How welfare regimes moderate the associations between cognitive aging, education, and occupation

Dan Orsholits*[a,b] PhD, Stéphane Cullati[c,d] PhD, Prof. Paolo Ghisletta[e,b,f], PhD, Prof. Marja J. Aartsen[g] PhD, Prof. Michel Oris[a,b] PhD, Prof. Matthias Studer[b,h] PhD, Prof. Jürgen Maurer[i,b] PhD, Laura Perna[j,k] PhD, Prof. Élvio R. Gouveia[l,m,a] PhD, Bruna R. Gouveia[m,n,o,a] PhD, Prof. Adilson Marques[p,q] PhD, Miguel Peralta[p,q] MPH, Priscila Marconcin[p] PhD, Prof. Matthias Kliegel[a,e,b] PhD, Andreas Ihle[a,b,e] PhD

[a]Centre for the Interdisciplinary Study of Gerontology and Vulnerability, University of Geneva, 1205 Geneva, Switzerland; [b]Swiss National Centre of Competence in Research LIVES – Overcoming vulnerability: Life course perspectives, 1015 Lausanne and 1205 Geneva, Switzerland; [c]Population Health Laboratory, Department of Community Health, University of Fribourg, 1700 Fribourg, Switzerland, [d]Department of Readaptation and Geriatrics, University of Geneva, 1206 Geneva, Switzerland; [e]Department of Psychology, University of Geneva, 1205 Geneva, Switzerland; [f]UniDistance Suisse, 3900 Brig, Switzerland; [g]NOVA, Norwegian Social Research, Oslo Metropolitan University, 0130 Oslo, Norway; [h]Institute of Demography and Socioeconomics, University of Geneva, 1205 Geneva, Switzerland; [i]Department of Economics, University of Lausanne, 1015 Lausanne, Switzerland; [j]Department of Translational Research in Psychiatry, Max Planck Institute of Psychiatry, 80804 Munich, Germany; [k]Division of Mental Health of Older Adults, Department of Psychiatry and Psychotherapy, University Hospital, LMU Munich, 80336 Munich, Germany; [l]Department of Physical Education and Sport, University of Madeira, 9020-105 Funchal, Portugal; [m]LARSyS, Interactive Technologies Institute, 9020-105 Funchal, Portugal; [n]Health Administration Institute, Secretary of Health of the Autonomous Region of Madeira, 9004-515 Funchal, Portugal; [o]Saint Joseph of Cluny Higher School of Nursing, 9000-535 Funchal, Portugal; [p]CIPER, Faculty of Human Kinetics, University of Lisbon, 1495-751 Lisbon, Portugal; [q]ISAMB, University of Lisbon, 1649-028 Lisbon, Portugal

* Corresponding author: Dan Orsholits, dan.orsholits@unige.ch

Abstract

Objectives

Previous studies have shown the importance of individual markers of cognitive reserve, such as education and occupation, for cognitive health in old age. However, there has been only little investigation so far on how this relationship varies across contexts.

Methods

We analyzed data from the Survey of Health, Ageing and Retirement in Europe, using second-order latent growth models, to assess the moderating role of welfare regimes on the relationship between education and occupation skill level in explaining overall cognitive functioning and decline in old age. Our sample includes 13 European countries using data from five regular waves of the survey (2004-2007 & 2011-2015) and two retrospective ones (2008-2009 & 2017). Cognitive functioning was modelled as a latent variable measured by immediate and delayed recall, verbal fluency, and numeracy.

Results

74,193 participants were included from the survey. Our analysis showed that the association of education with cognition was weaker overall in Scandinavian countries, but stronger in Southern European countries, relative to Bismarckian ones. However, educational differences in the decline of cognition were more pronounced only in Scandinavian compared to Bismarckian countries. Additionally, higher skilled occupations in Scandinavian countries had better overall functioning compared to the same occupations in Bismarckian countries but there was no difference in the decline in cognitive functioning.

Discussion

Our findings indicate that the associations of cognitive functioning and its decline with individuals' cognitive reserve markers (education and occupational skill level) vary according to welfare regimes, showing the importance of contextual factors in cognitive ageing processes.

