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Original Research Report

Cohort Differences in Cognitive Aging in the Longitudinal Aging Study Amsterdam

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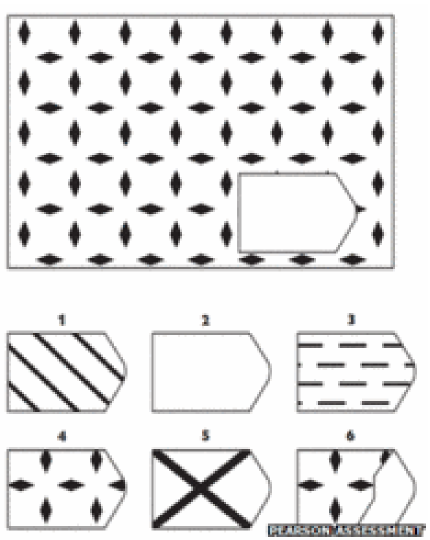
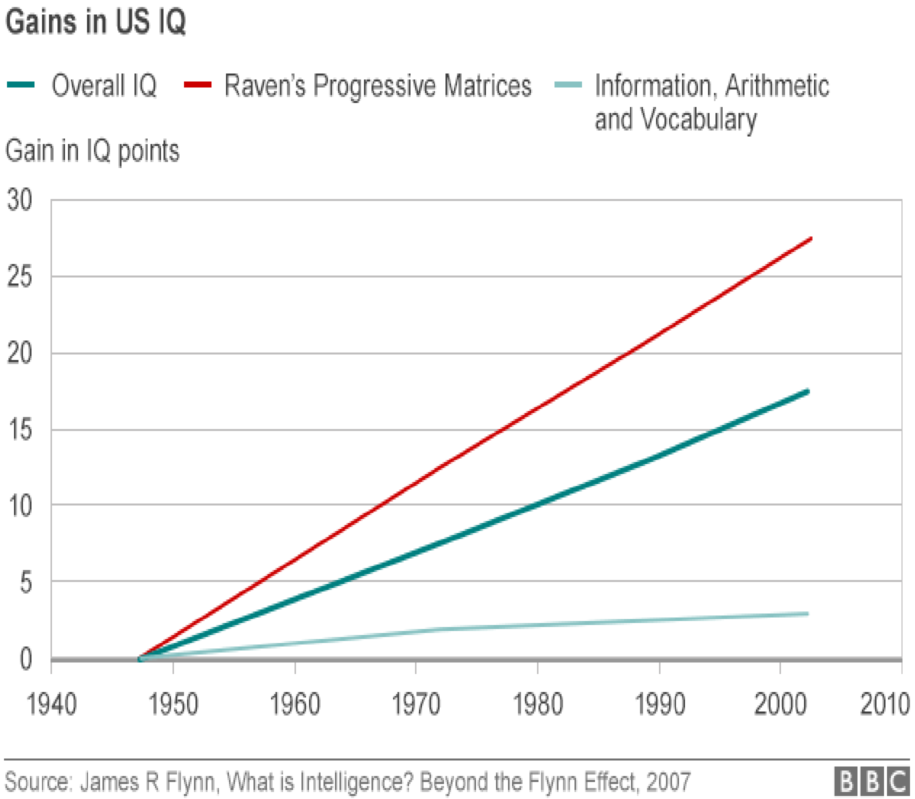
Background

✓ During the past century IQ scores have been rising in many parts of the world – **Flynn effect**

