Intelligence 52 (2015) 90–96

Contents lists available at ScienceDirect

Intelligence

Smarter every day: The deceleration of population ageing in terms of cognition

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ARTICLE INFO

Article history:
Received 2 April 2015
Received in revised form 23 July 2015
Accepted 28 July 2015
Available online 24 August 2015

Keywords:
Ageing population
Cognition
Flynn effect
ELSA
SOEP

ABSTRACT

Cognitive decline correlates with age-associated health risks and has been shown to be a good predictor of future morbidity and mortality. Cognitive functioning can therefore be considered an important measure of differential ageing across cohorts and population groups. Here, we investigate if and why individuals aged 50+ born into more recent cohorts perform better in terms of cognition than their counterparts *of the same age* born into earlier cohorts (Flynn effect). Based on two waves of English and German survey data, we show that cognitive test scores of participants aged 50+ in the later wave are higher compared with those of participants aged 50+ in the earlier wave. The mean scores in the later wave correspond to the mean scores in the earlier wave obtained by participants who were on average 4–8 years younger. The use of a repeat cross-sectional design overcomes potential bias from retest effects. We show for the first time that although compositional changes of the older population in terms of education partly explain the Flynn effect, the increasing use of modern technology (i.e., computers and mobile phones) in the first decade of the 2000s also contributes to its explanation.
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1. Introduction

Higher chronological age tends to be associated with lower cognitive functioning, which in turn correlates with a range of age-associated health risks such as hypertension and diabetes (McCrimmon, Ryan, & Frier, 2012; Slomski, 2014). Cognitive functioning is also a good predictor of future morbidity and mortality (Negash et al., 2011). Individuals with higher cognitive abilities tend to live longer and healthier lives (Batty, Deary, & Gottfredson, 2007; Der, Batty, & Deary, 2009). Cognitive functioning can therefore be considered an important measure of differential ageing across cohorts and population groups.

Cognitive functioning is a characteristic of individuals that is associated with but *not* determined by chronological age. The maintenance of good cognitive functioning is thus one of the central components of *successful* ageing (Rowe & Kahn, 1987). Some parts of the population start ageing earlier than others, education being a central factor in this regard. Higher educated individuals tend to participate in more cognitively stimulating activities during their lifetime and therefore remain cognitively fit until a higher age (Wilson, Barnes, & Bennett, 2003). Recent evidence shows that the lower educated start ageing earlier than those with higher levels of education — in terms of physical health and fitness (Christensen, Doblhammer, Rau, & Vaupel, 2009; Mäki et al., 2013; Sanderson & Scherbov, 2014) as well as in terms of mental health and cognitive functioning (Lièvre, Alley, & Crimmins, 2008). The expansion of education has therefore been among the primary explanations for why steadily increasing average scores on common tests of cognitive functioning (including classic IQ tests) have been observed since the end of the 19th century — the so-called Flynn effect (Flynn, 1984, 2000, 2007; Hiscock, 2007).

The majority of studies on the Flynn effect have focused on children, adolescents, and prime-age adults. However, some recent studies have shown that the Flynn effect extends to older populations (Baxendale, 2010; Christensen et al., 2013; De Rotrou et al., 2013; Gerstorf, Ram, Hoppmann, Willis, & Schaie, 2011; Skirbekk, Stonawski, Bonsang, & Staudinger, 2013). In other words, older populations today have aged more successfully in terms of their cognitive functioning than did earlier generations. An important reason for such secular trends may lie in the expansion of education and thus the fact that more recent cohorts tend to be more highly educated (Baker et al., 2015; Ceci, 1991).

The factors responsible for the Flynn effect are commonly assumed to be environmental rather than genetic given the speed at which average cognitive abilities have been rising (Dickens & Flynn, 2001; Flynn, 2007; Pietschnig & Voracek, 2015). In addition to improved education (Baker et al., 2015; Teasdale & Owen, 2005), a range of environmental explanations for the Flynn effect have been proposed such as improvements in medical care and nutrition (Lynn, 2009), reduced family size (Sundet, Borren, & Tambs, 2008; Zajonc & Mullally, 1997), and reductions in

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http://dx.doi.org/10.1016/j.intell.2015.07.005
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pathogen stress (Eppig, Fincher, & Thornhill, 2010). These formerly independent theories for explaining the Flynn effect (i.e., better education, improved nutrition, reduced family size, and lower pathogen stress) have been integrated by Woodley in a model of *life history speed* (Woodley, 2012a) that points to the important insight that the explanations for the Flynn effect are likely to vary across space and time.

In the context of explanations based on changes in environmental conditions, Neisser (1997) put forward the thesis that the increasing exposure to *visual and technical environments* may be a central factor for explaining the Flynn effect. The increasing use of computers and gadgets with visual interfaces in everyday life may have contributed to a rising complexity of our cognitive environments and in turn higher levels of cognitive stimulation and performance (Charness, Fox, & Mitchum, 2011; Dickens & Flynn, 2001; Neisser, 1997; Schooler, 1998). Especially the older parts of the population who used to withdraw from cognitively demanding tasks and environments at relatively young ages (i.e., mental retirement, cf. Rohwedder & Willis, 2010) are increasingly exposed to cognitive challenges in everyday life (Charness & Schaie, 2003). The thesis that the *increasing use of modern technology* in everyday life increases cognitive demands on the older population and in turn helps maintain cognitive capacities to higher ages is put to an empirical test in the present study.