Keywords: life course; life span; welfare states; cognition; cognitive reserve

Introduction

With an increasing life expectancy leading to an aging population, the number of older adults affected by cognitive impairment has increased. Maintaining good cognitive functioning in old age is crucial for ensuring autonomy and preserving overall health in old age (Hartley et al., 2018; Rowe & Kahn, 1997; Sardella et al., 2020). It is thus important to study and comprehend factors influencing not only the level of cognitive functioning but also its decline over time to better understand how it can be preserved in old age.

In this regard, the concept of cognitive reserve (Stern, 2002) postulates that cognitive engagement throughout an individual's life, including educational and occupational attainment, promote brain health as they may increase an individual's reserve capacity and thereby possibly compensate for brain damage, neurological loss, and pathological decline such as dementia (Stern, 2012). Specifically, inter-individual differences in the effective recruitment of neural networks and cognitive processes are hypothesized to explain differences in individuals' capacity to cope with or compensate for decline or pathology (Bartres-Faz & Arenaza-Urquijo, 2011; Stern, 2009, 2012). For individuals with healthy cognitive functioning, such reserve mechanisms may contribute to the adaptation of brain activity as task difficulty level is increased (Stern, 2012). Empirical evidence has shown that greater cognitive stimulation in young adulthood and midlife, such as attaining higher educational levels and pursuing a cognitively demanding working life, related to better overall cognitive functioning at older ages, even when suffering from neurological diseases such as dementia supporting the cognitive reserve hypothesis (Ihle et al., 2020; Opdebeeck et al., 2016; Wilson et al., 2019). However, research relating cognitive reserve to changes in cognitive functioning over time is less clear. Some studies have found that higher levels of cognitive reserve are associated with a steeper decline in cognitive functioning (Hall et al., 2007; Mungas et al., 2018) while, increasingly, more recent studies have found little to no change, or a less steep decline regardless of cognitive health (Lövdén et al., 2020; Nyberg et al., 2021; Seblova et al., 2020; Wilson et al., 2019).

Importantly, there is less research on the contextual factors that might play a role in modulating cognitive aging, despite their importance for individuals' health across the lifespan (Baltes et al., 1999) that could thus potentially shape the relationship between cognitive reserve and cognitive decline. One of the most crucial contextual factors affecting people's lives are welfare state arrangements, or welfare regimes (Esping-Andersen, 1990) which can determine the extent and access to social services and programs. Nordic countries, for instance, have more egalitarian and universal systems while in Continental European, or Bismarckian, countries they are often closely linked to occupational position (Esping-Andersen, 1990). Compared to Bismarckian countries, Southern European countries can be further distinguished by the greater importance of informal and family arrangements to deal with unequal access to welfare provisions (Ferrera, 1996).

Even once people have entered working life, in Nordic countries individuals have generally more life-long learning opportunities and are more likely to engage in them than in other welfare regimes (Boeren, 2016). However, it is possible that such policies could contribute to accentuating inequalities in cognitive functioning as more educated individuals are more likely to participate in, and benefit from, these types of programs especially in older cohorts (Tikkanen & Nissinen, 2016).

A large body of work exists in public health and epidemiology showing differences between the different types of welfare states in relation to health and quality of life in old age (Kim, 2017; McCartney et al., 2019; Niedzwiedz et al., 2014) with Nordic countries generally having less inequality in many, but not all, health outcomes. Nevertheless, most previous research on health inequalities, including cognitive health, in relation to welfare regimes has principally focused on overall, or *level*, differences. Consequently, there has been comparatively less research on the role of different welfare state types in relation to change in health outcomes over time i.e., *slope* differences. Sieber et al. (2020) showed that, for self-rated health, there is a convergence as people age as differences in health trajectories *between* types of welfare states decline. This suggests that contextual factors may play a larger role in the build-up of health differences earlier on in life than in their decline in old age. This is in line with the "age-as-leveler" hypothesis which posits that health in older individuals is mainly determined by age rather than other sociodemographic characteristics or resources (House et al., 1994). What has been lacking up until now, and what will be the key contribution of this study, is a large-scale investigation directly assessing the moderating role of macro-level factors on the association of cognitive reserve with *changes* in cognitive functioning over time in older individuals.

