Extended Working Lives in Denmark and Finland: Influences of Computerization[1]

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ABSTRACT

Extended working lives become important in aging populations. Yet, for a long time, increasing computer use pushed older individuals out of the workforce. Recently, older workers' computer skills have improved. This article investigates how computer use, experience, and training affect workforce participation in old age in countries with widespread computer use. It conducts regression analyses of Danish and Finnish survey data. Findings show that individuals who used computers had a higher chance of remaining in the workforce. Computer experience made older Finns marginally more likely to retire. However, computer training had no influence. Findings suggest that the relevance of computer use for extended working lives depends on a country's computerization level: the higher the level, the less of an obstacle to extended working lives computerization presents. Policymakers should facilitate older workers' computer use especially when computers are first introduced, and explore alternative means for extending working lives afterwards.

KEYWORDS

computers / Denmark / Finland / older workers / on-the-job training / retirement

Introduction

Extended working lives become important on the heels of population aging. This demographic shift challenges the financial sustainability of pension schemes and it reduces the size of the workforce (Komp 2018). Researchers and policymakers suggest that both challenges can only be met if individuals work until a later age. Accordingly, policymakers from across Europe have been reforming pension regulations in recent decades to extend working lives. They have been increasing the state pension age and closing pathways to early retirement (Kosonen et al. 2021; Nilsson 2012).

The push toward extended working lives changes the older workers' role and place in working life. The disengagement theory, which was published in the early 1960s, suggests that older individuals gradually withdraw from society in preparation for their deaths (Cumming & Henry 1961). Against this background, older workers play the role of individuals on their way out of the labor market, who accept that their knowledge becomes outdated and their employability declines (Baltes et al. 2012). The efforts of some workplaces to encourage early retirement tie in with this perspective, preferring to discard them over upskilling them (Perek-Bialas & Turek 2012). The activity theory claims the opposite, suggesting that being active increases the quality of life in ageing. Adopting this perspective, older individuals play the role of beings whom you do a service by extending their working lives (Baltes et al. 2012). They are the part of

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the workforce that may or may not have the needed qualifications, but that should be included for the greater good. In contrast, the continuity theory and life-course theory adopt a more differentiated perspective. They suggest that older workers differ in their characteristics, possibilities, and needs (Baltes et al. 2012; Kuitto et al. 2021). As a result, some of them have the skills and will to work longer, while others do not. This perspective gives older workers the role of a heterogeneous group within the labor market, whose working lives can be extended on a case-by-case basis. However, recent policies for extending working lives do away with these theory-based approaches, instead prescribing extended working lives to all (Phillipson 2019). The implicit assumption is that physical capabilities, skills, and interest are already uniformly present or will develop in the wake of the change. Against this background, older workers take on the role of a resource that is ready to be activated for extended working lives.

Yet, the increasing use of computers at workplaces may hamper extended working lives. Researchers have been wondering since the 1990s how older workers will fare when computer use at work spreads. Initially, the interest was in the use of a computer instead of off-line technologies, such as typewriters (Lawhon et al. 1996; Staufer 1992). Recently, however, the interest shifted to new technological advancements in computers, such as artificial intelligence (Alcover et al. 2021). In a best-case scenario, computers may assist older workers in their tasks, thereby enabling them to work until a later age (Damman 2016; Nagarajan & Sixsmith 2023). This outcome would facilitate the policy goal of extending working lives. In a worst-case scenario, computers may render older workers' skills obsolete, thereby pushing them into early retirement (Greenan & Messe 2018; Hudomiet & Willis 2022). This outcome would interfere with the policy goal of extending working lives. Therefore, numerous studies underline the need for offering computer training to older workers when computer use at work increases (Behaghel et al. 2014; Lee et al. 2008). In this context, older workers are typically understood as individuals aged 50 years or older (Komp-Leukkunen et al. 2022).

Most studies conclude that increasing computer use at work pushes older individuals out of the workforce. They consistently identified this net effect of spreading computer use at work in data reaching from the 1960s until 2017 (Bartel & Sicherman 1993; Behaghel et al. 2014; Friedberg 2003; Hudomiet & Willis 2022; Schleife 2006). However, these studies disagree on who is affected the most, with Hudomiet and Willis (2022) suggesting it is women and individuals with an intermediate skill level, while Malul (2009) suggests it is mainly individuals with low levels of training. Schleife (2006) even maintains that the effect of computer use on the employment status of older workers is entirely due to a selection effect. She finds that when controlling for characteristics of the individuals and companies, the effect of computer use is insignificant.

