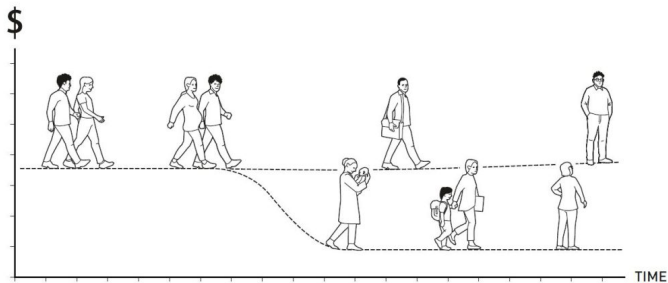


Motherhood and skills across the life course

Sonja Spitzer, Claudia Reiter, Adèle Lemoine

Vienna Institute of Demography,
Austrian Academy of Sciences

THE MOTHERHOOD EFFECT



Source: Johan Jarnestad for the Prize in Economic Sciences 2023 — The Royal Swedish Academy of Sciences

HUMAN CAPITAL LOSS DUE TO CAREER INTERRUPTIONS?

2. During the period of childbearing and child care, prolonged non-participation may cause the skills acquired at school and at work to depreciate. Some revisions of expectations and of commitments may also

crimination (i.e., employers discriminate against mothers), and human capital depreciation (i.e., time away from the job reduces relative job experience and job-relevant skills; Budig and England 2001). The present study examines deci-

Tharp & Parks-Stamm 2021

Mincer & Polachek 1974

leave occupational allocation through several channels. First, mothers can face human capital depreciation while on childcare leave (Mincer and Polachek 1978). Edin and Gustavsson (2008) show that leave

the practical performance of the job (Becker, 1993). During work interruptions, acquired human capital may lose value if, for instance, new routines replace old routines or people simply forget part of what they have learned. According to the theory, we would expect the human capital loss to increase with the time away from paid

Evertsson 2016

Pertold-Gebicka 2020

The skills of workers with career interruptions can depreciate because they may not be using or updating them during the interruption. More precisely, they may be

Görlich & de Grip 2009

Why would child-related career interruptions lead to skill loss?

SKILL LOSS DURING CAREER BREAKS

Human capital perspective

- Career breaks of mothers lead to human capital loss
(Becker 1985, Becker 1991, Mincer & Ofek, 1982, Mincer & Polachek 1974)
- **Atrophy from underuse:** if skills are not regularly used, they deteriorate

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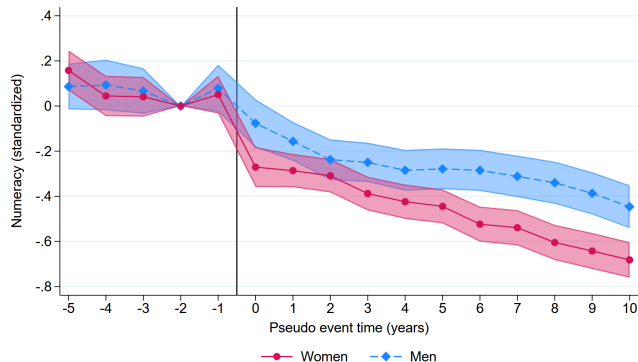
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Empirical evidence on skills

- Time away from paid work leads to lower literacy and numeracy scores
(Edin & Gustavsson 2008, Parsons & Bynner 1999)

CHILD PENALTIES IN NUMERACY SCORES (Jessen et al. 2025)



Notes: Figure shows the event-time coefficients α_j obtained from estimating equation (2). The dependent variable is the standardised numeracy score. Shaded areas represent 95% confidence intervals. The corresponding summary estimates are shown in Table B.4. Source: PIAAC international PUF.