To our knowledge, the relationship between types of welfare states and markers of cognitive reserve has so far not been systematically investigated in detail, especially in relation to changes in cognitive functioning over time with studies (Barbosa et al., 2020; Cermakova et al., 2018; Formanek et al., 2019; Grasshoff et al., 2021) only doing simple country comparisons, using cross-sectional data, or describing changes in cognitive functioning over time without considering cognitive reserve markers. Thus, our study has two goals: to investigate whether the relationship between indicators of cognitive reserve – education and job skill level – and overall cognitive functioning is moderated by context i.e., welfare regimes, and whether context also moderates the relationship between cognitive reserve *and change* in cognitive functioning over time. In terms of hypotheses that can be formulated, previous work has found that education-related inequalities are generally smaller in countries with more egalitarian welfare regimes. Consequently, we would expect that higher levels of education are associated with a smaller advantage in overall cognitive functioning in Scandinavian countries relative to other welfare regimes (H1). The evidence is less clear for job skill level. There are indications that workers in all levels are generally more involved in the production process in Nordic countries. Moreover, in more egalitarian welfare regimes, even occupations which are predominantly manual are associated with strong training programs which can continue during individuals' careers which are less common in countries with lower levels of labor market policy intervention such as Liberal economic or Southern European countries. Therefore, similarly to education, we would expect that the higher skilled jobs would have a weaker association with the overall level of cognitive functioning in more (compared to less) egalitarian welfare regimes (H2). As for change over time, recent studies increasingly suggest that indicators of cognitive reserve such as education are not associated with cognitive decline. Therefore, we would not expect to see any differences between welfare regimes (H3). This is further reinforced by evidence supporting the "age-as-leveler" hypothesis which suggests that contextual factors matter less as people age.

To investigate these hypotheses, the present study leverages the large cross-national data provided by the Survey of Health, Ageing and Retirement in Europe (SHARE) from which we analyzed a sample of 74,193 individuals from 13 different countries using a second-order latent growth curve model

within the structural equation modeling framework. We will focus on describing *between*-individual differences in cognitive functioning in relation to cognitive reserve across different contexts.

Methods

Participants and Sample

Our data was taken from seven waves of the Survey of Health, Ageing and Retirement in Europe (SHARE) which is a biennial panel survey of individuals aged 50 and older, and their partners, in Europe and Israel (Börsch-Supan et al., 2013). The main interview was conducted using computer-assisted personal interviewing (CAPI) with additional data collected with a drop-off self-administered questionnaire. In the third and seventh waves, the SHARE collected retrospective life course data from participants as part of the SHARELIFE module which used a life history calendar approach. The first wave of data collection occurred in 2004–2005, and 2017 for wave seven.

The sample used for this study included individuals aged between 50 and 90 living (mean 64.0, SD 10.0 at baseline) in one of 13 European countries (Austria, Belgium, Denmark, France, Germany, Greece, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and Switzerland). We selected these countries because they all participated in at least one wave of the retrospective life course module (wave 3 and/or wave 7) and represent countries with relatively stable welfare state arrangements. All countries except Portugal, which joined the survey in wave 4, and Luxembourg, which joined in wave 5, were part of the SHARE from the first wave. Additionally, the Netherlands left the survey after the fifth wave. We also excluded participants who joined the survey in the sixth (only one complete cognitive functioning module) or seventh wave (incomplete cognitive functioning module). This left us with a sample of 74,193 respondents.

Cognitive Functioning

We used four indicators to measure cognitive functioning: immediate recall, delayed recall, verbal fluency, and a numeracy test. Descriptive statistics for these variables and information on the assessment of these indicators in SHARE is available in the Supplementary Material. The full cognitive functioning module was conducted in waves 1, 2, 4, 5, and 6.

Covariates

Our main explanatory variable was the welfare regime of respondents' country of residence. Following the typology of Ferrera (1996), we grouped the 13 countries of residence in our sample into three welfare regimes: Bismarckian (Austria, Belgium, France, Germany, Luxembourg, the Netherlands, and Switzerland), Scandinavian (Denmark, and Sweden), and Southern European (Greece, Italy, Portugal, and Spain).

