



Early inequalities in education and inequality of cognitive functioning in old age¹

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1. Introduction and some facts

Cognitive functioning refers to the capacity for attention, thinking, understanding, learning, decision-making and problem solving. Thus, cognitive functioning is fundamental for the individual to reach autonomy, manage activities and fulfil goals. In particular, there are specific measurable cognitive skills like memory, attention, verbal skills and hypothesis formation whose levels evolve over the lifespan. From an economic perspective, cognitive abilities could be considered as a proxy for stock of human capital, which evolves over time, first increasing during education, socialization and training, and then declining over time during old age. This decline is such as the case of capital that depreciates over time with a specific depreciation rate, which may accelerate or slow down the fall. That is, some measures could be taken to repair, maintain or avoid a sudden deterioration of cognitive stock.

In old age, the process of cognitive ageing leads to a decline in cognitive functioning. Having low levels of cognitive functioning can jeopardize the ability of the elderly to enjoy an autonomous life, ageing actively and reaching a good quality of life. As all these variables are important for well-being, one can conclude that it is necessary to have a satisfactory degree of cognitive functioning in order to thrive. Furthermore, cognitive impairment or dementia is associated to higher incidence of disability and larger health expenditures.

There is an important body of research studying cognitive functioning in old age, including the collection of data measuring the levels of cognition by means of validated and standardized tests across countries. An example of this effort is the **Survey of Health, Ageing, and Retirement in Europe** (SHARE) which implements comparable surveys among the population aged 50 and older in European countries and Israel since



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¹ This Policy Brief summarizes and discusses the following publication: "Javier Olivera, Francesco Andreoli, Anja K. Leist, and Louis Chauvel (2018) Inequality in old age cognition across the world. *Economics & Human Biology* 29: 179-188". The original article can be found in the following link: <https://www.sciencedirect.com/science/article/abs/pii/S1570677X17301806>

2004. Among various available health indicators, SHARE also collects information about cognitive skills by implementing standardized tests that measure memory, verbal fluency, numeracy, and orientation. For example, the tests to assess memory consist of reading loud a list of 10 words and then asking the individual to repeat them. The number of correct answers indicates *immediate memory*. After some time into the survey, the interviewer asks again the individual to repeat the 10 words. For this case, the number of correct answers is a measure for *delayed memory*. The average number of correct answers is the *average memory score*. Figure 1 shows the levels of average memory in European countries by age groups.

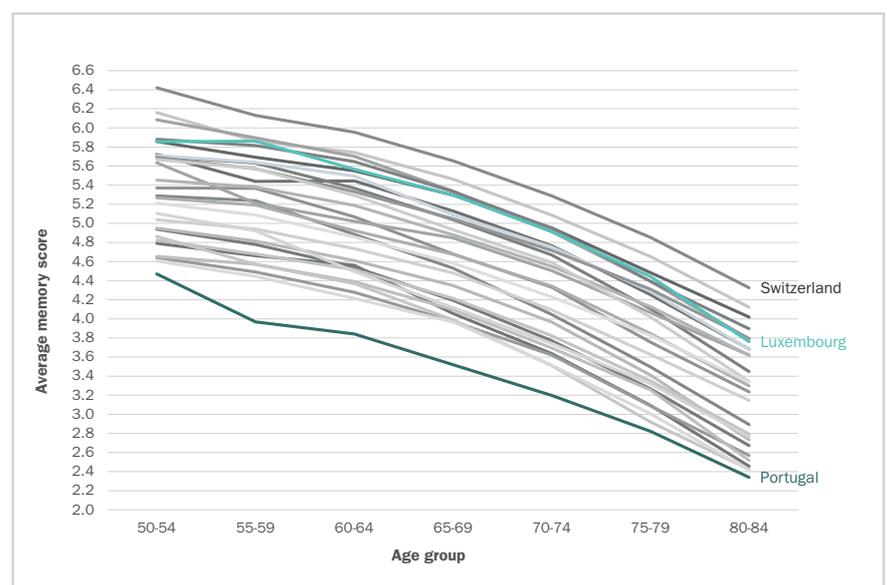
One of the first facts observed in Figure 1 is the decline of cognitive functioning across age, which is part of the overall process of ageing. Beyond the inevitable drop in cognitive skills, the question is rather how fast or slow this decline is. In addition, the figure shows important differences across countries on both levels and changes of cognitive functioning over age. Individuals in Switzerland have the highest memory score among the EU countries, whilst Portuguese individuals show the lowest levels. On average, the Swiss remember 2.1 more words than the Portuguese do; that is an overall of 60% additional words, yet the differences could be larger among older people. It is also observed that elderly individuals from Luxembourg fare very well in memory, being placed among the top performers in Europe.