Raven

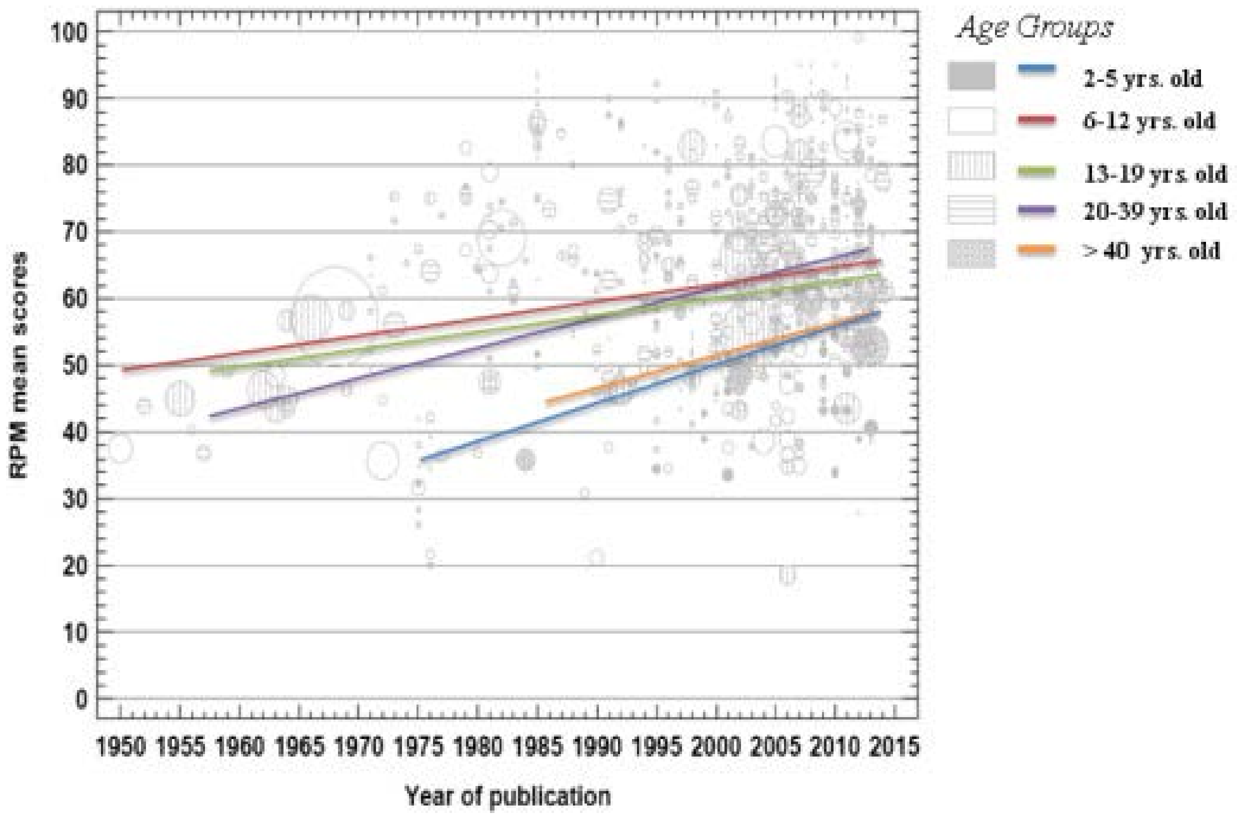


Are there larger gains in certain cognitive abilities?



✓ larger gains on fluid intelligence tests (up to 25 points) than crystallized intelligence tests

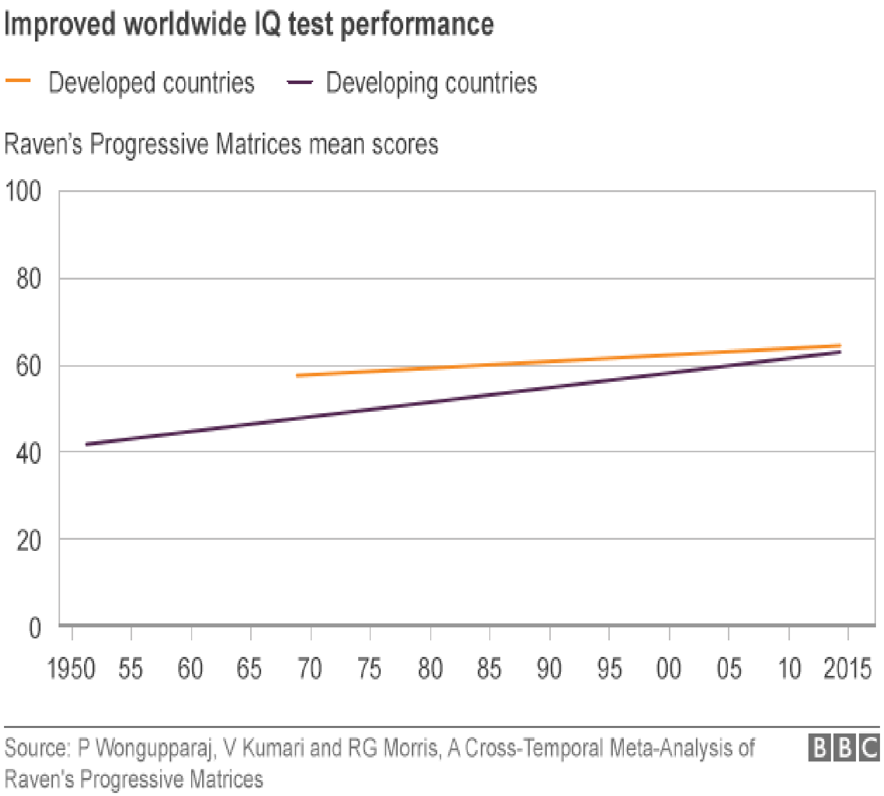
Are cognitive gains found across age groups?