Two variables served as cognitive reserve markers: education and the skill level of the respondents' main job as indicated in the life history calendar. Education was measured using the 1997 version of the International Standard Classification of Education (ISCED). We treated it as continuous variable ranging from 0, no completed education, to 6, second-stage tertiary education. We used each respondent's highest reported level of education across all waves. Job skill level was categorized in accordance with the four skill levels in the International Standard Classification of Occupations (ISCO) using the single-digit ISCO code of respondents' main job over the life course. From this we

created a binary variable distinguishing between high-skill occupations, skill levels 3 and 4, and low-skill occupations, skill levels 1 and 2.

Our control variables included respondents' sex, baseline (first measurement) age, self-rated health (SRH), and EURO-D depression scores. In the models, we centered age at 65, SRH at 3, and the EURO-D scale at 3. We also included binary variables indicating whether respondents ever smoked for at least a year and whether they consumed alcoholic beverages at least three to four times a week in the months prior to any survey interview. Descriptive statistics are shown in Table 1.

Statistical Analysis

We estimated a *linear* curve-of-factors (CUFFS) (McArdle, 1988), or second-order, latent growth curve model to study the level of, and change in, cognitive functioning. This type of growth curve model allowed us to model change over time in multidimensional constructs directly rather than creating an aggregate outcome (calculating a sum or mean for instance) providing less biased results and better detecting change over time (von Oertzen et al., 2010).

We specified the model with strong factorial invariance by constraining the factor loadings, factor variances, and indicator means to be equal across measurements. The means of the first-order factors measuring cognitive functioning were all set to zero so that the second order latent variables, the slope and intercept, could capture change in the factors measuring cognitive functioning. The residual errors for each indicator were allowed to covary across all measurements. The indicators of cognitive functioning were standardized using the means and standard deviations from the first measurement to deal with scaling differences. A simplified path diagram of the model is in the Supplementary Material.

We regressed the intercept and slope factors on the covariates, and we included interaction effects between the welfare regime variable and education, and between welfare regime and job skill level to test whether the association with cognitive reserve varied across welfare regimes. The models were estimated using full-information maximum likelihood with robust standard errors using the lavaan package (Rosseel, 2012) in R (R Core Team, 2020).

Results

Model Estimates

Model estimates are displayed in Table 1. The reference individual is male, with a baseline age of 65, an upper secondary level of education (ISCED 3) with a low-skill job, living in a Bismarckian country, who never smoked, and does not drink frequently. The model fit indices are presented in the Supplementary Material.

Level Differences (Intercept Factor)

Here we discuss the overall *time-constant* effects of the main explanatory variables: welfare regime and cognitive reserve. The welfare regime coefficients in Model 1, showed that individuals in Scandinavian countries had a higher overall level of cognitive functioning relative to those in Bismarckian countries while it was lower in Southern European countries. As for our two indicators of cognitive reserve, education, and job skill level, we found that a higher level of education was

associated with a higher overall level of cognitive functioning and individuals whose main occupation was classified as highly skilled also had a better overall level of cognitive functioning.

The interaction effects of welfare regime type with education in Model 2 were significant and showed that higher levels of education in Scandinavian countries had a less pronounced association with the level of cognitive functioning compared to Bismarckian countries. In other words, educational differences in the overall level of cognitive functioning were smaller in Scandinavian countries. This can be seen in panel A of Figure 1 where the distance between the lines for ISCED-3 and ISCED-6 at the first measurement is smaller for Scandinavian countries than Bismarckian ones. It was the opposite case for Southern European countries where higher levels of education gave a greater advantage in relation to cognitive functioning relative to Bismarckian countries. For job skill level, the interaction terms show that a high skill job in Scandinavian countries is associated with a higher overall level of cognitive functioning compared to Bismarckian countries. This result may be potentially explained by lifelong learning programs and other forms of adult education disproportionately favoring individuals with more skilled employment in Nordic countries where such programs are more common (Tikkanen & Nissinen, 2016).