2. Cognitive functioning and education: role of inequalities

One of the most important determinants of old age cognitive functioning found in the literature is the level of education. Indeed, education may increase cognitive reserve and serve as a protective measure against rapid deterioration of cognitive skills in later life. A study performed by researchers of LISER and the University of Luxembourg (Olivera et al. 2018) argues that the distribution of cognitive functioning in old age may reflect undeveloped potential for cognitive functioning due to early-life educational inequalities and lack of educational opportunities. Therefore, old age cognition inequality may be associated with low average levels of old age cognition. Costs of cognitive impairment and dementia represent an ever-increasing part of health expenditures, so that higher inequality in cognitive functioning may undermine the sustainability of healthcare systems.

Figure 1: Memory score by age groups in Europe

Notes: This figure uses pooled data from waves 7 and 8 from SHARE (2017-2020). The figure plots the conditional means of the memory score, which are estimated from linear regressions on age, age square, educational level, gender, survey year, and country dummies. The memory score is the average value of immediate memory and delayed memory tests. Each line represents a country surveyed in SHARE in waves 7 and 8 (EU countries, but Ireland, and including Switzerland and Israel).



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The mentioned study analyses the extent to which educational inequalities experienced at young age have long-run effects on inequality in cognitive functioning experienced in old age in a sample of 29 countries with available data. Importantly, the analysis takes into account the role of gender-specific survival rates (leading to differences on life expectancy) on cognition because differential survival rates could exacerbates today's inequalities due to lower access to education experienced by women, particularly among older cohorts.

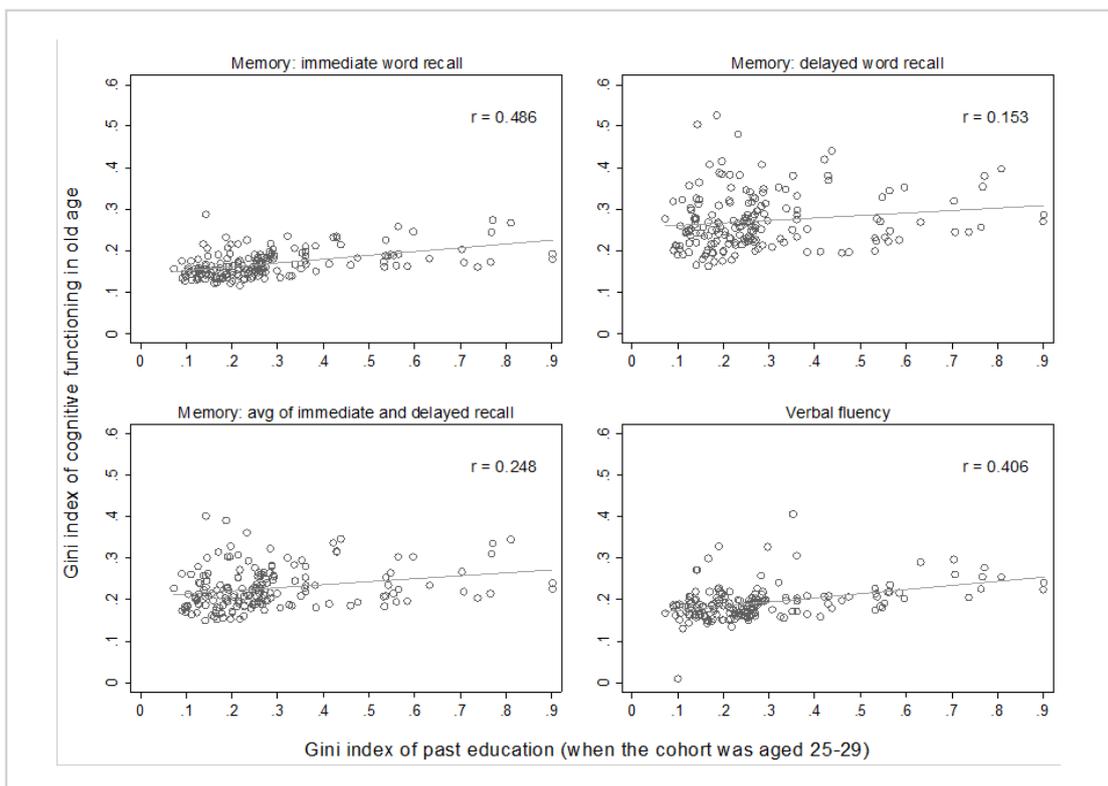
UK, allowing to pool information of individuals aged 50 and over gathered in 29 countries during 2007-2015 (representing about 61% of the World's 50+ population). Other data sources are population projections and the historical distribution of educational attainment.

