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Interim Report **IR-14-008**

The Education Effect on Cognitive Functioning: National versus Individual Educational Attainment

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June 5, 2014

International Institute for Applied Systems Analysis
Registration number: ZVR 524808900

Contents

Abstract

Maintaining good cognitive performance at all ages in light of demographic changes represents a social, economic, and health-related challenge, particularly in aging countries. A strong positive relation between individual level education and cognitive performance has already been identified in earlier research, but the differences in relation to national education across countries are uncertain. This study adds to the literature by disentangling the effect of national and individual education levels. It aims to determine the association between education (individual and national) and cognition across countries that vary substantially in terms of their demography, average national education, and level of economic and social development. We investigate common cognitive ability measures from representative surveys of individuals aged 50 and above. All data come from aging surveys conducted in 2007-2012 covering more than 24 countries in Africa, America, Asia, and Europe, and involving about 120,000 men and women aged 50+. We investigate two specific cognitive ability measures: episodic memory and category fluency (vocabulary size). A multilevel approach is used to assess the effect of individual as well as national education level, controlling for sex, age, and health. We find a positive education-cognition relation for individuals across all our countries despite their very different characteristics. Moreover, our results show that increasing the average national education level is related to better individual cognitive performance, net of the individual education effect.

Acknowledgments

The HRS (Health and Retirement Study) is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan. This paper also uses data from SHARE release 2.5.0, as of May 24th 2011. The SHARE data collection has been primarily funded by the European Commission through the 5th framework programme (project QLK6-CT-2001- 00360 in the thematic programme Quality of Life), through the 6th framework programme (projects SHARE-I3, RII-CT- 2006-062193, COMPARE, CIT5-CT-2005-028857, and SHARELIFE, CIT4-CT-2006-028812) and through the 7th framework programme (SHARE-PREP, 211909 and SHARE-LEAP, 227822). Additional funding from the U.S. National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, Y1-AG-4553-01 and OGHA 04-064, IAG BSR06-11, R21 AG025169) as well as from various national sources is gratefully acknowledged (see "http://www.share-project.org" for a full list of funding institutions). This work was funded by a grant from the European Research Council (ERC-2009-StG 241003-COHORT).

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1 Introduction

Cognitive decline among older individuals can be a major challenge both in low income countries, which have the largest absolute number of individuals suffering from poor cognitive health and Alzheimer's disease (Sosa et al. 2009; Wimo & Prince 2010), and in middle/high income countries where population shares of advanced aged individuals are larger (UN 2011).

Educational attainment is positively associated with cognitive performance, and this relationship has been shown to hold both at younger and older ages (Botwinick, Jack 1977; Christensen & Henderson 1991; Clouston et al. 2012; Nisbett 2009). Moreover, schooling also fosters the development of cognitive processes (Ceci 1991). However, the causal effect of education is difficult to identify because of the positive selection of individuals with better cognitive ability into higher schooling and other unobserved factors related to the outcome variables (education and cognition). Longitudinal studies suggest that education may positively influence subsequent cognition (Richards & Sacker 2003; Richards & Sacker 2011); e.g., an enduring effect of education was identified for IQ scores while no association with faster cognitive speed processing was found (Ritchie et al. 2013; Richards & Sacker 2011). In addition, evidence from increases in compulsory schooling suggest that schooling positively affects cognition (Brinch & Galloway 2012; Glymour 2008; Schneeweis et al. 2014).

In terms of the influence of education on cognitive decline rates, it is necessary to differentiate between cognitive domains since age-variation may differ across education and ability levels (Ardila et al. 2000). Education was associated with a parallel increase with age for some abilities (verbal fluency, spatial memory, and Raven's Progressive Matrices), while for others (visual attention and verbal memory), the age slope became only less steep with education (Capitani et al. 1996), and some cognitive domains (e.g., global function (MMSE test), implicit memory, visuospatial skills, and attention) declined irrespective of the education level (Leibovici et al. 1996; Muniz-Terrera et al. 2009). In addition to the decline rate, the onset of terminal decline also differs across cognitive domains as shown in a study on Australians (Batterham et al. 2011). However, the slope of the aging curve has been found to be relatively similar for those with the same initial ability or education, as shown in the Maastricht Aging Study (Van Dijk et al. 2008), the Berlin Aging Study (Baltes & Mayer 1999), the Victoria Longitudinal Study (Zahodne et al. 2011), as well as in data from Scotland (Deary et al. 2010) and England (Richards et al. 2004).