Differences in Change Over Time (Slope Factor)

The results from Model 1 showed that in Scandinavian and Southern European countries, cognitive decline was more pronounced than in Bismarckian countries. In the case of Scandinavian countries, this finding provides some evidence supporting the "age-as-leveler" hypothesis. Looking at the indicators of cognitive reserve, higher levels of education were associated with a more pronounced decline in cognitive functioning, while jobs with a higher skill level were associated with a less pronounced decline. However, Model 2 suggests that this counter-intuitive relationship is largely driven by Southern European countries.

In Model 2, the interaction of education with welfare regimes showed that a higher level of education in Scandinavian countries leads to a less pronounced decline in cognitive functioning than in Bismarckian countries. We observed the opposite relationship for Southern European countries. The effect of education on change in cognitive functioning is non-significant in Bismarckian countries for individuals with the reference profile. Differences in trajectories between the reference (ISCED-3) and the highest (ISCED-6) level of education are illustrated in panel A of Figure 1.

As for job skill level, the interaction term for Scandinavian and Southern European countries was non-significant. This suggests that, for individuals with the reference sociodemographic profile, there is no difference in the relative advantage of having had a high-skill job between Scandinavian or Southern European, and Bismarckian countries. Panel B of Figure 1 shows the trajectories of cognitive decline in relation to job skill level for Model 2.

Discussion

The goal of this study was to investigate the potential interaction between macro-level contextual factors and cognitive reserve in relation to individual cognitive aging. More particularly, we explored the influence of welfare state arrangements on differences in the level of cognitive functioning as well as the potential for contextual factors to modify the association between cognitive reserve and cognitive functioning over time.

Differences in the *level* of cognitive functioning were broadly in line with previous findings. As shown by Model 1 in Table 2, we found that individuals, with our reference profile, in Scandinavian countries had a generally higher level of cognitive functioning relative to the Bismarckian and Southern European welfare regimes. Bismarckian countries also showed higher levels of cognitive functioning than Southern European countries. These overall level differences between welfare regimes follow patterns that are generally observed for other health outcomes (Eikemo et al., 2008; Kim, 2017; Niedzwiedz et al., 2014). Our results are also in accordance with the cognitive reserve literature in that higher levels of education (Ihle et al., 2016; Wilson et al., 2009; Wilson et al., 2019) and jobs with higher skill levels (Andel et al., 2015; Fisher et al., 2014; Opdebeeck et al., 2016) are associated with a better overall level of cognitive functioning.

Importantly, the interaction effects suggest that the association of cognitive reserve with the level of cognitive functioning *changes depending on the context*. While individuals in Scandinavian countries showed better cognitive functioning overall, their advantage, relative to individuals in Bismarckian countries, was reduced or even disappeared the higher the level of education, which is in line with H1. While at first glance this may be somewhat surprising, there is evidence from other health outcomes that show similar patterns in Scandinavian countries (Leopold, 2016; Niedzwiedz et al., 2014). In fact, Leopold (2016) found that smaller educational differences are primarily found among *older* individuals in Sweden but not younger generations. The author argues that the less pronounced educational difference in Sweden among older cohorts is related to social policies that aim to reduce inequality at earlier stages of life which entails a long-lasting reduction in inequalities across the whole life course. Interestingly, this is not the case for job skill level as we find that highly skilled employment in Scandinavia provides a stronger protective effect going against H2. This might be due to lifelong learning programs being used by more educated and more skilled workers while such programs are less prevalent in other European welfare regimes.

When comparing the different welfare regimes in relation to *change* in cognitive functioning, we found that the relative advantage of Scandinavian countries compared to Bismarckian ones decreased over time. This is especially noteworthy as it shows that macro-level advantages do not necessarily persist over time and that welfare state arrangements that favor better cognitive functioning in earlier life stages do not necessarily continue to do so as people age. This dovetails with Sieber et al. (2020) who showed that past life-course factors as well as welfare state arrangements tend to become less pronounced with aging. Our results also corroborate those of Formanek et al. (2019) who found that individuals from Scandinavian countries experience a steeper decline in cognitive performance. Conceptually, the decrease of the relative advantage of Scandinavian countries could be explained by the "age-as-leveler" hypothesis which considers that in older age, health is more directly tied to age rather than other characteristics. Furthermore, Baltes and Smith (2003) contend that the older individuals get, the more difficult, and the less efficient, any form of intervention aiming to combat cognitive decline is. Thus, we could expect the differences between welfare regimes may narrow over time as it becomes increasingly difficult to reverse or attenuate declines due to aging through policy intervention. Nevertheless, this is not entirely the case as our results showed that the gap between Southern European and Bismarckian countries grew in the case of our reference profile.

