

# Disentangling Cohort Changes in the Cognitive Gender Gap in Europe: The Role of Work-Family Histories

Thomas Arnhold<sup>1,2</sup>, Daniela Weber<sup>1,2</sup>, Agneta Herlitz<sup>3</sup>, and Valeria Bordone<sup>1,4</sup>

<sup>1</sup>POPJUS Program, International Institute for Applied Systems Analysis (IIASA), Wittgenstein Centre for Demography and Global Human Capital (IIASA, OeAW, University of Vienna), Laxenburg, Austria

<sup>2</sup>Health Economics and Policy Division, Vienna University of Economics and Business, Vienna, Austria

<sup>3</sup>Department of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden

<sup>4</sup>Department of Sociology, University of Vienna, Vienna, Austria

**Extended abstract prepared for the European Population Conference 2026**

## Introduction

Across the 20th and early 21st centuries, standardized intelligence scores showed increases across European cohorts (Flynn effect) [1,2], a pattern extending into later adulthood [3–5]. In Europe, these cohort gains have often been more substantial for women than for men, particularly among older adults. Because later life cognitive functioning is closely linked to morbidity, functional limitations, and psychological wellbeing [6,7], these patterns have direct implications for population health in Europe. Rising education, reduced fertility, and improved living conditions are frequently cited drivers, benefiting women more. Nevertheless, the life course mechanisms behind these dynamics remain underexplored, despite their relevance for cognitive resilience in later life [8,9]. Guided by the cognitive reserve theory, which posits that cognitively stimulating experiences across life build resilience against age-related decline [10], and in light of growing evidence hinting at the decisive role of men's and women's distinct life course trajectories for later-life cognition [8,11], we argue that women's transition into more cognitively stimulating life courses contributed to their disproportionate cohort gains in later life cognitive functioning.

Prior research suggests that women often experience more substantial cognitive cohort gains than men. In Europe, despite women already outperforming men in some cognitive domains, disproportionate cohort gains for women have been reported [12,13]. Research on cognitive decline reveals a similar pattern, indicating that, in earlier cohorts, the rate of decline in episodic memory is more pronounced for women compared to men, whereas in later cohorts, it is more pronounced for men [14]. Studies also point to regional heterogeneity in the cognitive gender gap and its dynamics within Europe [13,15].

Education, fertility, and improved living standards, factors that may have benefited women disproportionately, have been proposed as explanations for women's larger cognitive cohort gains [13–15]. However, while these factors are related to later-life cognition, they are intertwined with gender differences in activities (e.g. labour market participation) and social roles pursued throughout the life course, which may be central for shaping cognitive functioning in later life. The cognitive reserve theory implies that such cognitively stimulating experiences enhance the brain's adaptability of cognitive processes, reducing its vulnerability to age-related cognitive decline in later life [10]. Consistent with this framework, recent longitudinal evidence in Germany shows that more frequent engagement of one's cognitive abilities throughout working age, both at home and at work, substantially delays the onset of cognitive decline [9].

Importantly, experiences across the life course are profoundly structured by gender, with gender-specific social norms and work-family policies shaping responsibilities at work and in the household [16,17]. In this context, Europe's rising female labour force participation, with later cohorts of women increasingly likely to work full-time or part-time [16], has increased occupational engagement of cognitive abilities in women, which may have caused larger cohort effects for women than for men. Indeed, empirical research focusing on Europe indicates that for women, working full-time or combining part-time work and family responsibilities predicts higher cognitive functioning than maintaining more marginal labour market attachment [8,11,18].

In this paper, we move beyond broad compositional explanations (education, fertility, living standards) for gender differences in cohort effects to the gendered life-course mechanisms they are intertwined with. Specifically, we decompose gender differences in cohort effects into the effect of (i) changes in the distribution of work-family life course types across cohorts (endowment effects) and (ii) changes in how these life-course types are associated with cognitive outcomes (coefficient effects). Furthermore, we assess regional heterogeneity consistent with cross-national differences in work-family policy regimes and cognitive outcomes.

## **Data**

We analyse data from the Survey of Health, Ageing and Retirement in Europe (SHARE), an ongoing panel survey covering health, social, and economic conditions of non-institutionalised people aged 50 and above across European countries and Israel [19]. We use data from regular panel waves 1, 2, 4, 5, 6, 8, and 9 (2004–2022), which provide repeated measures of cognitive functioning, demographic, and socioeconomic variables. In addition, we use retrospective information from the SHARELIFE waves 3 and 7, which collect complete work and family histories [20]. Our analytical sample comprises observations of individuals aged 50 to 79 with complete information on all model variables, living in countries that participated in all nine survey waves (65,202 observations of 18,463 women and 54,833 observations of 15,865 men).