Most studies have focused on the impact of individual characteristics within a country or a region (Baltes & Mayer 1999; Deary et al. 2010; Zahodne et al. 2011). However, in addition to individual-level education effects, country-level education effects should be

considered. That is, an individual's cognitive functioning may also be influenced by the education level of the whole population. The importance of one's surroundings has been shown for school performance, where being socialized with studious, disciplined peers can be beneficial (Aizer 2008; Bishop 2006; Morgan 2004), and similarly for self-ratings of cognitive health (Melrose et al. 2012). Therefore, this study contributes by investigating the effect of individual-level education in addition to national educational levels on specific cognitive abilities of people aged 50 and above across four continents.

2 Data

We used four harmonized aging surveys (ELSA, HRS, SAGE, and SHARE). Each survey provides information on physical and cognitive functioning, health (such as self-rated health and diagnosed diseases), and the economic and demographic information of the non-institutionalized population aged 50+. These data are collected from personal interviews in ELSA, SAGE, and SHARE while personal and phone interviews are used in HRS.

The ELSA (English Longitudinal Study of Ageing) data is a panel survey of the 50+ English population that began in 2002 (Marmot et al. 2003). Here, we use the fifth wave which was collected in 2010/11, including 9600 respondents between the age of 50 and 85 years, which we will focus on within this study. The HRS (Health and Retirement Study) is a large-scale longitudinal project launched by the University of Michigan in 1992 in the United States (National Institute on Aging 2007). The instruments of all our aging surveys were adapted from the HRS. For our analysis we used wave 10 collected in 2010/11, which is the first wave providing information about verbal fluency. The sample size for the population aged 50 to 85 is larger than for any other country we consider (n=19700). The Survey of Health, Ageing and Retirement in Europe (SHARE) was launched with its first wave 2004/05 in 11 Continental European countries (Börsch-Supan et al. 2005). The fourth wave of this multidisciplinary and cross-national panel database, which we use for our study, was collected in 15 countries (Austria, Belgium, Czech Republic, Denmark, Estonia, France, Germany, Italy, Netherlands, Poland, Portugal, Slovenia, Spain, Sweden, and Switzerland) in 2010-2012. The sample size for the 50+ up to 85 year old Europeans is almost 56000. Finally, developed by the WHO Multi-Country Studies unit as part of a Longitudinal Survey Programme, the Study on global AGEing and adult health (SAGE) compiles longitudinal information of 34500 respondents aged 50 to 85 years in six countries (including China, India, Ghana, Mexico, Russian Federation, and South Africa) between 2007 and 2010.

3 Measures

Cognitive functioning. We investigate two specific cognitive ability measures: 1) an episodic memory test, where ten words are read out and the respondents have one minute to recall immediately as many words as possible (in ELSA and HRS up to two minutes), and 2) a vocabulary size test (*category fluency*), where the task is to name as many different animals as the interviewee can think of within one minute.

Education. Respondents were asked for their highest completed school degree within all surveys. Educational attainment based on the International Standard Classification of Education (ISCED) is used to compare *individual education* across countries, with a distinction between the following categories: (i) no formal education or less than one year primary, (ii) uncompleted primary up to uncompleted lower secondary (ISCED 1), (iii) secondary which includes completed lower secondary, (un)completed higher secondary, and uncompleted tertiary education (ISCED 2-4), and (iv) tertiary including completed tertiary

(ISCED 5-6). To represent the *country education level*, we calculated the shares of tertiary educated within a country for both age groups.

Health condition. We designed a binary variable showing whether any of three risk factors for cognitive decline (namely stroke, heart attack, and depression) has ever been diagnosed (Li et al. 2011; Unverzagt et al. 2011).

Self-rated health. Self-reported health was measured on two different five-point response scales. The surveys ELSA, HRS and SHARE used a scale ranging from excellent, very good, good, fair, and poor, whereas interviewees in SAGE rated their health very good, good, moderate, bad, or very bad. For comparability issues we regroup excellent, very good, and good as well as very good, good, and moderate as good health and fair, poor as well as bad and very bad as bad health.