Concerning our first indicator of cognitive reserve, education, the estimates for Model 1 showed that there was a small negative association between education and change in cognitive functioning.

While this is in line with certain studies showing that the protective role of education decreases as people age (Hall et al., 2007; Mungas et al., 2018; Opdebeeck et al., 2016), the relationship is not pronounced which dovetails with recent studies showing a small, often inconsistent, association between education and greater declines in cognitive functioning in old age (Lövdén et al., 2020; Nyberg et al., 2021; Seblova et al., 2020; Wilson et al., 2019). Model 2 further shows us that this significant negative association seems to be primarily driven by countries in the Southern European welfare regime group. Moreover, the interaction effects suggest that the cognitive reserve hypothesis, in terms of decline, might be more applicable to Nordic countries than to other types of welfare regimes which is supported by previous research (Foverskov et al., 2018).

As for the second indicator of cognitive reserve, job skill level, our results are in line with the expectations of the cognitive reserve hypothesis as jobs with higher skill levels, which demand more cognitive resources, are associated with a less pronounced decline in cognitive functioning (Fisher et al., 2014; Pool et al., 2016) though this association is not consistently found (Aartsen et al., 2019; Rusmaully et al., 2017), indicating that it may be shaped by certain contextual factors.

The interaction effects in Model 2, which allowed us to test H3, suggest that the association between education and change in cognitive functioning may vary across welfare regimes. More specifically, relative to Bismarckian countries, a higher level of education in Scandinavia confers a greater advantage since cognitive decline over time is attenuated the higher the level of education. This dovetails with findings that higher levels of education can compensate for declines in cognitive functioning over time to some degree (Clouston et al., 2020). Regarding Southern European countries, the interaction effect being negative indicates that a higher level of education leads to a sharper decline in cognitive functioning relative to Bismarckian countries.

Thus, our results suggest that the effect of education is context-dependent and therefore the association between cognitive decline and education is not necessarily the same across all country contexts. In light of the typology of welfare state policies we employ here (Esping-Andersen, 1990; Ferrera, 1996), more generous welfare states can be viewed as being associated with greater educational inequalities when looking at changes in cognitive functioning over time. This counterintuitive result may be due to welfare states providing better aid to more frail individuals which extends their life expectancy but also makes educational differences persist for longer (Huijts & Eikemo, 2009). Another possibility also considered by Huijts and Eikemo (2009) is that a higher level of education is required to fully benefit from all the services and programs offered by the Scandinavian welfare system thus providing a comparative advantage to more educated individuals over time. Furthermore, there is evidence that more egalitarian welfare arrangements do not necessarily lead to better absolute health behaviors and outcomes but rather decrease relative differences (Mackenbach, 2020) which is in line with our findings for cognitive decline.

As for job skill level, we found no significant difference between Scandinavian or Southern European, and Bismarckian countries in relation to the association between the skill level of individuals' main job over the life course and cognitive decline suggesting that, unlike education, the protective effect of a more cognitively demanding job on declines in cognitive functioning may be similar across different welfare regimes.

Taken together, our results indicate that the effects of cognitive reserve on the overall level of cognitive functioning and subsequent decline vary across the different welfare systems. They

highlight the importance of taking into account contextual factors when investigating relationships between cognitive reserve and cognitive health. In terms of overall cognitive functioning, educational differences are less pronounced in Scandinavian countries than in Bismarckian or Southern European countries. The effect of education on cognitive change also differs across welfare states as it is more pronounced in Scandinavian countries than in Bismarckian or Southern European ones. This suggests that while more redistributive welfare regimes can attenuate differences in cognitive functioning related to education in earlier life phases, this is no longer the case for later life stages where inequalities in these countries do not decrease as people age. Our results also seem to be in line with the "Nordic paradox" which suggests that health inequalities stemming from differences in the level of education are not necessarily the smallest in Nordic countries especially in older cohorts (Mackenbach, 2017).