Wongupparaj et al. (2014)

✓ Generational increases in IQ scores are found across the lifespan

Are cognitive gains found both in developed and in developing countries?



- ✓ Stronger increases in IQ scores in developing countries than in developed countries
- ✓ May reflect different societal changes in socio-demographic and health factors (e.g., lower CVD, more physical activity, educational achievement)

What factors may account for cohort differences in cognitive aging?

- ✓ improvements in heath care and health behaviors
- ✓ increase in education attainment
- ✓ spread of cognitively demanding professions
- ✓ advances in technology, internet
- ✓ more experience with cognitive test taking
- ✓ lack of psychometric invariance of cognitive tests across cohorts

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Are there cohort differences in levels of cognitive performance in late life?

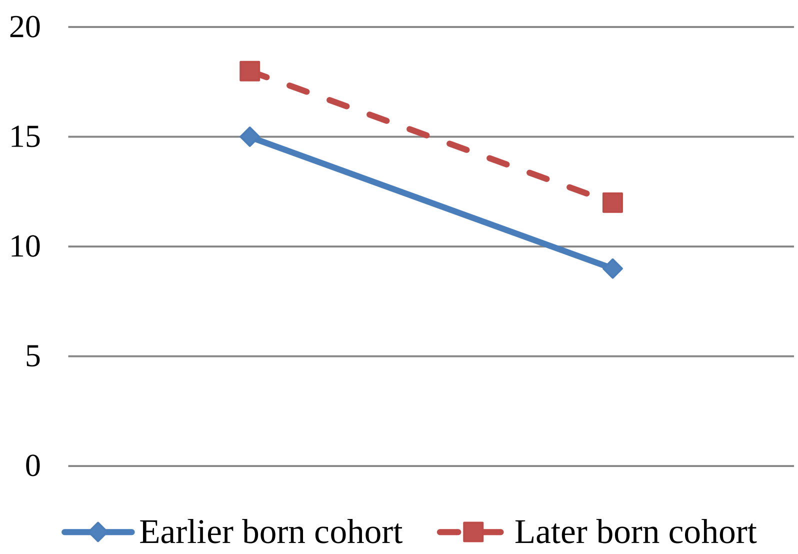
Study	Better performance in the later born cohorts	Mean age
Dodge et al. (2014)	• processing speed, executive function, letter & category fluency	65
Finkel et al. (2007)	• memory, verbal and spatial ability, but not processing speed	67.5
Baxendale (2010)	• list recall, visual recall, and visual learning	68
Gerstorf et al. (2011)	• spatial orientation, word fluency, inductive reasoning, and verbal meaning, but not numeric ability	70
Karlsson et al. (2015)	• logical reasoning and spatial ability	70
Zelinski & Kennison (2007)	• reasoning, spatial orientation, list and test recall	74
Gerstorf et al. (2015)	• perceptual speed performance	75
Christensen et al. (2013)	• general cognitive performance	93-95

Cohort effects may not persist in the final years of life (Gerstorf et al., 2011; Hulur, et al., 2013)

Are there cohort differences in the rate of cognitive decline?

✓ No cohort effect = similar rates of cognitive decline between cohorts

Preserved differentiation



Salthouse (2006)

Study	Cognitive domain	Age	Follow-up	Birth cohorts
Finkel et al. (2007)	verbal, spatial, memory, and processing speed abilities;	62-78	16 years	1900 - 1925 1926 - 1948
Dodge et al. (2014)	psychomotor speed, category fluency;	65 +	6 years	1912 - 1921 1922 - 1931 1932 - 1943
	letter fluency;			1922 - 1931 1932 - 1943
Zelinski & Kennison (2007)	reasoning, text and list recall, spatial ability; vocabulary,	56-71	9-22 years	1893 - 1923 1908 - 1940
	reasoning, spatial ability	77-86	9-22 years	1893 - 1923 1908 - 1940