## *Variables*

As outcome variables, we use episodic memory and verbal fluency, two dimensions of cognitive functioning that are susceptible to ageing-related cognitive decline [21,22]. Both outcome variables are z-standardized for better comparability.

To explain changes in the gender gap in the outcome variables, we use work-family life course typologies as key regressors, drawing on retrospective information on the respondents' work status (full-time employment, part-time employment, education, unpaid domestic work, unemployment, other) and family situation (partnered parent, partnered childless, single parent, single childless) from ages 15 to 50. Further, we control for participants' level of education and their number of children, two factors that were proposed as drivers of changes in the cognitive gender gap across cohorts [13–15]. We also control for learning effects in cognitive testing.

## **Method**

The method follows a two-step approach. First, we derive work-family history typologies using multichannel sequence analysis of life histories, considering the timing and interdependence between work and family trajectories.

Second, we investigate the role of these typologies on cohort differences in the gender gap, using a panel approach to the Oaxaca-Blinder Decomposition. This method separates how much observed change in the gender gap is due to (i) shifts in group composition (who is in which typology), (ii) changes in group-specific associations (how typologies relate to cognitive functioning), and (iii) their interaction [23].

## Preliminary findings

### *Cohort dynamics in the cognitive gender gap*

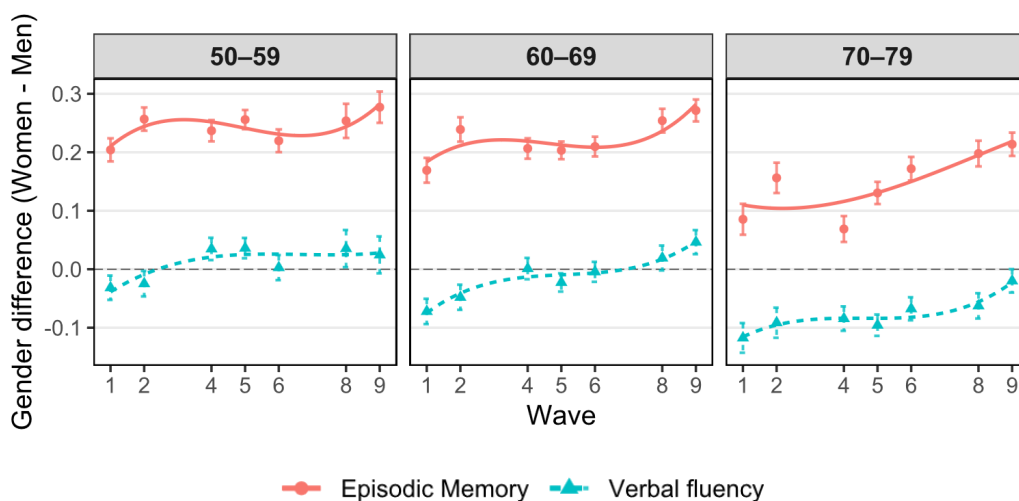
We track gender differences in cognition across SHARE waves separately for age groups 50–59, 60–69, and 70–79. Within an age group, later survey waves capture later-born cohorts.

Across waves, women consistently outperform men on episodic memory in every age group, with an increase in the gender gap in later cohorts for all three of the age groups (50-59; 60-69; 70-79). The increase in the gender gap from SHARE wave 1 (earliest-born cohort) to wave 9 (latest-born cohort) is most pronounced for individuals in the oldest age group, 70-79 (from 0.09 to 0.21 standard deviations (SD)), and least pronounced for the youngest age group, 50-59 (from 0.20 to 0.28 SD).

In contrast, verbal fluency shows less pronounced gender differences that vary by age group. Concerning cohort changes in the gender gap, the youngest age group, 50-59, remains near parity (from -0.03 SD in wave 1 to 0.02 SD in wave 9), the 60-69 age group moves from a male advantage to a female advantage (from -0.07 to 0.05 SD), and the oldest age group, 70-79, shifts from a clear male advantage toward parity (from -0.12 to -0.02 SD).

Overall, for both cognitive domains, cohort dynamics in the cognitive gender gap favour women, with changes in the gender gap being more pronounced for the two older age groups than the youngest one. Figure 1 displays the gender difference (Women - Men) across waves stratified by the three age groups.

**Figure 1** Gender gaps in episodic memory and verbal fluency across waves (Women - Men, z-scores), by age group.



*Notes.* Points plot the women-men difference in z-standardized episodic memory and verbal fluency scores by SHARE wave and age group (positive values favour women), including  $\pm 1$  standard errors. The lines are third-order polynomial smooths. Based on own calculations using SHARE waves 1-9.

