in the 2020–2021 wave, making it a cross-sectional predictor. Table A2 in the Supplementary File provides the wording of all main variables.

To capture the dissemination of workplace digitalization and telework across *occupational fields*, we used the 1-digit code of the German classification of occupations (KldB-2010), which differentiates between 10 occupational fields: (0) military; (1) agriculture, forestry, farming, and gardening; (2) production and processing of raw materials; (3) construction, architecture, and surveying; (4) science, ICT; (5) traffic, logistics, and security; (6) purchasing, sales, trading, and tourism; (7) business management and organization; (8) health care, education, and teaching; and (9) humanities, social sciences, economics, and arts. Because of the insufficient sample size, we excluded military occupations. The 1-digit code is a rough measure aggregating single occupations according to their similarity of activities within an occupational field and contrasting the various occupational activities between them.

Occupations do not vary only by workplace digitalization; they also systematically vary in the composition of employees with specific sociodemographic and job-related characteristics (Kortmann et al., 2022). Following the literature, we included sex, education (whether participants have a university degree, derived from the highest educational degree), age, and full-time work as important compositional factors. Moreover, to accommodate pandemic containment measures, including contact restrictions, closure of entire industries, and closure of schools and daycare facilities, we also control for children younger than six and 14 years living within the household (0 = *no children younger than 6/14 years*, 1 = *at least one child younger than 6/14 years*) and short-time work. Except for age, we dummy-coded all variables. Table A3 in the Supplementary File displays the main statistics for all variables.

3.3. Analytical Strategy

We calculated analyses of variance (ANOVAs) to confirm our assumption about the variation of digitalization and job quality across occupational fields. Here, digitalization and all job quality indicators in 2019–2020 served as dependent variables, and the occupational fields served as the independent variable. To investigate the changes in digitalization and aspects of job quality between 2019–2020 and 2020–2021, we analyzed t-tests with repeated measures for all indicators in separate analyses for each occupational field.

Finally, we applied hierarchical change score models to examine whether the change in digitalization is associated with changes in subjective job quality (Allison, 1990; Gu et al., 2018). Unfortunately, we cannot calculate fixed-effects models because the indicator for telework, our second main predictor, is available only in the 2020–2021 wave. In addition, change score models can directly represent change over time in a variable that can be examined as an independent or dependent variable. This modeling concept is similar to first difference models. Moreover, Castro-Schilo and Grimm (2018) compare change score models with residualized change models and recommend using the former in non-randomized samples because they are less biased in such instances. We set up 36 (4 × 9) models for each job quality indicator and occupational field. The intraindividual change in perceived job qualities served as the dependent variable and thus enabled us to reduce omitted variable bias by controlling time-constant heterogeneity by design. Our main predictors are the reported intraindividual change in the use of NDT and the cross-sectional indicator for telework frequency. We proceeded in three steps. First, we predicted the job quality change score with the digitalization change score and job quality in wave 2019–2020. Second, we included sex, age, age^2, university degree, and full-time work as control variables in the models. Third, we added our second main predictor, telework, along with the covariates short-time work and children to the models to control for Covid-19-related effects.

4. Results

4.1. Descriptive Results

Before answering our research questions, we had to investigate whether digitalization and all selected aspects of subjective job quality varied across occupational fields. The ANOVA confirmed this variation for workplace-related use of NDT and all aspects of job quality in the 2019–2020 wave. Moreover, all aspects of job quality were highest in occupational fields (OF) science/ICT (OF 4), business management (OF 7), and social sciences (OF 9), while they were lowest in agriculture (OF 1) and logistics/security (OF 5), except for work–family reconciliation, which was rather high in agriculture (OF 1). Information overload was also relatively low in health/education (OF 8) before the pandemic (see Figure 1). Interestingly, we find a similar pattern for workplace-related digitalization, which was particularly