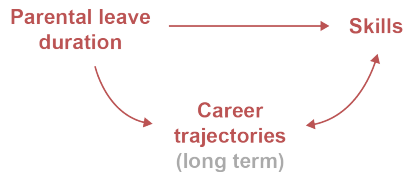
SKILL LOSS ALONG THE LIFE COURSE: “USE IT OR LOSE IT”

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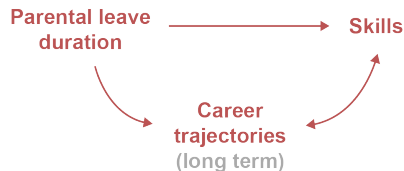
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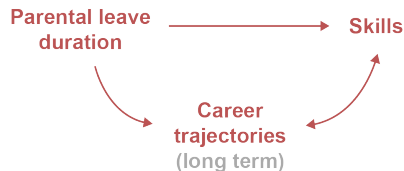
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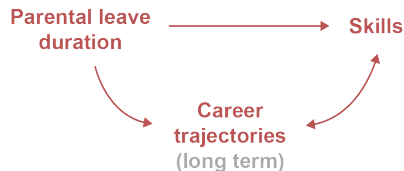
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- Motherhood penalty persists into old age (Möhring 2018)

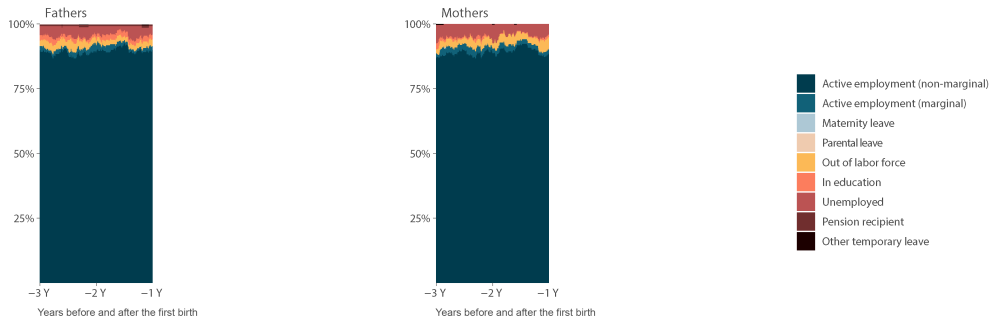


Are child-related career
interruptions linked
to lower skills?

DATA: DAILY LABOUR-MARKET HISTORIES & TESTED SKILLS

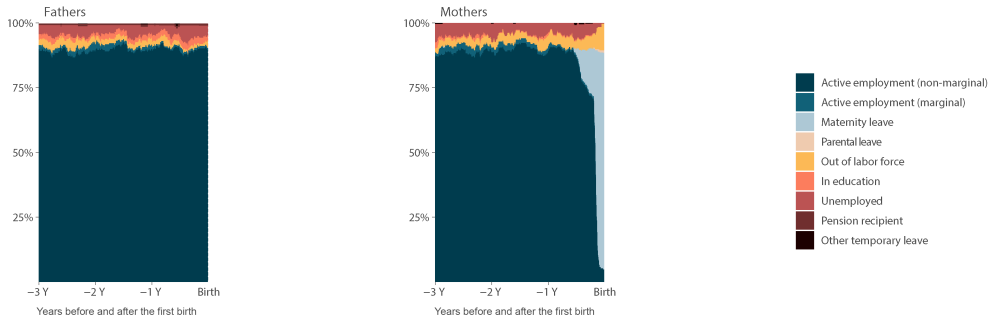
- **PIAAC Cycle 1:** tested numeracy in 2011–2012
- **Austrian registers:** daily labour-market status, leave, income, and births
- **Linked sample:** 5,130 PIAAC participants
- **First-birth subsample:** 226 fathers and 234 mothers; births in 2015–2022
- **Skill groups:** lower = PIAAC levels 0–2 (< 276); higher = levels 3–5 (≥ 276)

EMPLOYMENT AROUND THE FIRST BIRTH IN AUSTRIA (2015-2022)