Age. In our analysis we include *age* measured in single years.

4 Methods

In this study we examine the effect of educational attainment and national education level on cognitive performance (e.g., episodic memory and category fluency). We standardized both cognition measures, using means and standard deviations by country to allow comparisons. Multilevel analyses (Raudenbush & Bryk 2002) with two levels (individual as level 1 unit and country as level 2 unit) are carried out for each cognitive performance measure, each sex, and separately for two age groups.

Here, the first age-group, 50 to 64 year olds, represent the population where labor market participation is still relatively high and the second age-group (people aged 65-85) is supposed to represent retired older adults within all countries. The younger group is more likely to be economically active, which could affect cognitive performance. Further, these groups have passed through the school system during very different time periods. For instance, the younger group matriculated after World War II. Moreover, the older group is likely to have been exposed to more health problems, poor nutrition, and higher mortality as they grew up in periods with a lower life expectancy (see UN 2011).

In addition to individual education and country education we control for the covariates age, self-rated health, and health condition. Furthermore, there is very strong evidence that the effect of individual education varies between countries (verified with likelihood ratio tests). Consequently, we include a random intercept and the variation in individual education between countries (random slope). All surveys include incomplete data (Table 1 provides an overview for all investigated variables), which are treated as missing at random (Little & Rubin 2002).

Table 1. Overview of Incomplete Data for Each Investigated Variable by Country with Sample Size (% in parentheses)

country	immediate recall	fluency	education	health	at least one disease
Austria	165 (3.3%)	253 (5.1%)	84 (1.7%)	67 (1.3%)	68 (1.4%)
Belgium	151 (3%)	132 (2.6%)	104 (2.1%)	75 (1.5%)	74 (1.5%)
China	672 (5.1%)	690 (5.2%)	(0%)	370 (2.8%)	366 (2.8%)
Czech Republic	199 (3.4%)	223 (3.8%)	103 (1.8%)	88 (1.5%)	87 (1.5%)
Denmark	114 (5.2%)	112 (5.1%)	38 (1.7%)	84 (3.8%)	82 (3.7%)
England	469 (4.9%)	494 (5.1%)	1192 (12.4%)	440 (4.6%)	9 (0.1%)
Estonia	248 (3.8%)	309 (4.7%)	3 (0%)	23 (0.4%)	20 (0.3%)

country	immediate recall	fluency	education	health	at least one disease
France	240 (4.4%)	268 (4.9%)	166 (3.1%)	149 (2.7%)	150 (2.8%)
Germany	61 (4%)	63 (4.1%)	55 (3.6%)	41 (2.7%)	40 (2.6%)
Ghana	428 (9.4%)	416 (9.1%)	427 (9.4%)	403 (8.9%)	414 (9.1%)
Hungary	51 (1.7%)	55 (1.9%)	6 (0.2%)	10 (0.3%)	8 (0.3%)
India	668 (9.5%)	651 (9.2%)	583 (8.3%)	584 (8.3%)	585 (8.3%)
Italy	137 (3.9%)	149 (4.3%)	53 (1.5%)	68 (2%)	67 (1.9%)
Mexico	120 (5.5%)	118 (5.4%)	71 (3.2%)	71 (3.2%)	72 (3.3%)
Netherlands	70 (2.6%)	72 (2.7%)	108 (4.1%)	51 (1.9%)	50 (1.9%)
Poland	150 (8.5%)	155 (8.8%)	188 (10.6%)	129 (7.3%)	129 (7.3%)
Portugal	55 (2.8%)	56 (2.8%)	8 (0.4%)	20 (1%)	16 (0.8%)
Russia	180 (4.7%)	228 (5.9%)	3 (0.1%)	14 (0.4%)	51 (1.3%)
Slovenia	46 (1.7%)	44 (1.7%)	9 (0.3%)	14 (0.5%)	13 (0.5%)
South Africa	175 (4.7%)	163 (4.3%)	621 (16.6%)	80 (2.1%)	175 (4.7%)
Spain	196 (5.8%)	218 (6.5%)	142 (4.2%)	80 (2.4%)	79 (2.4%)
Sweden	111 (5.8%)	116 (6.1%)	78 (4.1%)	86 (4.5%)	84 (4.4%)
Switzerland	65 (1.8%)	57 (1.6%)	82 (2.3%)	34 (1%)	33 (0.9%)
United States	1434 (7.1%)	1470 (7.3%)	443 (2.2%)	448 (2.2%)	446 (2.2%)