When it comes to countering the effects on older workers, opinions differ. Bartel and Sicherman (1993) report that in the 1960s and 1970s, training kept older workers in the workforce. However, this protective mechanism only took hold when computers were introduced at a speed that was slow enough to train older workers in time. Behaghel et al. (2014) note that also in the late 1990s, training older workers increased their chances of remaining in the workforce. Yet, this protective effect was too small to offset the push out of the workforce that increasing computer use creates. Friedberg (2003) argues that in the 1980s and 1990s, computer use itself was sufficient to keep older individuals in the workforce. Hudomiet and Willis (2022) agree, documenting this mechanism in the years between 1984 and 2017. However, they also underline that the mechanisms observed will likely change over time. New cohorts of older workers will have more computer experience, and workplaces will increasingly use computers as a matter of course. Therefore, the protective effect of computer experience and training on workforce participation in old age may wear off. The present article tests this idea.

This article explores whether computer experience and training still increase workforce participation in old age when computer use at work becomes self-evident. To do this, it compares the situations of older individuals in Denmark and Finland – two of the most strongly digitalized countries in the Organisation for Economic Co-operation and Development (OECD) (OECD 2019). The comparison reveals whether the level of digitalization itself shapes the effects or whether country-characteristics may also play a role. In studying these countries, this article answers three research questions. First, to what extent does computer use at work affect workforce participation in old age? Computer use at work gives an indication of the work tasks carried out by older workers. It shows that office work makes up at least some of these tasks. Office work is often less physically demanding than manual labor, which can make it easier to carry out for older workers (Komp-Leukkunen et al. 2022). Second, to what extent does computer experience affect workforce participation in old age? Computer experience shows how many years individuals have already been using computers. More computer experience can bring about better computer skills, and therewith a higher employability in old age (Komp-Leukkunen et al. 2022). And third, to what extent does computer training affect workforce participation in old age? Computer training is part of workplace policies regarding human resource development. Such training is usually organized for employees of all ages, although older workers may not be encouraged to attend. A participation in computer training shows that the workplaces had at some point made an attempt to retain the workers when computer use spread (Komp-Leukkunen et al. 2022). To answer the research questions, micro-level data from the Survey of Health, Ageing and Retirement in Europe are analyzed. Findings indicate which social developments other countries might expect as they continue on the road to digitalization. They also indicate whether policymakers could facilitate computer use and computer training as a means to extending working lives.

Changes over time in older workers' computer use, experience, and training

Older workers' relationship with computers has changed over time. Although computer use was still a new and infrequent activity for older workers in the 1990s, it is a ubiquitous activity for them today (Lawhon et al. 1996; Staufer 1992). Many potentials of work computers have been realized, with them now being regularly used to write documents, send emails, and track work processes. At the same time, new applications for computers at work have emerged. For example, today, the uses of teleconferencing and artificial intelligence at workplaces are discussed (Alcover et al. 2021; Dropkin et al. 2016). Thus, computer use has become a more self-evident part of work in old age, despite specific computer applications continuing to develop.

As computer use spreads, older workers' computer skills are improving. Increasing encounters with computers give older people more options to practice, enabling them to develop their proficiency (Hudomiet & Willis 2022). These practicing and learning processes are not limited to situations at work; they also occur in the older workers' private lives. For example, older individuals may use computers for their banking and shopping, or to stay in contact with their kin (Neves et al. 2013). Gilleard and Higgs (2008) underline that family members may also help one another to acquire computer skills, which makes families institutions that may provide computer training. Older individuals can take the computer skills that they acquire in their private lives and apply them at work. This situation suggests that computer use at work is becoming less of an obstacle to older workers over time. However, it did not yet stop being an obstacle for all older workers.

Older workers' computer skills may increase across cohorts. Cohorts are groups of individuals that are born around the same time. In his seminal work 'Digital natives, digital immigrants', Prensky (2001a, 2001b) relates cohorts to digital skills. He argues that digital skills differ across cohorts depending on when the individuals have begun to use digital technologies. Younger cohorts were born into a digitalized society, making them digital natives who start using digital technologies in their formative years. Consequently, they are savvier and more comfortable with computers. In contrast, today's older workers saw the advent of digital technologies during their working years. They have to change their way of working if they want to use digital technologies, which makes them digital immigrants. Therefore, they may be less skilled with computers. Hudomiet and Willis (2022) suggest that because of these cohort differences, younger workers adopt computers earlier than older workers. However, this age gap closes over time, as the share of digital natives increases, and the share of digital immigrants declines across cohorts. Consequently, a person's computer experience may become less relevant for their chances of working in old age. However, the gap in experience has not yet closed.