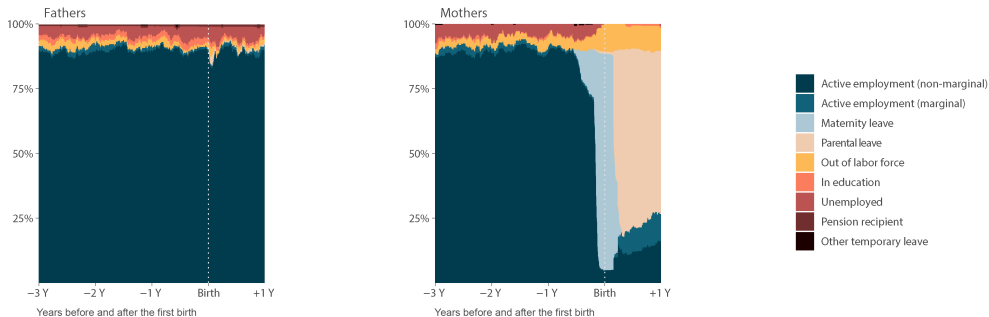
Source: "When gender trumps skills: Employment trajectories of Austrian parents after their first birth" with Claudia Reiter; data from Statistics Austria – register-based labour market information from the Austrian "Labour Market Careers" register (Registerbasierte Erwerbsverläufe), which provides a complete register of daily, non-overlapping labour market statuses for the total Austrian population, produced from various administrative registers; this graph shows a subsample of all PIAAC participants, their household members, (ex-)spouses, and co-parents, who had their first child between 2015 and 2022. Fathers: N = 1109; Mothers: N = 1137

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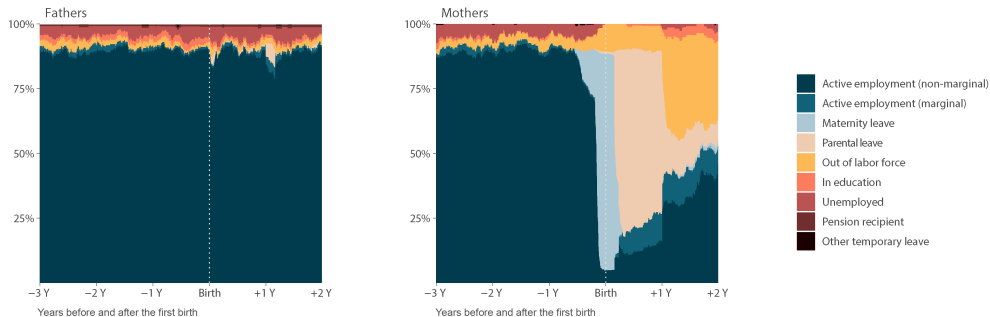
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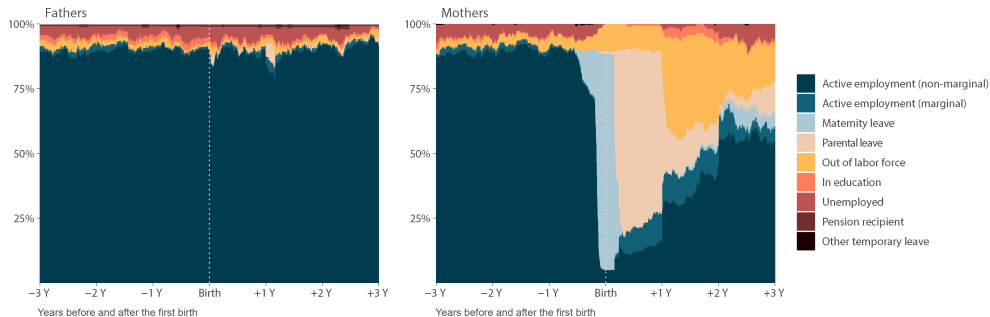
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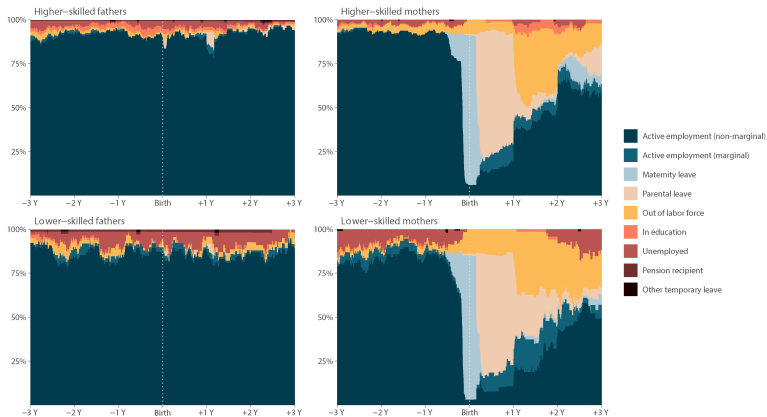
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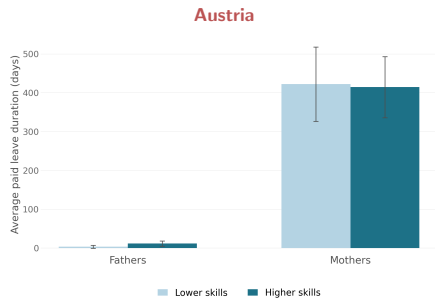
GENDER TRUMPS SKILLS: EMPLOYMENT BY SKILL LEVEL (PIAAC)