Consequently, we find some support for the long-term effects of cognitive reserve hypothesis in Scandinavian countries in *terms of cognitive decline*, but not in other countries where the "age-as-leveler" hypothesis seems to be more relevant when using education as a marker of cognitive reserve. Our results therefore suggest the additional importance of cognitive stimulation during individuals' working life in order to attenuate the decline of cognitive functioning. However, policies that provide additional education in later stages of life, such as lifelong learning, may exacerbate rather than attenuate educational differences in cognitive decline.

Nevertheless, our results, as illustrated in Figure 1, showed that cognitive reserve accumulated at earlier life stages provides a long-lasting advantage in cognitive functioning in old age in all welfare regimes. Moreover, unlike for cognitive decline, higher levels of cognitive reserve are associated with a better overall level of cognitive functioning across all welfare regimes indicating that policies which encourage higher education, for example, can contribute to better cognitive outcomes in all contexts.

There are nonetheless limitations to our study. First, we used retrospective data to assess respondents' highest level of education as well as their main occupation and countries of residence during the life course. Nevertheless, recall bias for the retrospective SHARELIFE modules is generally low (Garrouste & Paccagnella, 2011). Second, this is a correlational study. However, because we were mainly interested in comparing *between*-individual differences rather than *within*-individual differences this is trade-off that needed to be made. Third, there is a potential learning or retest effect, even if SHARE attempted to reduce it by using randomized word lists for the recall tests. This may lead us to potentially underestimate declines in cognitive functioning. Fourth, there is also a risk of selection bias as we only included individuals who joined in wave five or earlier. Nevertheless, the use of full-information maximum likelihood to include all cases meeting our selection criteria, including those with missing information on covariates, helps to reduce the introduction of additional biases due to missing information similarly to multiple imputation.

Despite these limitations, our study contributes to the literature on health and aging in general, as well as cognitive reserve and cognitive functioning in particular, by explicitly testing the moderating role of contextual factors on the relationship between cognitive reserve and cognitive functioning both in relation to its overall level and change over time using a large cross-national sample. The effect sizes (see Table S1) for the intercept and slope factors are large and medium respectively once the interactions are included. Thus, our results underscore the importance of taking into account the

moderating role of contextual factors especially when studying the relationship between cognitive reserve as measured by educational attainment.

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Author Contributions

D.O. and A.I. designed the analyses. D.O. analyzed the data. D.O. and A.I. drafted the initial manuscript. All authors interpreted the data and results. All authors revised the manuscript.

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Table 1. Descriptive statistics for covariates; means and standard deviations (in parentheses) for continuous variables, percentages for categorical variables.

Welfare Regime	
Bismarckian; Scandinavian; Southern European	56.9%; 15.6%; 27.6%
Age at baseline	64.0 (10.0)
Sex	
Male; Female	46.5%; 53.5%
Self-rated Health	3.0 (1.1)
EURO-D	2.3 (2.2)
Education	2.7 (1.6)
Job Skill Level	
Low; High	73.0%; 27.0%
Ever Smoked	
No; Yes	52.5%; 47.5%
Frequent Drinking	
No; Yes	61.2%; 38.8%
Part of Refreshment Sample	
No; Yes	35.8%; 64.2%

Table 2. Regression Coefficients from Linear Second-Order Growth Curve Models for Cognitive Functioning (*N* = 74,193)