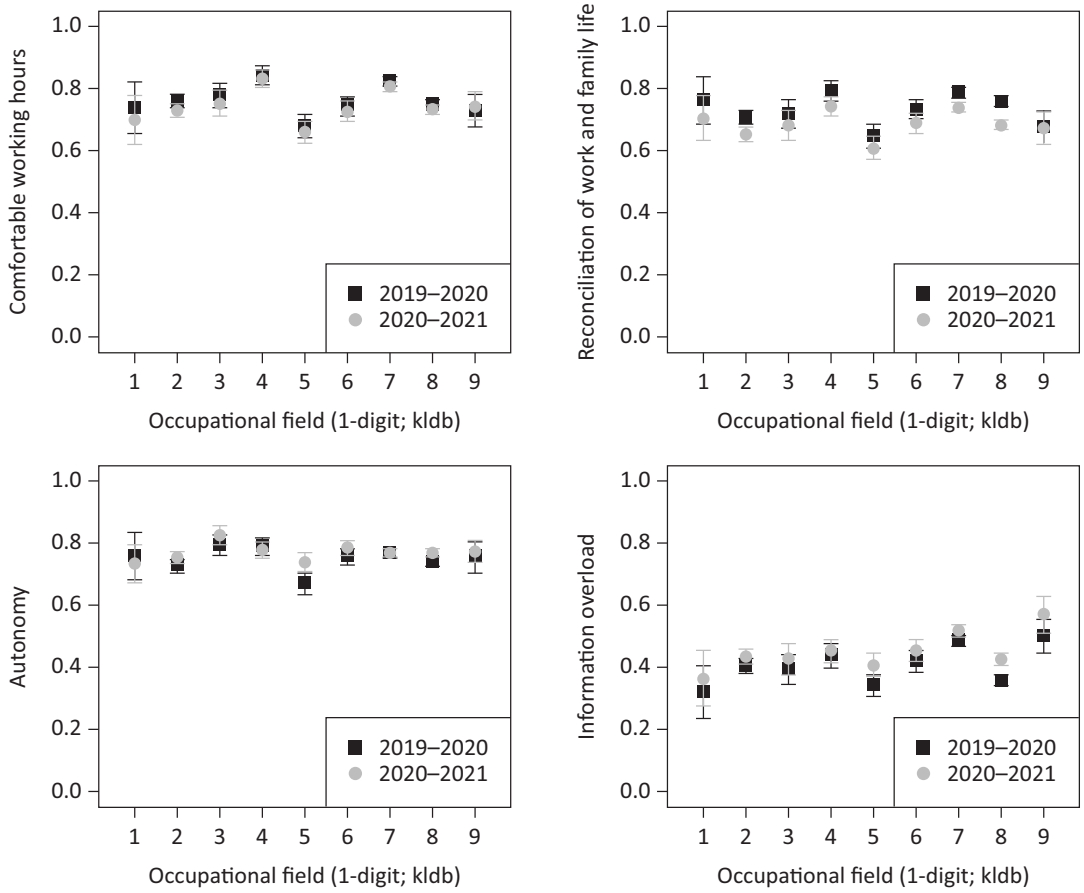

Figure 1. Means and 95% CIs of job quality aspects in the 2019–2020 and 2020–2021 waves for each occupational field. Occupational fields: (1) agriculture; (2) production; (3) construction; (4) science/ICT; (5) logistics/security; (6) trade; (7) business management; (8) health care/education; (9) social sciences. Source: NEPS-SC6, SUF 13.0.0.

high or low in the same occupational fields that scored high or low on the selected indicators of job quality (see Figure 2).

The first research question addressed the change in digitalization and the four subjective job quality indicators between the 2019–2020 and 2020–2021 waves. The repeated measures t-tests revealed that the two job qualities we assess as positive features of a job—comfortable working hours and work–family reconciliation—decreased somewhat in most occupational fields, although not always significantly. Comfortable working hours decreased significantly in production (OF 2) and business management (OF 7). Work–family reconciliation showed significant decreases in all occupational fields besides agriculture (OF 1) and social sciences (OF 9). In contrast, autonomy scored slightly higher in most occupational fields: production (OF 2), construction (OF 3), logistics/security (OF 5), trade (OF 6), and health/education (OF 8), but the changes were minimal. For the aspect of information overload due to digitalization, which we assess as a negative job feature, we again find moderately increased scores between the two waves in most occupational fields: production (OF 2), logistics/security (OF 5), trade (OF 6), business management (OF 7), health/education (OF 8), and social sciences (OF 9; see Figure 1). The results suggest that working conditions tended to slightly worsen during the pandemic in most occupational fields.

