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CENTER *for* RETIREMENT RESEARCH *at* BOSTON COLLEGE

COGNITIVE AGING AND ABILITY TO WORK

By Anek Belbase and Geoffrey T. Sanzenbacher*

Introduction

Working longer is an effective way to boost individuals' retirement security. Thus, understanding who can work longer and who may struggle is a key issue for researchers and policymakers. Some studies find that age-related declines in physical abilities can limit those in physically demanding jobs from working into their late 60s.[1] But the effects of changes in cognitive abilities on work have received less attention. At first glance, it appears that a decline in "fluid" intelligence – the capacity to process new information – and an apparent relationship between fluid intelligence and job achievement could pose a barrier to working longer. However, "crystallized" intelligence – accumulated knowledge – increases with age, and cognitive reserves can offer spare capacity against declining fluid intelligence. As a result, studies comparing the productivity of young and old workers find that age is a crude and unreliable predictor of performance.[2]

This *brief* – the second in a series of three – reviews the research literature to assess how cognitive aging affects the ability to work during ages 50-70. The first *brief* provided a primer on cognitive aging and the third *brief* will examine how it affects retirees' ability to manage their money from ages 70-90.

The discussion proceeds as follows. The first section documents that age is not generally related to productivity across a variety of occupations. The second section explains *why* declining fluid intelligence tends not to impede work ability. The third section looks at the minority of workers who may struggle to remain productive and why. The final section concludes that experience helps many workers in skilled jobs stay productive and workers in less skilled jobs might have more fluid intelligence than their job requires. However, two groups are vulnerable to age-related decline: those in jobs where accumulated knowledge cannot offset demand for fluid intelligence and those who experience cognitive impairment.

Age and Job Performance

Decades of research show that age does not reliably explain the variation in productivity among workers ages 20-65. While individual studies – which typically examine a subset of workers in specific occupations – can show relatively strong correlations (both positive and negative) between age and productivity, meta-studies that aggregate data across the individual studies and apply results to the whole population find practically no correlation. Several of these meta-studies have examined the relationship between age and productivity by standardizing variables across the samples used in prior research and analyzing the resulting "super" sample (see Table 1 on the next page).

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Table 1. Correlation between Age and Productivity, by Subjective and Objective Measures

Year	Authors	No. of samples	Correlation between age and productivity	
			Subjective	Objective
1986	Waldman & Avolio	40	-0.14	0.27
1989	McEvoy & Cascio	96	0.06	0.06
2003	Sturman	167	0.02	0.08
2008	Ng and Feldman	118	0.02	0.03

Source: Authors' review of the literature.

For example, Sturman (2003) collected 115 studies with 167 samples that measured productivity for workers ages 17-64. These samples were categorized by the type of performance measure, whether the samples included job tenure, and whether they contained workers in jobs with relatively complex requirements. After aggregating the individual samples based on these dimensions, and controlling for tenure and other factors, Sturman found practically no correlation between age and job performance. This finding applied using either subjective evaluations of employees' work by managers and coworkers or objective measures of their work based on quantity and quality of output. Using a similar methodology, Ng and Feldman (2008) also found a negligible correlation between age and productivity.[3]

Since most productivity studies compare young and old workers at one point in time, the minimal overall changes in productivity may simply be due to cohort differences (like older workers having a stronger work ethic) or selection biases (like productive workers sticking around while unproductive workers retire). But studies of cognitive ability that follow workers over time also show that productivity is maintained with age, even among workers who experience decreases in their capacity to process new information.[4] So, it appears that the majority of older workers can remain productive despite age-related losses in fluid intelligence. The questions are: how do these workers maintain productivity and is anyone left behind?

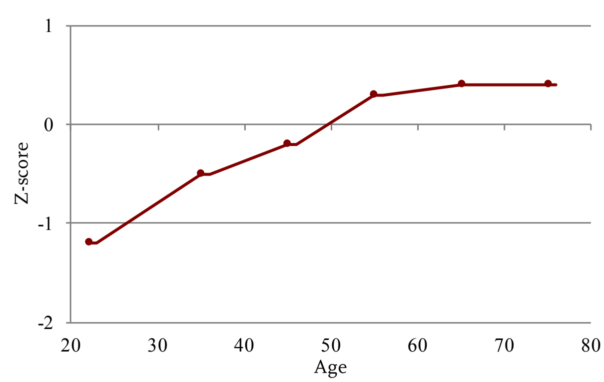
How Do Most Workers Stay Productive?