Source: ELSA, HRS, SAGE, and SHARE; own calculations

5 Results

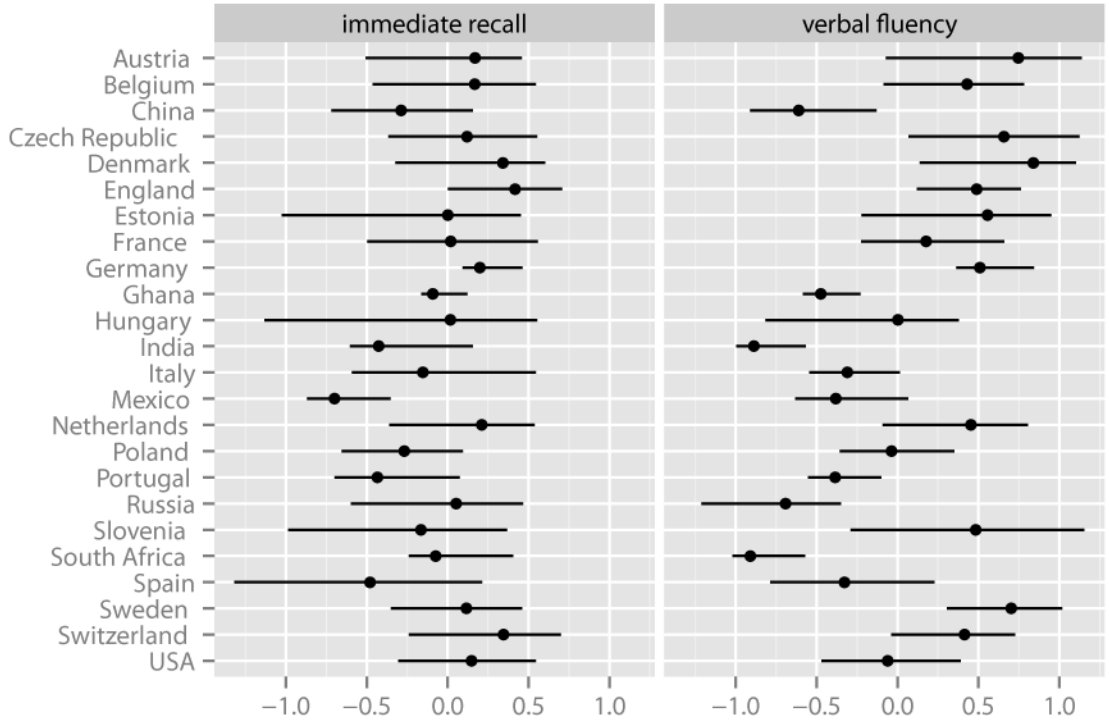
Descriptive results

Ranking the countries by their average immediate recall *z*-score, we find that northern European countries such as England and Denmark are among the top performers, while the Spanish and Mexicans perform poorly. In the case of category fluency, northern European countries, here Sweden and Denmark, are again among the leaders with regard to their average *z*-score; however, the pattern is different for the bottom of the ranking with the lowest average fluency scores being found in India, South Africa, and the Russian Federation (Figure 1; Table 2).

Comparing the average cognitive performance scores of each country and distinguishing individual education categories, we identified a large variation (see Figure 1). First, older adults' cognitive performance varies considerably between countries (immediate recall range: 2.03; verbal fluency range: 2.4; both in standard units). Whereas the tertiary educated English can be found among the top performers in immediate recall, with *z*-score 0.71, at the bottom of the ranking there are the non-educated Spanish, with a *z*-score of -1.32. In verbal fluency primary educated Russians gain a *z*-score of -1.21 only, whereas the highest educated Slovenians are among the top ranked countries (*z*-score 1.16).