The main results show significant long-term effects of past educational inequalities on inequalities in old age cognitive functioning observed today (described in Figure 2). It is also found that the relative higher life expectancy of women contributes to increase cognitive inequality. Furthermore, the study brings new evidence that countries that experienced a large gender gap in education are showing higher old age cognitive inequalities.

Figure 2: Gini indices of cognitive functioning in old age and past education

Notes: Each observation represents a particular age group in a country. There are 6 age groups and 29 countries, and hence the sample consists of 174 observations. The information corresponds mostly to years 2011-2015.

The data sources for the study include SHARE and other "sister" surveys, such as the Health and Retirement Survey in the US or the English Longitudinal Survey of Ageing in the



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The baseline estimation of the study finds that a one percent increase in educational inequality is associated to a positive and significant increase in inequality in old age cognitive functioning (between 0.10 to 0.45 percentage points depending on the cognitive functioning indicator). For example, in the case of *delayed memory*, a one-percentage point increase in the Gini index of past education is associated with an increase of 0.45 percentage points in the Gini index of *delayed memory*. This implies that educational inequalities experienced in the past may have a significant predictive power on inequality in old age cognition.

The effects are consistent in significance and size across a variety of robustness checks, including alternative ways to measure inequalities. Importantly, the results are also robust to the effects of unfair differences in parental background and gender. That is, inequality of opportunity experienced in early life contributes to explain inequality in cognitive functioning in old age. Note that inequality of opportunity occurs when circumstances beyond the control of the individual (such as parental education or gender) -that are normatively irrelevant in determining individual educational choices- do influence the level of educational attainment, and through this, increase inequality in education.

3. Concluding remarks

The results document significant long-term effects of past educational inequalities on inequalities in old age cognitive functioning observed in the present. Furthermore, relative higher life expectancy of women contributes to increased cognitive inequality. Given the lower educational attainment of older women, and the positive relationship between education and cognitive abilities, one can speculate that countries that experienced a large gender gap in education are showing higher old age cognitive inequalities. Thus, reducing the gender gap in education and improving the distribution of education among the young will reduce inequalities in cognitive functioning in the future.

Educational inequalities have been shown to have long-run consequences on hampering equality of opportunity for accumulation of resources over the life course. A very relevant result of the study is the finding that unequal opportunities for education -captured by differences in parental background and gender- also have significant and persistent effects on inequality of old age cognition.