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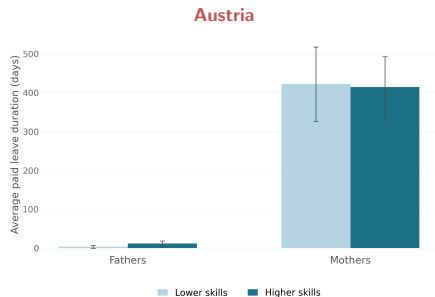
Source: This graph shows a subsample of all PIAAC participants who had their first child between 2015 and 2022 (higher-skilled fathers N = 157; higher-skilled mothers N = 150; lower-skilled fathers N = 69; lower-skilled mothers N = 83); skill level is defined based on PIAAC numeracy proficiency: lower-skilled comprises proficiency levels 0, 1, and 2 (1 276 points); higher-skilled comprises proficiency levels 3, 4, and 5 (276 points); PIAAC weights are applied. Source: PIAAC and Statistics Austria register-based labour market careers (Registerbasierte Erwerbsverläufe) and birth register (Statistik der Standesfälle).

LEAVE BY GENDER AND NUMERACY SKILL LEVEL: AT vs. SE

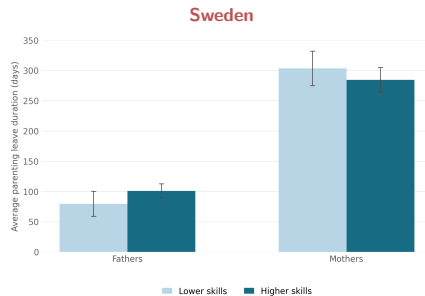


Note: PIAAC participants who had their first child between 2015 and 2018 (fathers $N = 122$; mothers $N = 113$). The outcome is paid maternity and parental leave accumulated during the three years following first birth. Lower skills comprise PIAAC numeracy levels 0–2 and higher skills levels 3–5. PIAAC weights are applied; whiskers show 95% confidence intervals. Source: Reiter & Spitzer (2026), Table 1; linked PIAAC and Statistics Austria register data.

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Note: Swedish parents who participated in PIAAC Cycle 1 and had their first child between July 2012 and December 2021. The outcome is paid net parental leave days, with partial leave converted into full-time equivalents. Leave is summed over the calendar year of first birth and the two following calendar years. Source: PIAAC Cycle 1 linked with Swedish register data.