As computer use spreads, the need for computer training at work changes. Previous research extensively documented the computer training needs and opportunities of older workers (for an overview, see Komp-Leukkunen et al. 2022). It showed that such training efforts have been on-going for several decades (e.g., Bartel & Sichermann 1993; Staufer 1992). Now that computer use is ubiquitous, training on basic computer functions becomes less urgent. Instead, a need for retraining emerges when technologies evolve. For example, a switch from traditional computer systems to systems that utilize artificial intelligence may trigger such a need to retraining (Jaiswal et al. 2022). Another example, the introduction of big data analytics as a basis for decision making in business may have also triggered a need for retraining (Schoenherr & Speier-Pero 2015). However, this need exists among all workers, not only the older ones (Hudomiet & Willis 2022). Moreover, the need to for computer training depends on how workplaces themselves operate. This need can decline if older workers are involved in the development and introduction of the technologies. For example, involving them in the development process can help identify the most useful technologies and the most easily accessible way of operating them (Fischer et al. 2021).

Older workers and computers in Denmark and Finland

How older workers deal with computers is a particularly pressing question in Denmark and Finland. Both countries are well advanced in the processes of population aging and digitalization (OECD 2019; United Nations 2022). Moreover, both countries are striving to extend working lives in reaction to population aging (Ni Leime et al. 2020). As a result, both countries are seeking ways in which to upskill older workers in computer use (OECD 2019).

In 2021, Denmark and Finland ranked among the 20 countries with the oldest populations worldwide. About 20% of Danes were aged 65 or older, whereas 23% of Finns belonged to this age group (United Nations 2022). However, Denmark has experienced a much slower progression of population aging than Finland. In Denmark, the share of the population aged 65 or older increased by six percentage points over the last four decades, whereas it increased by 11 percentage points in Finland in the same period (United Nations 2022). As a result, Finland needs to quickly introduce policy reforms to counter the effects of population aging, whereas Denmark can do so more slowly, using the trial-and-error principle (Komp-Leukkunen 2021).

In reaction to population aging, the Danish and Finnish governments have introduced reforms to extend working lives. Both countries belong to the social-democratic welfare regime, in which labor force participation rates are high among men and women (Esping-Andersen 1990). In 2021, 72% of Danes and 68% of Finns aged 55-64 years were working. These percentages are considerably higher than the European Union average of 61% (Eurostat 2022a). In both countries, older individuals currently work until shortly before the state pension age. In 2020, Danes retired on average at 64, whereas Finnish men retired at 64 and women at 63. In 2000, Danish men still retired at 63 and women at 59, whereas Finns retired at 59 (OECD 2022b). Both countries introduced pension reforms to close options for early retirement and to delay the state pension age (Hinrichs 2021; Mutual Information System on Social Protection 2022). In 2022, the state pension age was 67 in Denmark, and it was to be raised to 69 by 2035, hand-in-hand with changes in the life-expectancy. In Finland, the pensionable age for the earnings-related pension was between 63 and 65. It was to be raised to 65 by 2027, and then to be linked to changes in the life-expectancy. The pensionable age for the national pension was 65, and it was to be linked to changes in the earnings-related pension (Mutual Information System on Social Protection 2022). Thus, efforts to extend working lives have been underway in both countries, and they are to continue in the future. All these facts underline that Finland undergoes a faster extension of working lives than Denmark.

Computers play an important role in the working lives of older Danes and Finns. Denmark and Finland are among the OECD countries in which digitalization has progressed the furthest (OECD 2019). Already in 2017, all enterprises in Denmark and Finland had broadband internet access and more than 90% of enterprises gave mobile devices with internet access to their employees (Eurostat 2022b, 2022c). Among individuals aged 55-75, 97% of Danes and 92% of Finns used the internet in 2021, and 90% of Danes and 84% of Finns used a computer in 2017 (OECD 2022a). Due to these statistics, the OECD (2019) places Denmark and Finland among the OECD countries in which workers' tasks have changed the most due to ICT use and in which individuals aged 55-65 have the best cognitive and ICT skills. Thus, both Denmark and Finland are already widely digitalized, but this process is even further advanced in Denmark than in Finland.