	Model 1						Model 2					
	Intercept			Slope			Intercept			Slope		
	Est.	95% CI	*p*	Est.	95% CI	*p*	Est.	95% CI	*p*	Est.	95% CI	*p*
Factor Mean	-0.115	[-0.144, -0.086]	0.000	-0.107	[-0.168, -0.046]	0.001	-0.117	[-0.147, -0.086]	0.000	-0.101	[-0.166, -0.037]	0.002
Factor Variance	0.466	[0.454, 0.477]	0.000	0.841	[0.821, 0.860]	0.000	0.462	[0.450, 0.473]	0.000	0.829	[0.808, 0.849]	0.000
Covariance	-0.299	[-0.333, -0.265]	0.000	-0.299	[-0.333, -0.265]	0.000	-0.290	[-0.325, -0.255]	0.000	-0.290	[-0.325, -0.255]	0.000
Covariates												
Welfare regime (ref. Bismarckian)												
Scandinavian	0.070	[0.060, 0.080]	0.000	-0.158	[-0.178, -0.139]	0.000	0.056	[0.040, 0.072]	0.000	-0.140	[-0.171, -0.109]	0.000
Southern	-0.136	[-0.147, -0.126]	0.000	-0.134	[-0.156, -0.112]	0.000	-0.105	[-0.123, -0.087]	0.000	-0.215	[-0.252, -0.178]	0.000
Education	0.351	[0.338, 0.364]	0.000	-0.079	[-0.107, -0.051]	0.000	0.359	[0.341, 0.377]	0.000	-0.024	[-0.062, 0.014]	0.211
Scand. x Educ.							-0.065	[-0.078, -0.051]	0.000	0.035	[0.007, 0.062]	0.013
South. x Educ.							0.047	[0.029, 0.066]	0.000	-0.155	[-0.194, -0.117]	0.000
Job Skill (High)	0.025	[0.007, 0.043]	0.007	0.084	[0.049, 0.119]	0.000	0.021	[-0.002, 0.044]	0.077	0.074	[0.028, 0.120]	0.001
Scand. x Job Skill							0.027	[0.003, 0.052]	0.029	-0.025	[-0.071, 0.022]	0.299
South. x Job Skill							-0.009	[-0.029, 0.012]	0.423	0.035	[-0.008, 0.077]	0.110
Controls												

Age	-0.315	[-0.326, -0.304]	0.000	-0.284	[-0.309, -0.259]	0.000	-0.315	[-0.326, -0.304]	0.000	-0.290	[-0.315, -0.265]	0.000
Sex (Female)	0.133	[0.122, 0.143]	0.000	0.029	[0.007, 0.051]	0.010	0.136	[0.125, 0.146]	0.000	0.027	[0.005, 0.049]	0.017
EURO-D	-0.157	[-0.168, -0.146]	0.000	0.090	[0.066, 0.113]	0.000	-0.153	[-0.164, -0.142]	0.000	0.084	[0.060, 0.107]	0.000
SRH	0.135	[0.121, 0.149]	0.000	-0.005	[-0.033, 0.024]	0.742	0.133	[0.119, 0.147]	0.000	-0.001	[-0.030, 0.027]	0.919
Ever Smoked (ref. No)	0.039	[0.028, 0.049]	0.000	-0.023	[-0.044, -0.003]	0.027	0.035	[0.024, 0.045]	0.000	-0.016	[-0.037, 0.005]	0.130
Frequent Drinking (ref. No)	0.033	[0.024, 0.043]	0.000	0.038	[0.017, 0.058]	0.000	0.039	[0.030, 0.049]	0.000	0.029	[0.008, 0.049]	0.006
Refreshment Sample (ref. No)	0.046	[0.035, 0.057]	0.000	0.190	[0.167, 0.212]	0.000	0.049	[0.038, 0.059]	0.000	0.187	[0.164, 0.210]	0.000

Note: Estimates are fully standardized (β). Reference individual is a 65-year-old male, living in a Bismarckian country with upper secondary education (ISCED-3), a low-skill job, and not part of a refreshment sample. Confidence intervals (CI) based on robust standard errors. SRH = Self-rated Health. EURO-D = EURO-D scale for depression.

Figure 1. Estimated trajectories for each welfare regime from Model 2. Panel A shows educational differences for each welfare regime group. Panel B shows differences related to job skill level for each welfare regime group. All other covariates are set to the reference category (categorical) or zero (continuous). Overall level differences in cognitive functioning can be evaluated by comparing the distance between lines at Survey Wave 1.