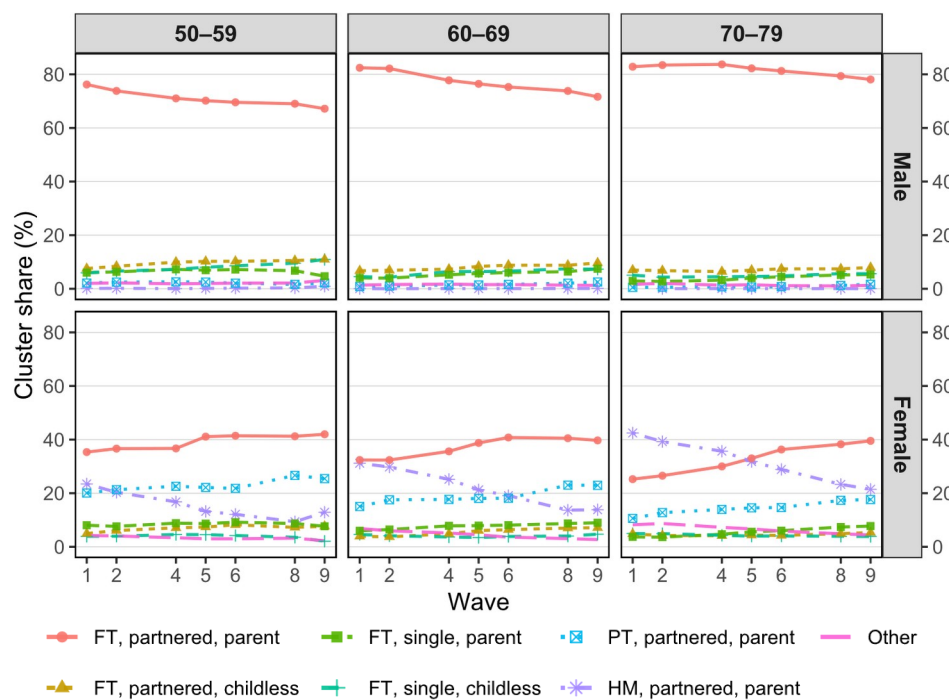
### Cohort dynamics in work-family histories

Applying multichannel sequence analysis and standard clustering diagnostics, we distinguish seven work-family life-course typologies: *Full-time employed, partnered, parent (FT-P-P)*; *Full-time employed, partnered, childless (FT-P-CL)*; *FT, single, parent (FT-S-P)*; *FT, single, childless (FT-S-CL)*; *Part-time employed, partnered, parent (PT-P-P)*; *Homemaker, partnered, parent (HM-P-P)*; and *Other*. Figure 2 shows the percentage of each typology in each SHARE wave by gender and age group. Within each age group, changes across waves again reflect changes across cohorts.

Among men across all age groups, typology shares are highly concentrated in *FT-P-P*, with modest reallocation between cohorts. Among those aged 50 to 59, the *FT-P-P* share declines from 76.2% (wave 1) to 67.2% (wave 9; -9.0 percentage points (pp)), mostly offset by increases in *FT-S-CL* (+5.0 pp) and *FT-P-CL* (+3.4 pp); other typologies remain rare for men. Patterns are similar for age group 60-69, with a decline in *FT-P-P* (-10.8 pp). In age group 70-79, the *FT-P-P* share reduction is less pronounced (-4.8 pp). Taken together, men's changes are limited and driven more by shifts in family status than by labour market attachment.

In contrast, women in all age groups show a clear shift toward greater labour-market attachment in later cohorts, primarily through compositional gains in typologies characterized by full-time or part-time employment and a marked decline in *HM-P-P*. Among women aged 50 to 59, *FT-P-P* rises by 6.6 pp and *PT-P-P* by 5.4 pp, offset by a decrease in *HM-P-P* (-10.6 pp). This pattern is more pronounced for those aged 60 to 69: *FT-P-P* increases by +7.3 pp, *PT-P-P* by +7.9 pp, while *HM-P-P* falls substantially (-17.3 pp). The largest compositional change towards more labour market attachment appears at the oldest age group (70-79). *FT-P-P* rises by +14.3 pp and *PT-P-P* by +7.1 pp, alongside a substantial reduction of *HM-P-P* of -21.0 pp.