This study aims to contribute to our understanding of why individuals at age 50 or above today perform better in tests of cognitive functioning than people of the same age did in the past. First, to ascertain the presence of a Flynn effect, we investigate change over time in the cognitive functioning of the population aged 50+ in England and Germany. We use a wide range of different cognitive tests that differ in their sensitiveness to the biological ageing processes of the brain (Hiscock, 2007), including tests of processing speed and accuracy, a test of verbal fluency, and two tests of verbal memory. Second, we test if education and the increasing use of modern technology help explain the Flynn effect. To date, evidence for the use of modern technology as a cause for the Flynn effect is still warranted (Pietschnig & Voracek, 2015).

Studies pointing to a sustained upward drift in mean cognitive abilities over time (i.e., the presence of a Flynn effect) have usually paid little attention to subgroup differences by age, sex, or level of education (Ang, Rodgers, & Wänström, 2010). Recent exceptions include the work by Pietschnig and Voracek (2015) who find significantly stronger Flynn effects for adults than for children and adolescents. Ang et al. (2010) find an accelerated Flynn effect for children of more educated mothers. No sex differences in the Flynn effect have been found (Pietschnig, Voracek, & Formann, 2011). The present study explores age and sex differences in the Flynn effect as well as differences by educational attainment.

2. Data and methods

2.1. Surveys and sampling

This study is based on data from two surveys, the German Socio-Economic Panel (SOEP) and the English Longitudinal Study of Ageing (ELSA). In order to avoid retest effects, we do not use the longitudinal samples of these surveys but restrict the samples of analysis to individuals taking part in the cognitive tests only once.

SOEP is a survey of private households that provides representative, longitudinal micro-data that have been collected on an annual basis since 1984. All samples are multi-stage random samples which are regionally clustered. Survey households are selected by random-walk, interviewers trying to obtain face-to-face interviews with all household members aged 16 and over. To date, cognitive testing has been carried out in two waves. In 2006, a subsample of 7440 participants (all ages) was randomly selected to participate in the cognitive tests. We focus on individuals aged 50–90, which reduces our sample to 2741 cases with valid test scores. Many of the 2006 test participants were again tested in 2012. Additionally, a randomly selected refresher sample of 2354 individuals aged 50–90 was tested for the first time in 2012. For this analysis we focus on the sample of individuals aged 50–90 tested for the first time either in 2006 or 2012. The average age of the SOEP sample has slightly increased over time (from 63.0 in 2006 to 64.8 in 2012). The share of female respondents remained fairly stable at 51.3% and 51.8%, respectively. Also the average number of years of education remained stable at 12.0 years in both survey waves (see Table 1a for a description of the SOEP sample).

Table 1a
Summary statistics of dependent and independent variables, SOEP sample.

	2006 (N = 2013)				2012 (N = 2878)			
Female	51.3%				51.8%			
	Min	Max	Mean	SD	Min	Max	Mean	SD
Age	50	89	63.0	[8.9]	50	90	64.8	[9.5]
Years of education	7	18	12.0	[2.7]	7	18	12.0	[2.7]
SDT30	0	23	7.1	[3.4]	0	24	7.4	[3.3]
SDT60	0	33	15.2	[6.5]	0	38	16.2	[6.0]
SDT90	0	50	23.2	[9.0]	0	54	24.9	[8.1]

Note: the difference in mean age between waves is significant at $p < 0.001$ (t-test). Mean differences in all three SDT scores between waves are significant at $p < 0.01$ (t-tests).

The ELSA sample is drawn from respondents to the Health Survey for England (HSE) — a study conducted jointly by the Department of Epidemiology and Public Health, UCL, and the National Centre for Social Research, on behalf of the Department of Health. Around 12000 respondents from three separate waves of the HSE survey were recruited to provide a representative sample of the English population aged 50 and over. Data have been collected on a biannual basis starting in 2002/03. In wave 4 (2008/09), additional respondents aged 50–74 and their co-residing partners were sampled from HSE to rejuvenate the sample and to top up the general sample that has shrunk due to panel attrition (for details, see Cheshire et al., 2012). We focus on individuals participating in the cognitive tests for the first time in 2002/03 or 2008/09. Because the refreshment sample in wave 4 does not contain respondents aged 75 or older, our sample for repeat cross-sectional analysis on the English data are respondents aged 50–74.[1] The average age of the ELSA sample has slightly increased over time (from 61.2 in 2002 to 62.2 in 2008). The share of female respondents remained stable at about 54% (see Table 1b for a description of the ELSA sample). ELSA provides information on respondents' educational qualifications, which we recoded into high, medium, and low levels of education,[2] retaining a residual category for foreign or other qualifications. We observe significantly rising shares of respondents at higher levels of education across the observation period (see Table 1b). This corresponds with the education reforms that took place in England in the 1940s, which have extended the duration of compulsory schooling (cf. Banks & Mazzonna, 2012).

Previous studies on the Flynn effect were based on varying sample sizes. While some of the studies were based on very large samples (e.g., Flynn, 1998; Sundet, Barlaug, & Torjussen, 2004; Teasdale & Owen, 2005), much of the existing work on the Flynn effect (for an overview, see e.g., Pietschnig & Voracek, 2015; Trahan, Stuebing, Hiscock, & Fletcher, 2014) including studies of the Flynn effect in older populations (e.g., Baxendale, 2010; De Rotrou et al., 2013; Rönnlund & Nilsson, 2008) is based on fairly small samples. The present study examines secular changes in the average cognitive functioning of the population aged 50+ using representative survey data that involve much greater numbers of observations than most of the previous work on older populations.

[1] Robustness checks on SOEP data considering the same age group as in ELSA (i.e., aged 50–74) show very similar results to those shown for the sample of individuals aged 50–90 (available on request).

[2] Low education pertains to 'no qualification' and NVQ1/CSE. Medium education pertains to NVQ2/GCE O-level equivalent; NVQ3/GCE A-level equivalent. High education pertains to higher education below degree or NVQ4/NVQ5/Degree. Foreign or other qualifications are retained in a separate category.

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