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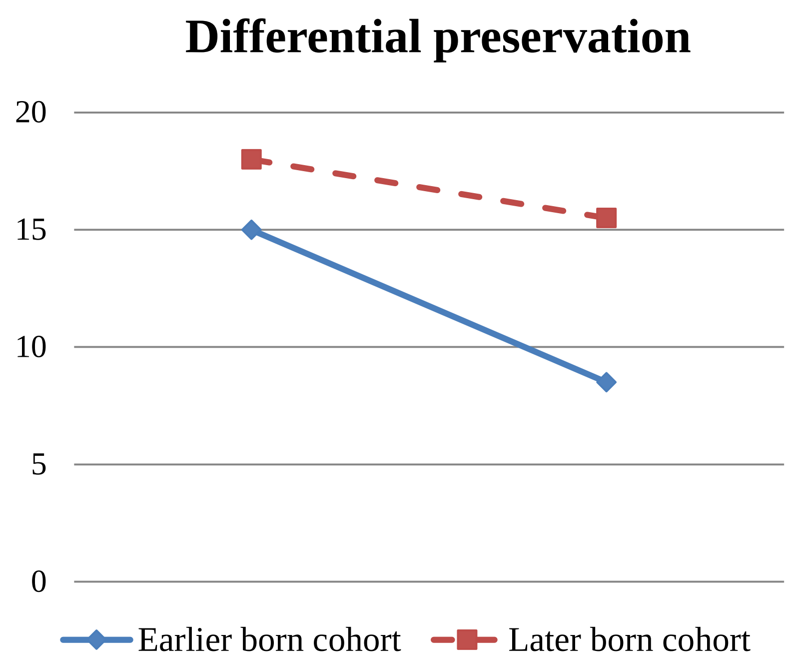
Are there cohort differences in the rate of aging-related cognitive decline?

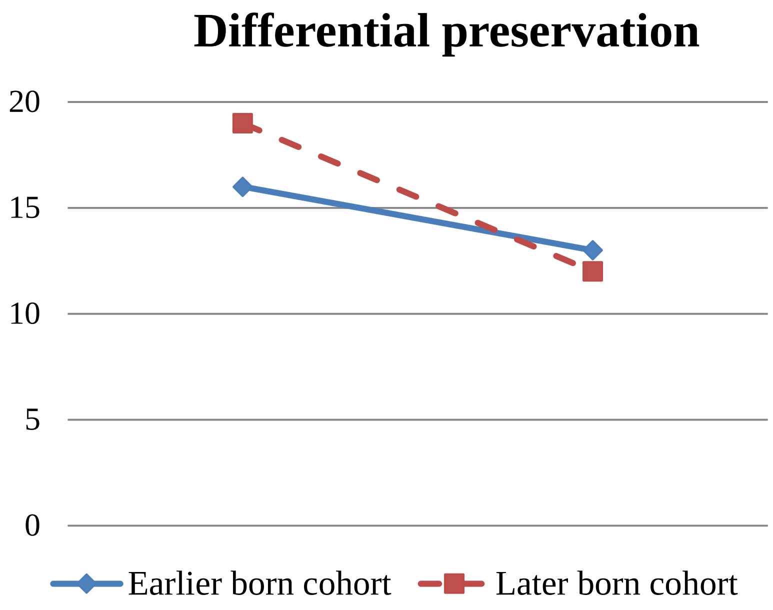
✓ Positive cohort effect - more cognitive decline in the earlier born cohorts



Study	Cognitive domain	Age	Follow-up	Birth cohorts
Gerstorf et al. (2011)	spatial orientation, word fluency, inductive reasoning,, numeric ability	50-80	49 years	1886-1913 1914-1948
Zelinski & Kennison (2007)	vocabulary	77-86	9-22 years	1893-1923 1908-1940
Dodge et al. (2014)	executive function;	65 +	6 years	1902-1911 1912-1921 1922-1931 1932-1943
	letter fluency;			1902-1911 1912-1921 1932-1943
	psychomotor speed, category fluency;			1902-1911 1932–1943

Are there cohort differences in the rate of aging-related cognitive decline?