Materials and methods

Materials

This study analyzed data from Wave 7 of the Survey of Health, Ageing and Retirement in Europe (SHARE), which was collected in 2017. SHARE is a panel study on the employment and social situation, health status, and activities of Europeans aged 50 and older. It contains a probability sample of the population aged 50 years and over. In the countries analyzed in this study, Denmark and Finland, the sample was drawn from the population register. The sample is representative of the population in terms of age, gender, and region. The respondents' partners and other age-eligible persons in the household were also interviewed. Refresher samples were drawn in the course of the panel to include younger cohorts that just turned 50 and to even out the effects of sample attrition (Bergmann et al. 2019). The data are collected through computer-assisted personal interviewing (Börsch-Supan et al. 2013). SHARE was the first European Research Infrastructure Consortium established by the European Commission. This status gives it its own legal personality. SHARE distributes its survey data itself. These data can be applied for from the SHARE Research Data Center, via the SHARE homepage http://www.share-eric.eu/data/. The SHARE Research Data Center collaborates with CentERdata Archive, Tilburg University, Netherlands, and the Data Archive for the Social Sciences, GESIS Leibniz-Institute for the Social Sciences, Germany.

This study analyzes the life-history interviews conducted in Wave 7. These interviews collected retrospective information on the respondents' entire life-courses, utilizing event history calendars to ensure accurate recollections (Banks et al. 2020). Also, the life-history interviews contain the questions on computer use at work, computer training, and years since first computer use at work that are analyzed in this article. A total of 1907 Danes and 1963 Finns participated in these life-history interviews. In a first step, individuals aged 51-70 years were selected to obtain information on the last years of working life. As many as 1381 Danes and 1302 Finns belonged to this age group. Next, I selected those individuals who were working or retired, to ensure that the employment statuses analyzed were meaningful and sufficiently frequent for the analysis to work. A total of 1268 Danes and 1179 Finns had these employment statuses. Subsequently, I excluded cases with missing values. The dataset contained 58 cases with missing values, which is 2%. Most of these cases were missing information on how many years ago they first used a computer at work. The cases with missing values were analyzed, revealing that information was missing completely at random (Allison 2001). They were excluded because their number was low, and their exclusion created no bias in the dataset. The final dataset contained 1225 cases from Denmark and 1164 cases from Finland.

Variables

The explained variable is the employment status ('working'/'retired'). The explanatory variables are whether individuals ever used a computer at work ('yes'/'no'), whether they received computer training at work ('yes'/'no'), and how many years ago they first used a computer at work (continuous variable). The control variables are gender ('male'/'female'), age ('51–55'/'56–60'/'61–65'/'66–70'), marital status ('married'/'not married'), limitations in instrumental activities of daily living (iADL, 'yes'/'no'), and sector ('private'/'public'/'self-employed'). Gender is relevant because women sometimes exit the workforce early to focus on their household responsibilities (Komp-Leukkunen 2021). Age differences can occur because of pension regulations and cultural age-norms. Marital status is relevant because unmarried individuals often have fewer family obligations that pull them out of the workforce (Szinovacz et al. 2001). The instrumental activities of daily living are an indicator of health status (Scheel-Hincke et al. 2020). The sector gives an impression of the workplace conditions. Educational level could not be used as a control variable because it was correlated with the participation in computer training at work and with the number of years since an individual first used a computer at work. Occupational category could not be used as a control variable because it was correlated with the sector.

Table 1 presents descriptive statistics for the sample by country. It presents these statistics once for the entire sample and once only for individuals who had used a computer at work. Only these individuals were asked the questions about receiving computer training and about how many years ago they first received a computer at work. Table 1 shows that the reference individual in the sample is a healthy, married woman aged between 56 and 60, who is working in the private sector, has used a computer at work, first did so 26 years ago, and received computer training at their workplace. The Danish sample is slightly younger and healthier than the Finnish one, and it contains more individuals who are working, male, married, and used a computer at work. Moreover, it