Moreover, the magnitude of the difference in cognition also varies within countries. While almost no difference can be found between the low and high educated population of Ghana (immediate recall variation: 0.3 in standard units; verbal fluency variation: 0.4 in standard units), the variation in immediate recall within Hungary is 1.7 and the variation in verbal fluency within Slovenia is 1.4 (both in standard units).

Figure 1. Descriptive Perspective on the Performance in Cognition (Immediate Recall on the Left Side and Verbal Fluency on the Right Side) within All Countries



Note: The range between the average *z*-scores of the lowest educated and the highest educated population within a country are represented with a solid line, while the dots represent the average z-scores per country for both measures. Source: ELSA, HRS, SAGE, and SHARE; own calculations

Immediate recall

Our results show that poor health conditions (reported diseases) and low self-rated health are correlated with lower scores in immediate recall. Furthermore, the decrease in scores achieves strong significance by age, in particular for older adults; e.g., -0.01 points per year for younger women and -0.04 points per year for older women (Table 3).

Consistent with literature for single countries and our expectations, the fixed effect estimates for individual education (Table 3) indicate that higher individual education is associated with higher immediate recall scores. For instance, immediate recall score decreases due to no education are almost twice the decrease of primary education, whereas the gap is slightly smaller among the older population. Furthermore, the advantage of tertiary education in comparison to secondary education is stronger for 65-85 year olds (about 0.30 for females and 0.32 for males; see Table 3). Regarding the within country variation, it is quite consistent for both age groups and both sexes (it ranges between 0.72 and 0.79). The between-country variance is highest for tertiary educated younger women and no educated men and women of both age-groups, while it is lowest for secondary educated. This implies that the country of residence matters most for non-educated followed by tertiary educated population.

Table 2. Sample Characteristics by Country with Mean Scores (SD in Parentheses) on Cognition Measures and Age

country	Sample size	immediate recall	fluency	age	primary educ. (%)	female (%)	good health (%)	at least 1 disease (%)
Austria	5009	0.17 (1.08)	0.75 (1.17)	65.2 (9.0)	12.5	57.0	70.2	19.8
Belgium	4982	0.17 (0.99)	0.43 (0.87)	64.3 (9.6)	18.0	54.3	70.2	23.2
China	13174	-0.29 (0.98)	-0.61 (0.63)	62.8 (9.0)	37.0	53.0	79.6	11.7
Czech Republic	5845	0.12 (0.94)	0.66 (1.00)	65.0 (8.7)	16.8	56.9	57.6	23.9
Denmark	2198	0.34 (0.93)	0.84 (0.90)	64.3 (9.5)	10.6	53.1	79.3	18.9
England	9636	0.42 (1.00)	0.49 (0.88)	66.0 (8.5)	35.4	54.7	74.2	8.0
Estonia	6508	0.00 (1.05)	0.56 (0.95)	66.1 (9.3)	5.2	59.0	29.1	33.0
France	5421	0.02 (1.01)	0.18 (0.85)	65.2 (9.6)	36.0	55.2	64.0	31.0
Germany	1533	0.20 (0.93)	0.51 (0.92)	67.6 (7.8)	0.4	51.9	59.0	19.6
Ghana	4548	-0.09 (0.90)	-0.47 (0.69)	63.2 (9.4)	21.1	50.2	84.1	7.0
Hungary	2926	0.02 (1.00)	0.00 (0.75)	64.5 (8.7)	1.7	55.8	39.3	34.7
India	7064	-0.43 (0.87)	-0.89 (0.47)	61.5 (8.5)	25.4	49.3	79.5	10.5
Italy	3469	-0.15 (1.03)	-0.31 (0.75)	66.4 (8.8)	46.0	53.9	60.0	18.3
Mexico	2189	-0.7 (0.83)	-0.38 (0.66)	67.2 (8.3)	82.6	60.4	87.7	16.6
Netherlands	2663	0.21 (0.91)	0.46 (0.86)	65.4 (8.6)	10.3	55.1	71.4	17.1
Poland	1768	-0.27 (1.04)	-0.04 (0.96)	67.2 (8.4)	42.1	55.2	43.5	23.4
Portugal	1969	-0.43 (1.00)	-0.39 (0.97)	64.7 (8.9)	56.8	55.5	38.5	32.7
Russia	3853	0.05 (0.95)	-0.69 (0.87)	64.6 (9.7)	10.6	64.4	72.6	37.2
Slovenia	2644	-0.16 (1.00)	0.48 (1.01)	64.9 (9.4)	9.4	55.8	57.0	22.6
South Africa	3751	-0.07 (0.97)	-0.91 (0.53)	62.1 (8.9)	48.3	57.2	83.9	11.6
Spain	3358	-0.48 (0.99)	-0.33 (0.82)	67.0 (9.7)	51.0	53.7	53.6	26.0
Sweden	1906	0.12 (0.91)	0.70 (0.93)	68.9 (7.9)	28.8	53.5	69.3	22.0
Switzerland	3551	0.35 (0.94)	0.41 (0.86)	64.8 (9.3)	9.5	53.5	82.9	14.2
United States	20064	0.15 (0.91)	-0.06 (0.94)	64.9 (9.8)	24.4	56.3	70.8	38.9