Regarding the changes in the use of NDT, Figure 2 shows that, in tendency, digitalization overall intensified. We find significant increases in production (OF 2), logistics/security (OF 5), trade (OF 6), business management (OF 7), and health/education (OF 8). The increase was marginal or insignificant mainly in occupational fields with already high exposure (e.g., OF 4, OF 7, OF 9). Tables A4 and A5 in the Supplementary File provide the results of the ANOVAs and t-tests. Overall, we find both a tendency toward a slight increase in digitalization and a mild depreciation in subjective job quality at the onset of the pandemic, with varying extent of these trends across occupational fields. In the next step, we investigate whether there is an association between these developments.

4.2. Multivariate Results

Our study aims to analyze whether there is an association between the change in workplace digitalization and specific aspects of subjective job quality across different occupational fields. Therefore, we ran hierarchical change score models and summarized their results in Figure 3. These coefficient plots display the effect of the intraindividual change in the use of NDT and of the cross-sectional indicator of telework on change in each aspect of job quality separately for all nine occupational fields (find detailed results of the full models in Table A6 of the Supplementary File). We ran separate regression models for each job quality indicator but combined them into one figure per occupational field. Furthermore, we included all control variables in the models. In an intraindividual change score model, positive (negative) coefficients reveal whether an aspect of job quality has additionally positively (negatively) changed compared to the corresponding reference category (e.g., observed change in the predictor). For example, in health care, education, and teaching occupations (OF 8), information overload

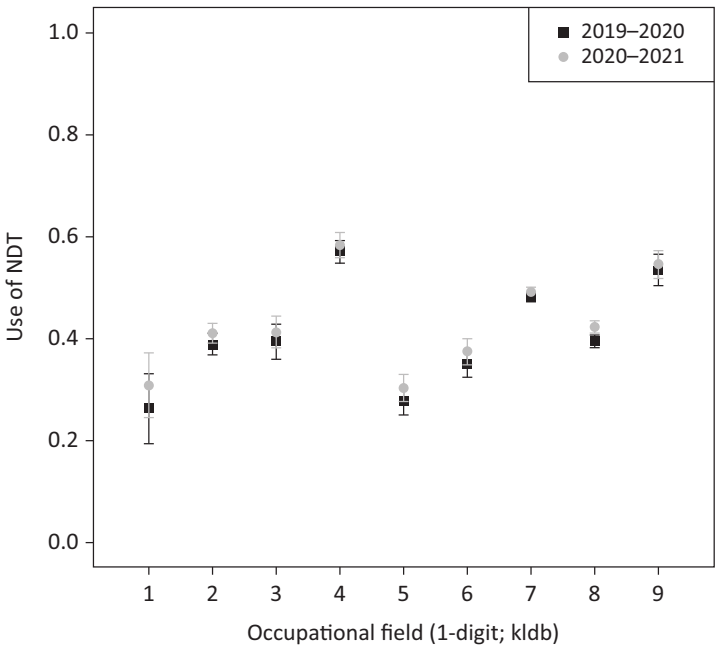

Figure 2. Means and 95% CIs of digitalization in the 2019–2020 and 2020–2021 waves for each occupational field. Occupational fields: (1) agriculture; (2) production; (3) construction; (4) science/ICT; (5) logistics/security; (6) trade; (7) business management; (8) health care/education; (9) social sciences. Source: NEPS-SC6, SUF 13.0.0.

and the use of NDT increased between the two waves. As the regression coefficient of change in NDT on information overload is positive, information overload is associated with even more substantial increases for employees with a more considerable increase in the use of NDT.