Table 1 Descriptive statistics of the sample, by country

	Denmark	**Finland**	**Total**
Entire sample	n = 1225	n = 1164	n = 2389
Employment status: working	72.5%	54.0%	63.5%
Ever used computer at work: yes	90.8%	78.3%	84.7%
Gender: female	52.3%	52.5%	52.4%
Marital status: married	76.1%	75.0%	75.6%
Limitations iADL: no	94.0%	93.0%	93.5%
Sector: private	50.8%	50.2%	50.5%
public	42.6%	39.8%	41.2%
self-employed	6.6%	10.1%	8.3%
Age: 51–55	22.3%	20.9%	21.6%
56–60	37.1%	24.5%	31.0%
61–65	20.3%	26.5%	23.3%
66–70	20.3%	28.1%	24.1%
Only those who ever used a computer at work	n =1112	n = 911	n = 2023
Employment status: working	75.4%	60.9%	68.9%
Received computer training at work: yes	52.7%	71.4%	61.1%
Years since first used computer at work	26.3	26.1	26.2
Gender: female	53.7%	55.3%	54.4%
Marital status: married	77.2%	75.5%	76.4%
Limitations iADL: no	94.5%	94.7%	94.6%
Sector: private	49.5%	46.4%	48.1%
public	43.8%	44.5%	44.1%
self-employed	6.7%	9.1%	7.8%
Age: 51–55	22.8%	23.9%	23.3%
56–60	37.9%	26.3%	32.7%
61–65	20.5%	26.3%	23.1%
66–70	18.8%	23.4%	20.9%

contains fewer self-employed individuals. The Danes have been using computers at work for more years, and fewer of them received computer training at work. When comparing the entire sample to those individuals who ever used a computer at work, further differences become obvious. Those individuals who did use a computer at work were slightly younger and healthier, more often men, working in the public sector, and married.

Analysis

Logistic regression analyses were carried out, explaining whether or not individuals were working. The first analysis utilized the entire sample. It used the question on whether individuals had ever used a computer at work as the explanatory variable. The second and third analyses only include individuals who had ever used a computer at work. The second analysis used participation in computer training at work as the explanatory variable, and the third analysis used years since first computer use. These two explanatory variables are studied in separate regression analyses because they are correlated with one another ($p < 0.001$ in both countries). All regression analyses were stratified by country and carried out as stepwise regressions to obtain a more detailed impression of the extant influences (Harrell 2001). The first step calculated an empty model with the constant only. A second step added the control variables, and a third step added the explanatory variable. In all the analyses, categorical variables were assigned their mode as the reference category, and the continuous variable was centered on its mean. The variable capturing age had different modes in both countries. To facilitate comparisons, the category 56–60 years was used as the reference category in both countries.

The goodness-of-fit of the models is assessed using Hosmer and Lemeshow's *p* and Nagelkerke's *R* squared. Hosmer and Lemeshow's *p* was developed specifically for logistic regressions. *p* values equal to or greater than 0.05 denote an appropriate model fit. However, the size of values higher than 0.05 provides little information because it depends on the sample size and structure (Hosmer et al. 1997; Nattino et al. 2020). Nagelkerke's *R* squared was not specifically developed for logistic regressions, making its values less precise for these kinds of regressions. However, when used together with Hosmer and Lemeshow's *p*, it increases the robustness of the goodness-of-fit assessment. With Nagelkerke's *R* squared, a higher value indicates a better fit (Allison 2012).

Findings

The goodness-of-fit indices in Table 2 give us a first overview of the findings. The indices are presented for each country, model, and analysis step separately. Thereby, they allow us to assess how much of an influence each of the explanatory variables has in each country. For this purpose, the table presents Hosmer and Lemeshow's *p* and Nagelkerke's *R* squared. Table 2 shows that all the models have an acceptable fit, once the control variables are included. However, adding the explanatory variables makes little difference to the goodness-of-fit. It only improved the fit when computer use at work was added to the model. In contrast, computer training and experience do not improve the fit, at least not at the level of precision of two decimal places. This situation is the same in Denmark and Finland.

Table 2 Goodness-of-fit indices, by country and model

	Denmark		Finland	
	Hosmer & Lemeshow's *p*	**Nagelkerke's R^2**	**Hosmer & Lemeshow's *p***	**Nagelkerke's R^2**
Model 1: Computer used at work				
Constant only	–	0.25	–	0.01
+ control variables	0.86	0.66	0.77	0.68
+ explanatory variable	0.11	0.68	0.87	0.69
Model 2: Computer training				
Constant only	–	0.32	–	0.06
+ control variables	0.41	0.68	0.91	0.70
+ explanatory variable	0.90	0.68	0.76	0.70
Model 3: Computer experience				
Constant only	–	0.32	–	0.06
+ control variables	0.41	0.68	0.91	0.70
+ explanatory variable	0.56	0.68	0.98	0.70

The odds ratios for the three models provide more detailed information. These models are presented in Tables 3-5. All tables have in common that they show individuals aged 66-70, and those with limitations in their instrumental activities of daily living to be the most likely ones to be retired. The self-employed are less likely to be retired.