Source: ELSA, HRS, SAGE, and SHARE; own calculations

Interestingly, the national education level (i.e., the share of tertiary educated) is strongly significant associated with women's and young men's immediate recall scores. Thus, we find that the average immediate recall score of a person is also higher within countries with a higher share of tertiary educated. The highest increase due to country-level education is evident for women. In particular, older females benefit most; an increase of tertiary educated by one point results in a gain of 1.27 points.

Table 3. Multilevel Model of Immediate Recall with Random Intercept and Random Slope (Random Individual Education Effect) and Fixed Effects Age in Years, Self-Reported Health, Health Condition, Individual Education (Categorical) and Share of Tertiary Educated (Level 2 Explanatory Variable) Applied Separately for Both Sexes and Both Age Groups

	females 50-64			females 65-85			males 50-64			males 65-85		
	estimate	SE	t	estimate	SE	t	estimate	SE	t	estimate	SE	t
Country level												
share tertiary educ.	1.23	0.25	4.9	1.27	0.44	2.9	0.94	0.21	4.5	0.55	0.36	1.5
Individual level												
education (secondary)												
no education	-0.63	0.06	-10.9	-0.59	0.08	-7.3	-0.64	0.11	-5.9	-0.58	0.07	-8.6
primary	-0.43	0.04	-10.7	-0.38	0.03	-12.1	-0.34	0.03	-12.0	-0.36	0.03	-13.9
tertiary	0.27	0.03	8.8	0.30	0.04	8.0	0.28	0.03	9.1	0.32	0.03	10.3
age	-0.01	0.00	-9.9	-0.04	0.00	-41.4	-0.02	0.00	-11.5	-0.04	0.00	-32.8
bad health condition	-0.08	0.01	-6.3	-0.09	0.01	-7.5	-0.08	0.02	-4.8	-0.07	0.01	-4.7
bad self-rep. health	-0.22	0.01	-19.4	-0.24	0.01	-20.5	-0.24	0.01	-17.2	-0.25	0.01	-18.2
intercept	0.80	0.09	8.8	2.68	0.11	25.0	0.95	0.09	10.2	2.35	0.10	23.0
Random effects-variance												
intercept	0.03	0.16		0.05	0.22		0.02	0.13		0.03	0.16	
education (secondary)												
no education	0.05	0.21		0.06	0.25		0.12	0.35		0.05	0.23	
primary	0.03	0.17		0.02	0.12		0.01	0.10		0.01	0.09	
tertiary	0.02	0.13		0.02	0.14		0.02	0.13		0.01	0.12	
Residual	0.72	0.85		0.77	0.88		0.76	0.87		0.79	0.89	
sample size	32763			29027			25960			23287		

Note: Generally, a t-value greater than |2| is acceptable as significant; Source: ELSA, HRS, SAGE, and SHARE

Table 4. Multilevel Model of Verbal Fluency with Random Intercept and Random Slope (Random Individual Education Effect) and Fixed Effects Age in Years, Self-Reported Health, Health Condition, Individual Education (Categorical) and Share of Tertiary Educated (Level 2 Explanatory Variable) Applied Separately for Both Sexes and Both Age Groups.