Regarding the two job quality aspects we assess as positive job features, our analyses provide the following results: for *comfortable working hours*, we find only a negative association between the use of NDT and this job quality aspect in agriculture (OF 1). However, as we do not observe an increase in digitalization or a change in comfortable working hours in this small occupational field (N = 40), we refrain from interpreting this association. In contrast, we find an association between telework and comfortable working hours in various occupational fields. Employees in production (OF 2), logistics/security (OF 5), trade (OF 6), and healthcare/education (OF 8) who worked more often from home experienced a smaller decrease in comfortable working hours compared to the general decrease in this job quality aspect in most occupational fields after the pandemic offset.

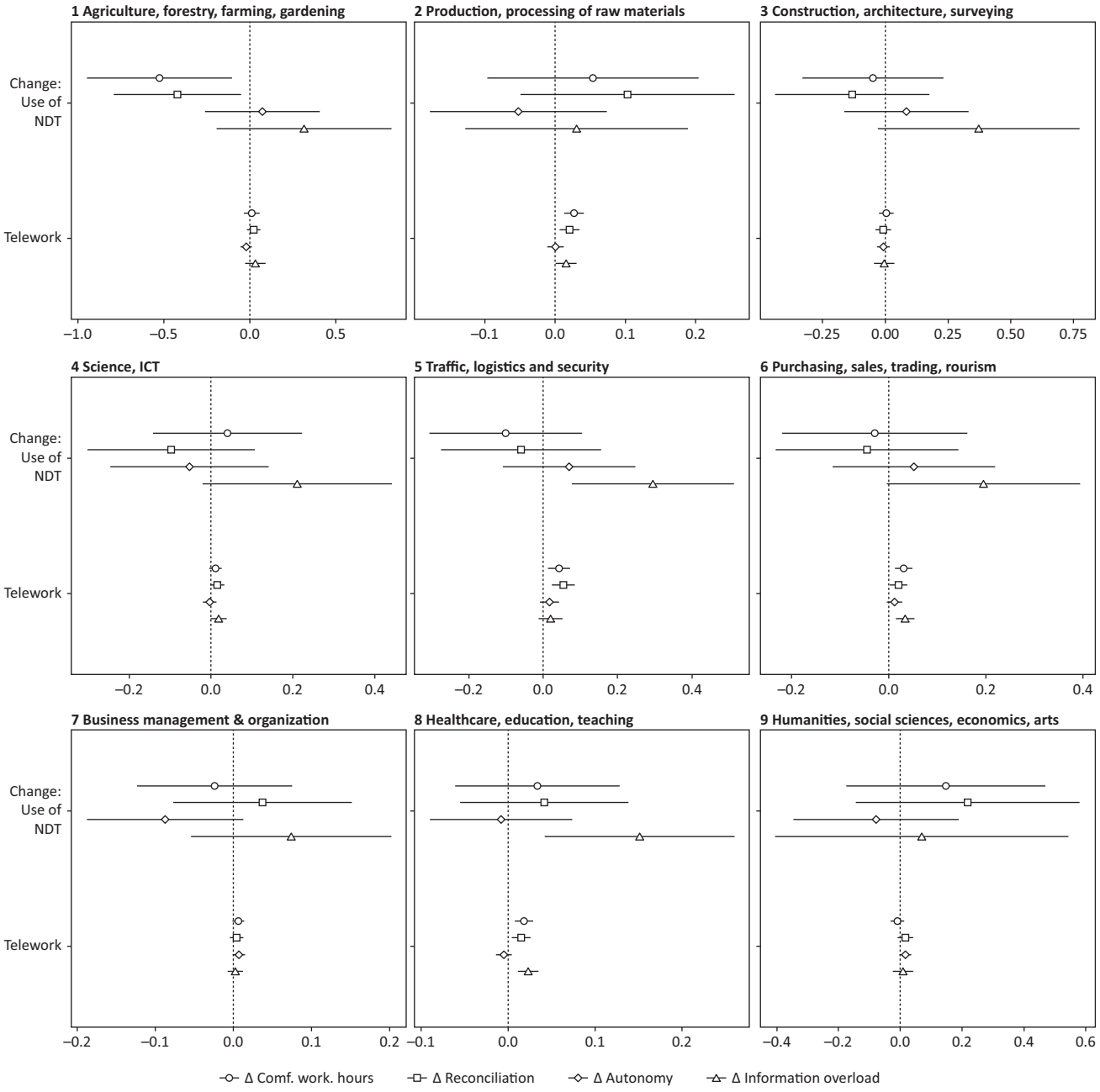

Figure 3. Change score models for each occupational field. Notes: Positive (negative) coefficients indicate an increase (decrease) in the dependent variable in comparison with the reference category; control variables include job quality indicators (2019–2020), sex, university degree, age, age^2, children under 6 and 14 years, full-time work, and short-time work; see Table A5 in the Supplementary File for detailed regression results. Source: NEPS-SC6, SUF 13.00.