**Figure 2** Work-family life-course typology composition (in percent), by gender, age group, and SHARE wave.



*Notes.* Points show the percentage of respondents in each of the seven work-family life course typologies, with panels separating men and women aged 50-59, 60-69, and 70-79. The x-axis indicates the survey wave. The y-axis represents the typology share in percent. Based on own calculations using SHARE waves

## References

1. Flynn JR. Massive IQ gains in 14 nations: What IQ tests really measure. *Psychological Bulletin* 1987;**101**:171–91.
2. Pietschnig J, Voracek M. One Century of Global IQ Gains: A Formal Meta-Analysis of the Flynn Effect (1909–2013). *PERSPECT PSYCHOL SCI* 2015;**10**:306.
3. Hessel P, Kinge JM, Skirbekk V *et al*. Trends and determinants of the Flynn effect in cognitive functioning among older individuals in 10 European countries. *J Epidemiol Community Health* 2018;**72**:383–9.
4. Rehnberg J, Fors S, Ford KJ *et al*. Cognitive performance trends among European older adults: exploring variations across cohorts, gender, and educational levels (2007–2017). *BMC Public Health* 2024;**24**:1646.
5. Skirbekk V, Stonawski M, Bonsang E *et al*. The Flynn effect and population aging. *Intelligence* 2013;**41**:169–77.
6. Boxtel MPJ van, Buntinx F, Houx PJ *et al*. The Relation Between Morbidity and Cognitive Performance in a Normal Aging Population. *J Gerontol A Biol Sci Med Sci* 1998;**53A**:M147–54.
7. Llewellyn DJ, Lang IA, Langa KM *et al*. Cognitive function and psychological well-being: findings from a population-based cohort. *Age and Ageing* 2008;**37**:685–9.
8. Bertogg A, Leist AK. Gendered life courses and cognitive functioning in later life: the role of context-specific gender norms and lifetime employment. *Eur J Ageing* 2023;**20**:7.
9. Hanushek EA, Kinne L, Witthöft F *et al*. Age and cognitive skills: Use it or lose it. *Science Advances* 2025;**11**:eads1560.
10. Stern Y, Arenaza-Urquijo EM, Bartrés-Faz D *et al*. Whitepaper: Defining and investigating cognitive reserve, brain reserve, and brain maintenance. *Alzheimers Dement* 2020;**16**:1305–11.
11. Tattarini G, Uccheddu D, Bertogg A. Staying sharp: Gendered work-family life courses and later-life cognitive functioning across four European welfare states. *Am J Epidemiol* 2025:kwaf194.
12. Nooyens ACJ, Wijnhoven HAH, Schaap LS *et al*. Sex Differences in Cognitive Functioning with Aging in the Netherlands. *Gerontology* 2022;**68**:999–1009.
13. Weber D, Dekhtyar S, Herlitz A. The Flynn effect in Europe – Effects of sex and region. *Intelligence* 2017;**60**:39–45.
14. Wolfova K, Frycova B, Seblova D *et al*. Sex differences in cognitive decline among middle-aged and older adults: a cohort study in Europe. *Age Ageing* 2024;**53**:afae078.
15. Weber D, Skirbekk V, Freund I *et al*. The changing face of cognitive gender differences in Europe. *Proceedings of the National Academy of Sciences of the United States of America* 2014;**111**:11673.
16. Firat M, Visser M, Kraaykamp G. Work-family trajectories across Europe: differences between social groups and welfare regimes. *Front Sociol* 2023;**8**, DOI: 10.3389/fsoc.2023.1100700.
17. Zigel H, Van Winkle Z. Women’s Family and Employment Life Courses Across Twentieth-Century Europe: The Role of Policies and Norms. *Soc Polit* 2022;**29**:446–76.
18. Ice E, Ang S, Greenberg K *et al*. Women’s Work-Family Histories and Cognitive Performance in Later Life. *American Journal of Epidemiology* 2020;**189**:922–30.
19. Börsch-Supan A, Brandt M, Hunkler C *et al*. Data Resource Profile: The Survey of Health, Ageing and Retirement in Europe (SHARE). *International Journal of Epidemiology* 2013;**42**:992–1001.
20. Brugiavini A, Orso CE, Genie M *et al*. Combining the retrospective interviews of Wave 3 and Wave 7: the third release of the SHARE Job Episodes Panel. 2019, DOI: 10.6103/SHARE.jep.710.
21. Gonzalez-Burgos L, Hernández-Cabrera JA, Westman E *et al*. Cognitive compensatory mechanisms in normal aging: a study on verbal fluency and the contribution of other cognitive functions. *Ageing (Albany NY)* 2019;**11**:4090–106.
22. Machado A, Barroso J, Molina Y *et al*. Proposal for a hierarchical, multidimensional, and multivariate approach to investigate cognitive aging. *Neurobiology of Aging* 2018;**71**:179–88.
23. Kröger H, Hartmann J. Extending the Kitagawa–Oaxaca–Blinder decomposition approach to panel data. *The Stata Journal* 2021;**21**:360–410.