Table 3 presents the model including the effects of computer use at work. Therewith, it provides the information necessary for answering the first research question. This research question inquires to what extent computer use at work affects workforce participation in old age. The table reveals that computer use at work increases the chances of participating in the workforce. The odds of working were about seven times higher among Danes who used a computer, and about three times higher among Finns who used a computer. The constant in this model indicates that most individuals in the samples analyzed were working. Gender and marital status only had a significant influence in Finland, where women and married individuals were more likely to work. Limitations in the instrumental activities of daily living had a significant influence in both countries. Retired individuals were five times more likely to experience such limitations in Denmark, and eight times more likely to experience them in Finland. Public sector employees were less likely to work in Finland, but not in Denmark. The self-employed were more likely to work in both countries. Age differences exist in both countries. Overall, the odds to be retired increase with age. In Denmark, this increase starts in the age-group 61-65 years, where the odds of being retired are almost 18 times as high as for the age-group 56-60 years. In the age-group 66-70 years, the odds of being retired are even more than 250 times higher. In Finland, the odds of being retired already start to increase in the age-group 56-60 years. The increases get more substantial with age, with the age-group 61-65 years having odds of being retired that are already nine times as high as those of the previous age-group. In the age-group 66-70 years, the odds are even 235 times higher.

Table 3 Odds ratios for the model including computer use at work, by country

	Denmark		Finland	
	Odds ratio	**95% CI**	**Odds ratio**	**95% CI**
Constant	0.03***	0.02–0.05	0.05***	0.03–0.09
Gender: female	reference category		reference category	
male	0.68	0.45–1.04	1.81**	1.23–2.65
Marital status: married	reference category		reference category	
not married	1.34	0.83–2.09	2.00**	1.32–3.05
Limitations iADL: no	reference category		reference category	
yes	5.43***	2.58–11.44	8.05***	3.85–16.82
Sector: private	reference category		reference category	
public	1.14	0.74–1.75	1.63*	1.08–2.44
self-employed	0.16***	0.06–0.40	0.42*	0.21–0.84
Age: 51–55	0.59	0.24–1.47	0.31**	0.15–0.63
56–60	reference category		reference category	
61–65	17.89***	10.08–31.76	9.33***	5.96-14.62
66–70	255.65***	130.91–499.24	235.17***	114.74–482.02
Computer use at work: yes	reference category		reference category	
no	7.46***	3.81–14.63	3.24***	2.06–5.12

Note: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.
CI, confidence interval.

Table 4 displays the influence of the number of years since first computer use at work. It provides the information regarding the second research question. This research question inquires about the extent to which computer experience affects workforce participation in old age. It highlights that years of computer experience have a minute significant effect in Finland, but none in Denmark. In Finland, each year of computer experience increases the odds of being retired by 0.03. The effects of the control variables are comparable to the effects in the previous model. The constant indicates that most individuals were working. Women and married individuals in Finland were more likely to work. Moreover, limitations in the instrumental activities of daily living had a significant influence in both countries. Retired Danes were five times more likely to experience such limitations, and retired Finns were 13 times more likely to experience them. Finnish public sector employees were less likely to work, whereas the self-employed in Denmark and Finland were more likely to work. Age differences can be found in both countries. In Denmark, those in the age-group from 61-65 years have odds of being retired that are 19 times as high as those for the age group 56-60. In the oldest age group, from 66 to 70 years, the odds are even more than 270 times as high. In Finland, the odds start to increase from the youngest age group on. Those aged 61-65 years have odds that are more than 11 times as high as those for the age-group 56-60. In the age group 66-70 years, they are even more than 400 times as high.

Table 5 displays the effects of computer training at work. In doing so, it provides the information asked for in the third research question. This research question asks in how far computer training affects workforce participation in old age. Table 5 shows that training has no significant effect in either of the countries. The control variables show a

Table 4 Odds ratios for the model including computer experience, by country

	Denmark		Finland	
	Odds ratio	**95% CI**	**Odds ratio**	**95% CI**
Constant	0.03***	0.01–0.05	0.04***	0.02–0.07
Gender: female	reference category		reference category	
male	0.80	0.51–1.25	1.95**	1.24–3.07
Marital status: married	reference category		reference category	
not married	1.40	0.82–2.30	2.13**	1.30–3.47
Limitations iADL: no	reference category		reference category	
Yes	5.00***	2.14–11.67	13.37***	5.45–32.79
Sector: private	reference category		reference category	
public	1.21	0.76–1.91	1.66*	1.04–2.63
self-employed	0.09***	0.03–0.26	0.28**	0.11–0.72
Age: 51–55	0.27	0.06–1.23	0.41*	0.17–0.94
56–60	reference category		reference category	
61–65	19.07***	10.03–36.23	11.68***	6.69–20.39
66–70	273.97***	131.15–572.31	415.91***	167.78–1030.99
Computer experience	1.02	0.99–1.04	1.03*	1.00–1.05

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
CI, confidence interval.