The job quality aspect of *work–family reconciliation* results in similar patterns as comfortable working hours. The use of NDT is associated with lower work–family reconciliation in agriculture (OF 1) only. Again, this association should be considered with caution. However, telework again buffers the negative trend of this aspect of job quality in production (OF 2), logistics/security (OF 5), trade (OF 6), and healthcare/education (OF 8). Thus, we hardly find any association between digitalization and these job qualities. Additionally, our assumption about increased comfortable working hours and better work–family reconciliation connected to digital transformation finds no support. However, we observe that telework helps to cope with the decline in job quality caused by the pandemic.

For *autonomy*, we do not find any associations between the more or less pronounced increase in workplace digitalization or the frequency of telework use across occupational fields. This result does not support our assumption about an increase in autonomy that accompanies increasing digitalization or telework use.

Finally, regarding the negatively assessed job quality *information overload*, our models depict positive associations between the significant increase in NDT use and the significant increase in information overload due to digitalization in logistics/security (OF 5), trade (OF 6), and health/education (OF 8). In the other occupational fields, change in digitalization is not significantly related to change in information overload. This finding only partly supports our assumption that increased workplace digitalization connects to increased information overload and work intensification and thus may cause job strains for employees. In addition, we find that telework is associated with an additional enhancement in information overload in production (OF 2), science/ICT (OF 4), trade (OF 6), and healthcare/education (OF 8). These results partially align with our assumptions and with previous findings on the effect of telework on work intensification (Pfeiffer, 2012; Wöhrmann & Ebner, 2021).

4.3. Robustness Checks

We additionally estimated various model specifications to validate our findings. First, we tried to reduce potential selection bias in our restriction of the analysis sample. As the statutory retirement age in Germany was 65 in 2020, we excluded all older individuals from our analysis sample to focus only on regularly working employees. Using the restricted sample (N = 3,118), the change score models provided similar findings to the initial sample.

Second, to check how robust our findings are against the specification of our measure of workplace digitalization, we exchanged our main predictor use of NDT for a variable that records how digitalized employees assessed their workplaces. Again, we reproduced most but not all findings with the change score models. However, this confirms that the use of NDT is the superior indicator, which captures changes better over a short observation period of one year.

Next, to investigate job quality trends over a more extended period—especially before the Covid-19 pandemic—we looked at the means of all three previously available items of job quality since 2018–2019. Comfortable working hours and work–family reconciliation increased, and autonomy decreased from 2018–2019 to 2019–2020. Hence, before the pandemic, most job qualities followed an upward trend while they dipped during the pandemic. Interestingly, all three job qualities almost returned to their initial level in 2020–2021.

Finally, based on our data, it is difficult to tell whether subjective job quality changed due to the pandemic's impact on most people's everyday lives or to advancing digitalization. To address this, we performed additional analyses after splitting the respondents into two groups according to their occupational field with or without changes in digitalization. Those in occupational fields with modified digitalization also experienced significant changes in all selected aspects of job quality. However, those without changes in digitalization only experienced significant decreases in work–family reconciliation and increases in information overload. This finding supports our assumption that changes in job quality may be related to advancing digitalization. In the Supplementary File (Tables A7–A12 and Figure A1) we discuss the robustness checks in more detail and provide corresponding results.