	females 50-64			females 65-79			males 50-64			males 65-79		
	estimate	SE	t	estimate	SE	t	estimate	SE	t	estimate	SE	t
Country level												
share tertiary educ.	2.10	0.53	4.0	2.37	0.64	3.7	1.49	0.33	4.5	2.12	0.60	3.5
Individual level												
education (secondary)												
no education	-0.55	0.05	-11.1	-0.57	0.07	-8.0	-0.53	0.06	-9.1	-0.40	0.05	-7.8
primary	-0.36	0.04	-9.3	-0.29	0.03	-8.6	-0.32	0.04	-9.1	-0.26	0.03	-7.9
tertiary	0.35	0.04	8.5	0.31	0.03	10.6	0.27	0.03	8.2	0.28	0.02	11.8
age	-0.01	0.00	-11.4	-0.03	0.00	-33.3	-0.01	0.00	-8.6	-0.02	0.00	-26.0
bad health conditions	-0.02	0.01	-1.8	-0.5	0.01	-5.2	-0.02	0.01	-1.0	-0.04	0.01	-3.3
bad self-rep. health	-0.16	0.01	-15.3	-0.19	0.01	-19.2	-0.17	0.01	-12.8	-0.18	0.01	-15.4
intercept	0.58	0.16	3.7	1.59	0.14	11.4	0.62	0.14	4.5	1.50	0.14	10.5
Random effects-variance												
intercept	0.21	0.45		0.15	0.38		0.19	0.44		0.14	0.37	
education (secondary)												
no education	0.04	0.19		0.09	0.30		0.05	0.23		0.04	0.19	
primary	0.03	0.16		0.02	0.15		0.02	0.15		0.02	0.14	
tertiary	0.03	0.18		0.01	0.12		0.02	0.14		0.01	0.08	
Residual	0.62	0.79		0.56	0.75		0.66	0.82		0.59	0.77	
sample size	32722			28932			25903			23196		

Note: Generally, a t-value greater than |2| is acceptable as significant; Source: ELSA, HRS, SAGE, and SHARE

Fluency

The results with respect to verbal fluency show negative effects of bad self-reported health and bad health condition on verbal fluency scores and a negative age effect, which is higher for older individuals. It is noteworthy that the national education level is strongly significantly associated with verbal fluency (3.5 up to 4.5 times its standard error). Older women seem to benefit most from higher shares of tertiary educated (e.g., national education level), while the younger adult men in our sample benefit the least. In respect to individual education, we recognize a similar pattern to immediate recall results. Higher education is associated with higher verbal fluency scores and tertiary educated women have the highest gain (Table 4).

The within country variance in verbal fluency is lower than in immediate recall, as it ranges between 0.56 and 0.66. Interestingly, the between country variance is larger than in immediate recall. Moreover, here the highest variance is among tertiary educated while the lowest variance is among no educated. Specifically, younger tertiary educated women show the highest variance between the countries (0.33 in standard units), while their male counterparts have a between country variance of 0.26. Thus, in terms of verbal fluency scores, the country matters most for tertiary educated individuals.

6 Conclusion

It has previously been shown that higher individual education is associated with higher cognitive performance at younger and older ages, and that increases in compulsory schooling have a positive effect on cognition. In this study we contribute to literature showing that older adults' cognitive performance (i.e., episodic memory and category fluency) varies not only within countries, but also between countries regardless of education. Interestingly, not only does the individual educational level matter for older adults' episodic memory and category fluency, but also the educational level of a country. Here, we show in particular, that the cognitive improvements, associated with individual education, are greater in less educated societies. This is consistent with a model of community level spill-over effects, net of individual level influences.

At the global level, Northern Europeans and Americans have the highest educational attainment among their 50+ population, which can be an important reason for their relatively high cognitive performance at older ages (KC et al. 2010, p.201; Skirbekk et al. 2012). Investments in education to strengthen cognition on an individual as well as country level is particularly important in some low- and mid-income countries (like China and Spain) where cognitive functioning is relatively low among the current older population (Skirbekk et al. 2012).

Our findings suggest scientific and policy related implications. First, more attention should be paid by researchers to the national context when considering interventions to raise cognitive performance of the younger and older population. Second, the quality of education is an important factor to consider, but nevertheless countries that have longer periods of compulsory schooling are likely to be better equipped to face demographic changes.

7 References

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