The absolute levels are not directly comparable because leave duration is measured differently in Austria and Sweden

WHAT LINKED PIAAC CAN – AND CANNOT – IDENTIFY

What it can do

- Trace leave and re-entry by **tested skill level**
- Use daily register histories (in Austria)

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What it cannot do here

- Observe within-person skill change: **PIAAC is cross-sectional**
- Support causal inference methods: **too few births**

Do child-related career
interruptions lower mothers'
skills in later life?

VIENNA INSTITUTE OF DEMOGRAPHY

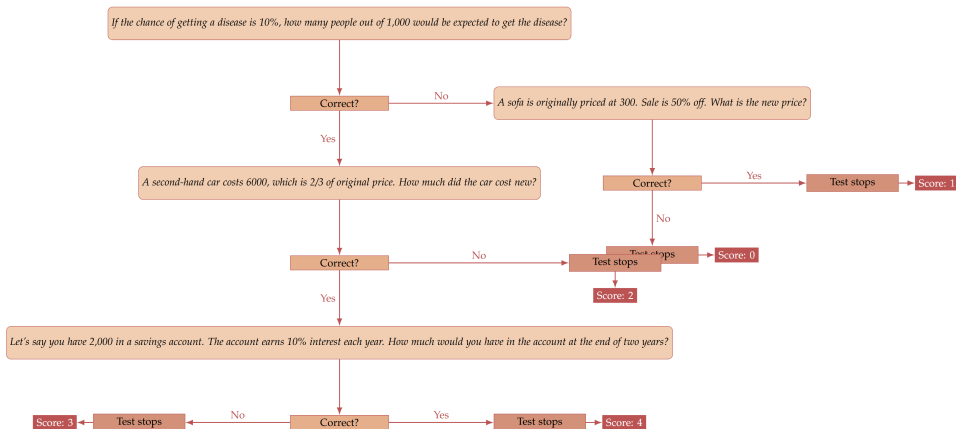
WORKING PAPERS

03/2025

PARENTING LEAVE DURATION AND MOTHERS' SKILLS
ALONG THE LIFE COURSE

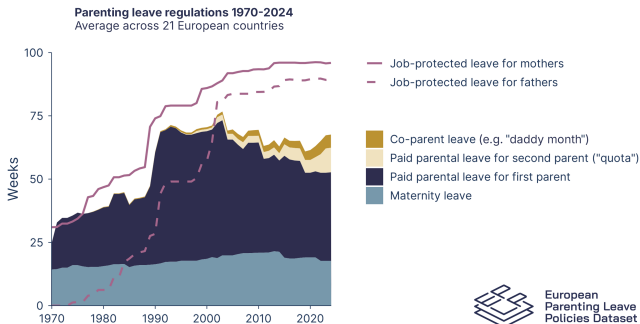
ADÈLE LEMOINE, SONJA SPITZER, AND CLAUDIA REITER