5. Discussion and Conclusions

This study elucidates the association between advancing digital transformation and changes in selected aspects of subjective job quality across occupational fields. Job quality was proclaimed a central priority by the OECD's Job Strategy to increase social inclusion (Kortmann et al., 2022) because ongoing workplace digitalization systematically invades yet unevenly changes the various aspects of working and employment conditions for different employee groups. Thus, digitalization subsequently influences employees' productivity, mental health, and well-being (e.g., Arends et al., 2017; Meyer et al., 2019; Reimann & Tisch, 2021).

We extended previous literature by analyzing which occupational fields experienced changes in workplace digitalization and selected aspects of job qualities and how these were related at the onset of the Covid-19 pandemic. However, this connection is confirmed in surprisingly few occupational fields. Only a differentiated look across the occupational fields reveals that, for example, work–family reconciliation slightly worsened in almost all occupational fields. At the same time, this applies only in a few occupational fields to the decrease in comfortable working hours. In contrast, autonomy and information overload moderately increased in almost all fields. With the change score analyses, we find a relationship

between advancing digitalization and increasing information overload only in some occupational fields. Thus, our findings support the literature on technostress and the negative aspects of digital transformation, at least in some occupational fields (Borle et al., 2021; Meyer et al., 2019; Tarafdar et al., 2015).

Nevertheless, we prefer not to interpret our results in such a negative light. After all, we also recognize the role of telework during this time. Although the boost in telework contributes to a further increase in work intensification through information overload, we also find that telework buffers the unfavorable pandemic effects for most of our selected job qualities. Similar to digital transformation, telework can, in some respects, serve as a job resource to improve workers' well-being (Sardeshmukh et al., 2012); in other respects, it increases job demands and intensifies work (Pfeiffer, 2012; Wöhrmann & Ebner, 2021).

Naturally, our study has several limitations. Looking at the changes between 2019 and 2020 is a double-edged sword. On the one hand, at the beginning of the Covid-19 pandemic, there was a substantial digitalization boost in some occupational fields, which helps us to measure the changes in digitalization in the workplace. On the other hand, the restrictions imposed because of the pandemic had a sizeable impact on daily life and work. For example, the reconciliation of work and family considerably deteriorated due to school and daycare closures. Digitalization or telework had, if any, a beneficial effect on the groups eligible for telework under these circumstances. Unfortunately, since our data on digitalization were collected first in 2019–2020, we cannot properly disentangle the influence of the pandemic on changes in our indicators of job quality from that of digital transformation.

Another limitation is that our results are not necessarily causal. Although we control for the main compositional factors, such as sex, age, education, children, full-time work, short-time work, and occupational fields, many other factors could also impact job quality. Thus, we cannot completely rule out the existence of omitted variables. Additionally, two observation points are insufficient to run a panel analysis, which would rule out this issue. Therefore, future research is needed to examine how advancing digitalization impacts working conditions for different employee groups with a longer observation window.

Despite these limitations, our study provides four main findings. First, occupational fields differ significantly in the levels of digitalization and subjective job qualities. Second, during the Covid-19 pandemic, digitalization increased in many occupational fields, while working conditions worsened simultaneously. Third, the pandemic-driven digitalization boost is not connected to a change in positively assessed job qualities (at least in the short term). However, in some cases, it is connected to increased information overload, which we consider unfavorable job quality, as it may reduce employees' well-being. Fourth, telework partially buffered the pandemic-related deterioration in subjective job qualities but simultaneously increased information overload and, thus, work intensification. Looking at these results, the declared goal of national and international public policy to improve job quality, create better jobs (BMAS, 2020; Cascales Mira, 2021; Cazes et al., 2016; Kortmann et al., 2022) and enhance the labor force was not accomplished during the pandemic. Especially for the implementation of telework in the post-pandemic period, they should keep a close eye on the developments in job quality and how occupational safety measures can be meaningfully applied (Reinert, 2016). These considerations prepare the ground for the upcoming debates on so-called Industry 5.0, which deals with developing a sustainable, human-centric, and resilient business environment by integrating advanced technologies and human values (Karmaker et al., 2023). Such developments are essential for the better inclusion of all working groups in the labor market and the struggle related to shortages of labor forces in aging societies.

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Conflict of Interests

The authors declare no conflict of interests.

Supplementary Material

Supplementary material is available online in unedited format provided by the author.

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