Two cognitive factors explain why most workers remain productive despite a decline in fluid intelligence: 1) crystallized intelligence – knowledge that accumulates with age – can offset declines in fluid intelligence; and 2) cognitive reserves, or fluid intelligence that exceeds job demands, can provide workers with a buffer. The first factor tends to particularly help skilled workers, while the second factor tends to benefit unskilled workers more.

Benefits of Crystallized Intelligence

Older workers can make up for declining fluid intelligence by drawing on their crystallized intelligence. When these workers were younger, their fluid intelligence was at its peak, which made it easier to acquire job-related skills. For example, pharmacists need a great deal of fluid capacity in pharmacy school and early in their careers to learn the facts, concepts, and procedures needed to do their jobs well. Their fluid intelligence helps them quickly build this storehouse of knowledge. As pharmacists grow older and more experienced in their jobs, their crystallized intelligence offsets declines in fluid intelligence because: 1) the amount of information they need to learn declines, reducing the need for fluid intelligence; and 2) the steady accumulation of knowledge over time makes up for their loss of fluid capacity. Figure 1

Figure 1. Ability to Finish *New York Times* Crossword Puzzle by Age, in Standard Deviation Units



Source: Salthouse (2012).

provides an everyday example of how performance of a task that requires both fluid reasoning ability and knowledge – completing a crossword puzzle – can improve over time as knowledge offsets declining fluid intelligence.

A Cognitive Buffer

While skilled workers can use knowledge to offset declining fluid intelligence, many workers – particularly those in jobs that involve simple or routine tasks – may also have more fluid intelligence than their job requires. For example, many clerical positions require workers to perform routine activities that become automatic with time, leaving such workers with enough fluid capacity in "reserve" to act as a buffer against decline.

Why Are Some Workers More Vulnerable to Decline?

While most workers can stay sharp on their jobs as they age, two types of workers may struggle to maintain their productivity: 1) those in high-skill occupations with intense demand for fluid intelligence; and 2) those who experience unusually severe cognitive decline.

High Fluid Intelligence Requirements

The interplay of fluid and crystallized intelligence is evident from a study of simulated performance of a typical task faced by air traffic controllers. The study included four groups of participants: 1) old non-controllers; 2) old controllers; 3) young non-controllers; and 4) young controllers. Table 2 shows how each group rates on fluid and crystallized intelligence relative to the task.

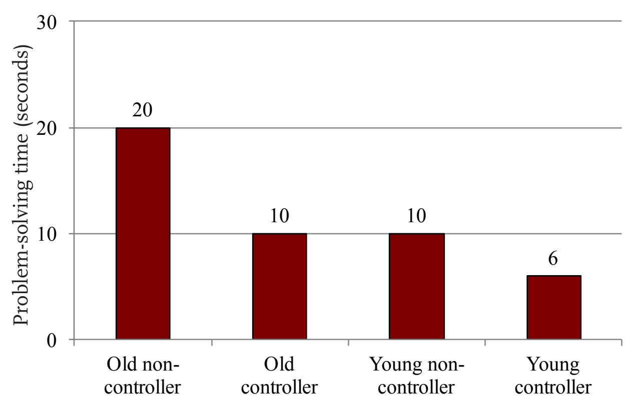
To assess each group's performance, researchers measured how long it took them to re-route two planes on a collision course, so the quicker the solution, the better. Not surprisingly, the older non-controllers had the worst performance, requiring 20 seconds to complete the task. The older controllers only needed half the time – 10 seconds – but the younger controllers only needed 6 seconds. Interestingly, the older controllers performed no better than younger individuals *who were not controllers* (see Figure 2). So, because of the high fluid intelligence demands of the task, old controllers – even with their decades of experience – could not out-perform young people with no background in the field. Not surprisingly, then, air traffic controllers are a prime example of an occupation in which cognitive aging often leads to early retirement; controllers employed by the Federal Aviation Authority are actually required to retire at age 56.[6]

Table 2. Fluid and Crystallized Intelligence for Participants in Air Traffic Controller Simulation

Type of participant	Fluid intelligence	Crystallized intelligence
Old non-controller	Low	Low
Old controller	Low	High
Young non-controller	High	Low
Young controller	High	High

Source: Nunes and Kramer (2009).