✓ Negative cohort effect - more cognitive decline in the later born cohorts



Study	Cognitive domain	Age	Follow-up	Birth cohorts
Zelinski & Kennison (2007)	text and list recall;	77-86	9-22 years	1893 - 1923 1908 – 1940
Karlsson et al. (2015)	spatial ability, reasoning ability;	70-79	9 years	1901 - 1902 1906 - 1907 1930

Our study

Aims

✓ To examine cohort differences in levels and trajectories of cognitive performance among Dutch older adults

✓ To determine the extent to which educational attainment may account for these cohort effects

Participants

Birth cohort 1 (1920-1930)	Birth cohort 2 (1931-1941)
Baseline (1995-1996) N = 705 Age 65 – 75	**Baseline** (2005-2006) N = 646 Age 65 – 75
First follow up (1998-1999) N = 599 Age 68 - 78	**First follow up** (2008-2009) N=540 Age 68 – 78
Second follow up (2001-2002) N = 599 Age 71 - 81	**Second follow up** (2011-2012) N = 452 Age 71- 81

Method

- ✓ Cognitive measures:
  - general cognitive performance (MMSE)
  - inductive reasoning (Raven Colored Progressive Matrices)
  - processing speed (Coding Task)
  - immediate recall (15 word list)
  - delayed recall (15 word list)
- ✓ Analysis: Linear Mixed Models (Maximum Likelihood estimation)
  - Model 1: cohort differences in baseline levels of cognitive performance, controlling for age, gender and chronic diseases
  - Model 2: cohort differences in baseline levels of cognitive performance, controlling for age, gender and chronic diseases + education
  - Model 3: cohort differences in cognitive decline, controlling for age, gender and chronic diseases
  - Model 4: cohort differences in cognitive decline, controlling for age, gender and chronic diseases + education

Findings - Cohort differences in initial levels of cognitive performance

Cognitive ability	Models unadjusted for education		Models adjusted for education	
	B	**Effect size**	**B**	**Effect size**
General cognitive ability	**0.09****	0.14	0.03	0.04
Inductive reasoning	**-0.57****	0.16	-0.16	0.04
Processing speed	**-5.02*****	0.25	**-2.54***	0.13
Immediate recall	0.27	0.04	**0.79***	0.13
Delayed recall	0.12	0.04	0.29	0.10

✓ Later born cohorts showed higher baseline levels of general cognitive ability, processing speed and inductive reasoning

✓ Education accounted for cohort differences in general cognitive ability and inductive reasoning, but not processing speed

✓The earlier born cohort had better immediate recall performance after (but not before) adjusting for education.

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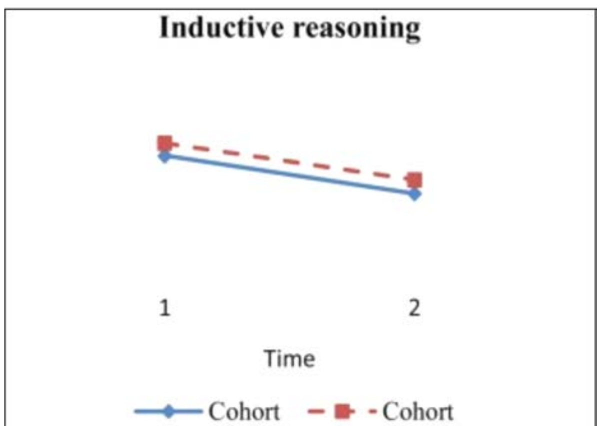
Findings - Cohort differences in rates of cognitive decline

No cohort effect: similar rates of decline in:

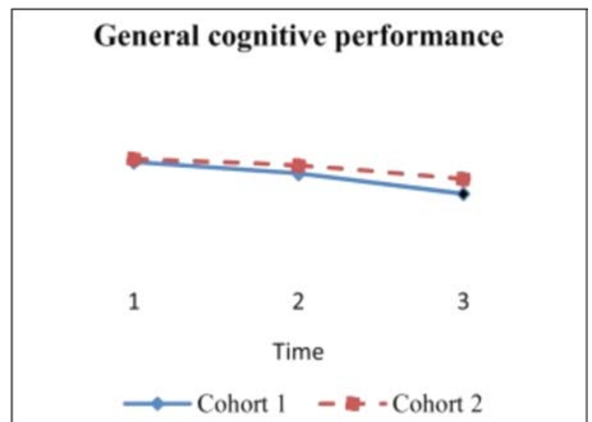
✓ general cognitive performance

✓ inductive reasoning

Preserved differentiation



- No cohort differences at baseline
- No cohort differences in rates of decline

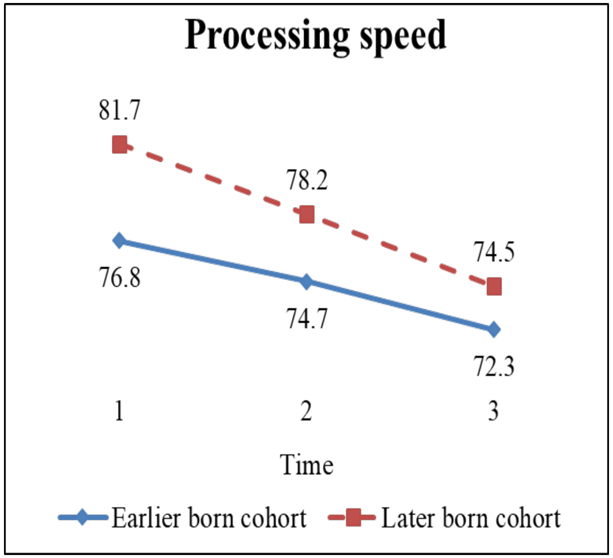


- No cohort differences at baseline
- No cohort differences in rates of decline

Findings - Cohort differences in rates of cognitive decline

Negative cohort effect – faster processing speed decline in the later born cohort

Differential preservation



✓ Education did not account for cohort differences in rates of decline (similar to Dodge et al., 2014)

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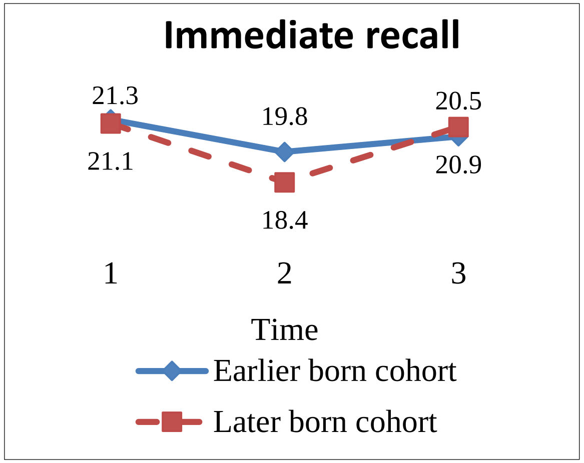
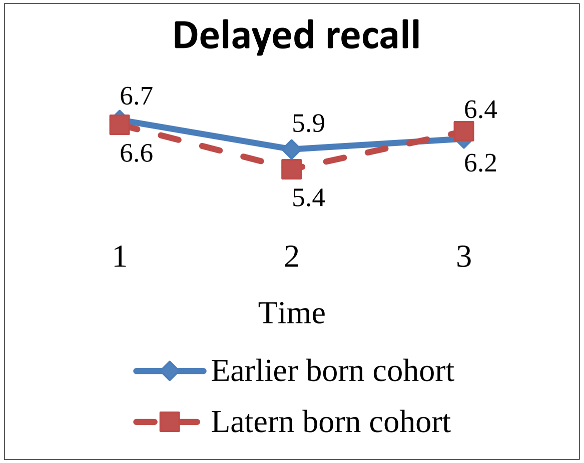
Negative & positive cohort effect for memory ability } Differential preservation



- More decline from T1 to T2 in the later born cohort
- Less decline from T1 to T3 in the later born cohort



- More decline from T1 to T2 in the later born cohort
- Less decline from T1 to T3 in the later born cohort

Education only accounted for cohort differences in immediate recall decline from T1 to T3

cohort 1 & cohort 2

T1 → T2 → T3

Word list 1 | Word list 2 | Word list 1

↓

Potentially more difficult - may contain words less familiar to the later born cohort

Conclusions

- ✓ Later born cohorts showed better levels of cognitive performance in some domains (general cognitive ability, processing speed and inductive reasoning).

  → evidence for the Flynn effect

- ✓ Education accounted for cohort differences in levels of cognitive performance in some domains (general cognitive ability and inductive reasoning).

  → evidence for the role of cognitive reserve

- ✓ Depending on the cognitive ability assessed, later born cohorts showed either similar, faster or slower cognitive decline.

  → evidence for both preserved differentiation & differential preservation of cognitive function

- ✓ Education did not account for cohort differences in cognitive decline.

- ✓ Attrition rates, causes and predictors were similar between cohorts; pattern mixture analyses suggest that substantive conclusions were not affected by dropout.

Limitations

The absence of larger cohort effects may be due to:

- the short interval between birth cohorts (10 years)
- the short duration of follow up (6 years)
- the small difference in educational attainment (1 year)

Future directions

✓ Higher cognitive reserve may offer later born participants an initial edge in cognitive performance, but it does not slow down their cognitive decline.

✓ Other factors than education may account for cohort differences in cognitive functioning in old age (e.g. occupational attainment, cognitive training in late-life).

✓ A continuation of cohort improvements in cognitive functioning could offset the negative effects of population aging (Skirbekk et al., 2013).

Thank you!