Table 5 Odds ratios for the model including computer training, by country

	Denmark		Finland	
	Odds ratio	**95% CI**	**Odds ratio**	**95% CI**
Constant	0.03***	0.02–0.06	0.04***	0.02–0.08
Gender: female	reference category		reference category	
male	0.84	0.53–1.33	1.95**	1.24–3.06
Marital status: married	reference category		reference category	
not married	1.42	0.84–2.38	2.09**	1.28–3.42
Limitations iADL: no	reference category		reference category	
yes	5.22***	2.22–12.29	13.37***	5.48–32.61
Sector: private	reference category		reference category	
public	1.13	0.71–1.79	1.57	0.99–2.48
self-employed	0.09***	0.03–0.26	0.27**	0.11–0.69
Age: 51–55	0.28	0.06–1.26	0.40*	0.17–0.92
56–60	reference category		reference category	
61–65	19.46***	10.24–36.99	11.72***	6.72–20.45
66–70	277.35***	132.79–579.30	425.65***	172.26–1051.74
Computer training: yes	reference category		reference category	
no	0.65	0.42–1.00	0.80	0.50–1.28

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
CI, confidence interval.

similar pattern as in the other two analyses: the constant reveals that most individuals in the sample were not working, women and married individuals were more likely to work in Finland, and limitations in the instrumental activities of daily living increased the odds of being retired. In both countries, public sector employees had the same odds of working as private sector employees. However, the self-employed were more likely to work in both countries. Age increased the odds of being retired. In Denmark, the increase started in the age-group 61-65 years, which was almost 20 times as likely to be retired as the younger age-group. The oldest age-group even was more than 270 times as likely to be retired. In Finland, the increase started with the youngest age group. It amounted to almost 12 times for the age-group from 61 to 65 years, and more than 420 times for the age-group 66-70 years.

Discussion

The use of a computer at work is increasing and for a long time, older workers have been particularly vulnerable to the adverse effects of this. They often lacked computer skills, which presented them with a choice between upskilling or leaving the workforce. However, over the last decades, computer use at work has become widespread and part of the everyday work activities of many individuals. The computer skills of older workers have improved, which reduces their vulnerability in the labor market. Their need for computer training decreases, as does their risk of leaving the workforce because of outdated skills. This article takes a closer look at how the relevance of computers has changed for older workers. It explores how the influences of computer use, training, and experience on older workers play out today. For this purpose, it analyzed micro-level data from Denmark and Finland.

The first research question is to what extent computer use at work affects workforce participation in old age. This question utilizes computers as an indicator for the nature of work tasks, with computer use signifying office tasks. Such office tasks are often less physically demanding than manual work, making them preferrable for older workers. Findings show that computer use at work increases the chances of older workers participating in the workforce. Older Danes using computers were seven times more likely to work, while their Finnish counterparts were three times more likely. These numbers indicate that computer use makes a considerable difference to work tasks. It reduced their physical demands to such a degree that they become easier to handle for older workers. Therewith, the benefits of work computerization that, e.g., Damman (2016) and Nagarajan and Sixsmith (2023) are expecting have already been visible in Denmark and Finland in 2017.

The second research question inquires about the extent to which computer experience affects workforce participation in old age. Computer experience is measured in the number of years since individuals first used a computer at work. Therewith, it is a proxy for computer skills and employability in computerizing workplaces (Komp-Leukkunen et al. 2022). Findings show that computer experience has no effect in Denmark, and only a marginal effect in Finland. In Finland, each additional year of computer experience increases the odds of being retired by 0.03. Ten years of additional computer experience increase the odds by 0.3 only. This amount is so low that a strong content-wise interpretation of this finding would be out of place. This circumstance is remarkable, considering that this variable has the most differentiated measurement of all explanatory variables. If anything, one would expect the measurement to increase the effect size. Therefore, it can be concluded that computer experience plays no role worth mentioning in older workers' chances of participating in the workforce. This insight suggests that both Denmark and Finland have already progressed so far in the process of digitalization that computer experience is ubiquitous and generally sufficient, making it the standard instead of an unusual characteristic.