Figure 2. Problem-Solving Time for Old and Young Air-Traffic Controllers and Non-Controllers



Source: Nunes and Kramer (2009).

Another subset of workers who are vulnerable to declining fluid intelligence are those who end up switching occupations. In this case, job-switchers have no crystallized intelligence and must start from scratch to develop the specific knowledge and skills that are needed. Such workers could struggle to remain productive compared to younger workers because age erodes their fluid intelligence and, thus, the capacity to learn new skills, particularly if the skills are unrelated to their existing knowledge base.[7]

Cognitive Impairment

Workers who begin to develop a cognitive impairment in their 60s may not be able to work as long as they planned due to a declining ability to meet job demands. A cognitive impairment typically starts out as a mild, and often temporary, condition that primarily affects fluid intelligence, judgment, and reasoning ability. However, over half the cases of mild impairment progress to dementia, which erodes all cognitive functions irreversibly.[8]

While the incidence of Alzheimer's disease (the most common type of dementia) in one's 50s and early 60s is low – less than 4 percent of people under age 65 – it rises to 15 percent of 65-74 year olds.[9] Dementia develops gradually, so many who end up having it in their 70s may already have developed significant symptoms in their 60s.[10] This situation can go unnoticed because people who develop it typically lack awareness of their declining abilities.[11] The increasing risk of dementia with age suggests two types of workers would benefit from regular screening after age 65: workers in cognitively demanding occupations; and those in jobs where errors could significantly harm others, like surgeons. Screening could protect the public from harm and potentially allow the cognitively impaired to qualify for retirement under the disability program.[12]

Conclusion

Working longer is a powerful way to improve retirement preparedness, so understanding individuals' capacity for stretching out their work years is important. At first glance, recent research suggests cognitive aging might hinder working longer due to declining fluid intelligence. However, studies comparing the productivity of workers in their 20s to workers in their 30s, 40s, 50s and 60s find that age is unrelated to performance in most occupations.[13] As people age, improvements in knowledge appear to largely offset declines in fluid intelligence, and the amount of fluid capacity that most workers have through their late 60s seems to offer a sufficient buffer against any declines.

However, some groups of older workers are vulnerable to cognitive decline. Workers in jobs that require a high degree of fluid intelligence (which can include those who end up shifting careers) or who experience a cognitive impairment are likely to have trouble extending their worklives. As policymakers consider ways to encourage working longer, they may want to pay close attention to the potential impact of any proposed changes on such workers, as well as the effects on disability and unemployment programs that could see increased demand.

Endnotes

1 For research on physical abilities and aging, see Holden (1988); Lund, Iversen, and Poulsen (2001); and Karpansalo et. al. (2002).

2 Kuncel, Ones, and Sackett (2010).

3 While these meta-analyses do not show a general correlation between age and productivity, they do find correlations when skilled and unskilled workers are examined separately. For unskilled workers, performance is positively correlated with age early in a worker's career, until about 30 or 40, and negatively correlated with age thereafter (e.g., Sturman 2003). One reason might be that physical capacity could be more important than cognitive capacity in determining the productivity of unskilled workers. In contrast, the productivity of skilled workers continues to be positively correlated with age throughout their careers, including their 50s and 60s. This finding is particularly true when other age-related factors like motivation and tenure are taken into account; see Ng and Feldman (2008). Note that while Ng and Feldman examine workers between 17 and 59, other studies suggest that performance declines in one's 60s relative to peak performing years, even among skilled workers.

4 Salthouse (2012).

5 Salthouse (2012).

6 Nunes and Kramer (2009). Controllers with exceptional skills and experience are allowed to work up to age 61.

7 Schaei and Willis (2016).

8 Alzheimer's Association (2014).

9 Alzheimer's Association (2014).

10 For example, see Manly et al. (2008) and Katz et al. (2012). Important factors affecting reporting of the prevalence of mild cognitive impairment include the type of assessment used, the type of dataset, and cohort effects.

11 Okonkwo et al. (2008)

12 Adler and Constantinou (2008).

13 Kuncel, Ones, and Sackett (2010).

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