The third research question asks in how far computer training affects workforce participation in old age. Computer training was long considered the prime means of upskilling older workers. When computers were first introduced to workplaces, training was needed to introduce workers to computers as such (Staufer 1992). As computer use became more widespread, training shifted to specific computer technologies, such as artificial intelligence-based programs (Alcover et al. 2021). Findings show that computer training as such has no significant influence on whether older individuals participate in the workforce anymore. This lack of an influence can have two reasons. First, it can be a methodological artifact. The variable used to measure computer training is dichotomous, without any differentiation between basic computer training and training in advanced technologies. It is possible that nowadays, basic computer training is irrelevant, while training in more advanced computer technologies still makes a difference. Future research is needed to explore the effects of different kinds of computer training. Second, the lack of a significant influence can be the result of Denmark and Finland having advanced in the process of digitalization. Basic computer skills and computer use in the free time may be so common, and individuals can teach themselves how to use more advanced computer technologies. In this case, computer learning would still take place, but it would take place outside of computer courses. This situation would be in line with Gilleard and Higgs (2008). Future research is needed to explore when and where older workers nowadays pick up computer skills.

The findings have scientific implications. They reaffirm Hudomiet and Willis' (2022) message that the effects of computerization on workforce participation in old age change over time. Thus, they underline the necessity of regularly revisiting our extant insight into this area. The two case-study countries that are advanced in the digitalization process indicate which direction the development may take in other countries in the future. As a consequence, county-comparative studies on computerization and older workers, such as Lee et al. (2020) and Van Dalen et al. (2009), have to be interpreted with particular care. There might be country differences in the mechanisms observed, possibly even opposed ones. Future research could use this insight as a sampling strategy for countries to include in comparative case studies. This sensitivity to time and place is particularly pronounced when it comes to studies on computer training for older workers, as was found in Lee et al. (2008) and Stauffer (1992). When computer use at work is widespread, these training measures as such have no significant influence on workforce participation in old age. Therefore, case studies on such training has to either explore the different types of training measures, or to capture computer learning across all areas of life.

The insight generated in this article also has practical implications. First, computer use at work initially counteracts the policy goal of extending work lives. However, as computer use spreads, this obstacle to extended working lives vanishes. Older workers start to reap the benefits that computers bring, with physically easier working tasks catering to declining health in old age. Therefore, policymakers may want to facilitate older workers' computer use especially when computers are newly introduced to workplaces. When computer use has already spread within a workplace, they may consider refocusing their attention on other goals.

Besides its merits, this study also has limitations. First, this study analyzes the situation in 2017, which is before the COVID-19 pandemic. During the pandemic, technologies became essential for the functioning of the home office model, and older workers had to catch up quickly with these technologies. As a result, the relationship between computers and older workers changed during the COVID-19 pandemic. This study does not capture these more recent changes. Consequently, future research may want to reassess how far advanced countries are in computer use at work after the COVID-19 pandemic. This insight does not change the mechanisms observed in the present article, but it does indicate which countries should currently be grouped together when studying similar levels of computerization at work. Second, this study includes no information on the older workers' managerial tasks. Such tasks have been found to stabilize an individual's retirement expectations, making them less dependent on external influences (De Grip et al. 2013). Therefore, it would be worthwhile including a variable on the existence of managerial tasks as a control variable in the analysis. This study did not do so because such a variable does not exist in the life-history interviews analyzed. Future research with a different dataset could repeat the analysis while also including managerial tasks as a control variable. Third, this study did not include any variables on workplace policies for older workers. Such policies can steer early retirement decisions and training uptake, thereby influencing when older individuals leave the workforce (Wilson et al. 2020). Therefore, it would be worthwhile including variables on workplace policies as control variables in the analysis. The dataset analyzed did not include any such variables. If future research on the same topic is carried out using a different dataset, then it should consider including such variables.

Conclusion

All in all, computers fundamentally change work and how older individuals can participate in the labor force. Although computer use was long considered an obstacle to longer working lives, it stops being one when computer use becomes widespread. In this situation, older workers benefit from the physically easier work tasks that computer use brings. Consequently, future research needs to consider the aspects of time and place when studying the connection between computer use at work and extended working lives.

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