MEASURING NUMERACY SKILLS IN SHARE

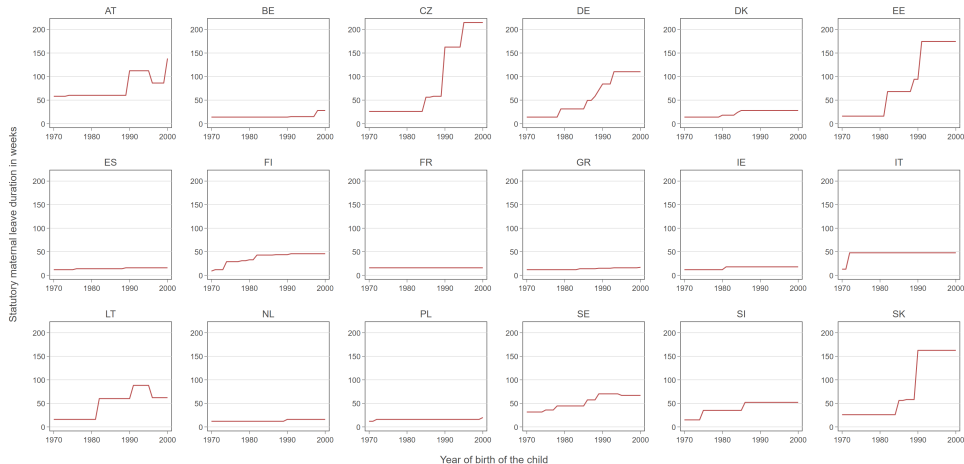


THE EUROPEAN PARENTING LEAVE POLICES (EPLP) DATASET

- 21 countries
- 1970-2024
- **Leave types:** Maternity, co-parent, paid parental, job-protected
- **33 variables:** partner leave, flexibility, incentives to share, (benefits) ...
- www.eplp-dataset.com

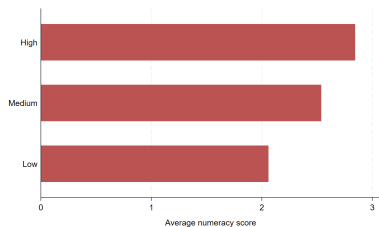


MAXIMUM STATUTORY MATERNAL LEAVE DURATION BY COUNTRY



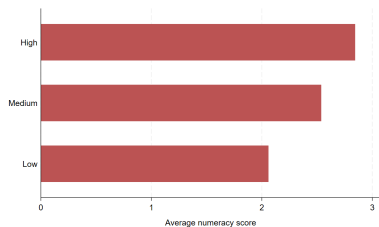
NUMERACY BY EDUCATIONAL ATTAINMENT AND OCCUPATION

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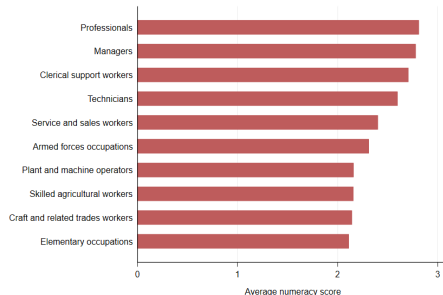


Numeracy score by educational attainment (ISCED)

NUMERACY BY EDUCATIONAL ATTAINMENT AND OCCUPATION



Numeracy score by educational attainment (ISCED)



Numeracy score by occupation (ISCO)

RESULTS

LONGER LEAVE REDUCES SKILLS, BUT ONLY MODESTLY

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Each additional year of statutory parenting leave reduces mothers' numeracy scores by 3% to 5%

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Pathways: Use it or lose it

- **Short run:** longer leave entitlements lengthen career breaks
- **Long run:** longer leave → less time in employment across the life course

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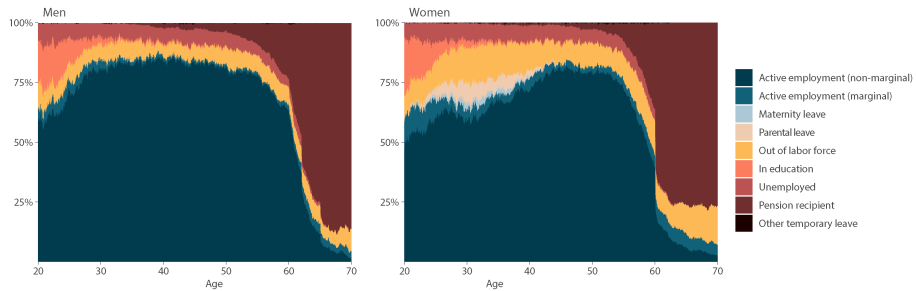
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- **Long run:** longer leave → less time in employment across the life course
- **Non-linearities:** shorter leave does not harm skills, whereas extended leave does

CONCLUSION

- Mothers' employment falls sharply after first birth, while fathers' trajectories remain stable
- **Gender trumps skills:** No skill differences
- Austria and Sweden show the same broad pattern (but different levels)
- **Longer leave is associated with modest skill losses:**
 - One additional year of statutory leave → 3–5% lower numeracy later in life
 - Channel: longer career breaks & less employment

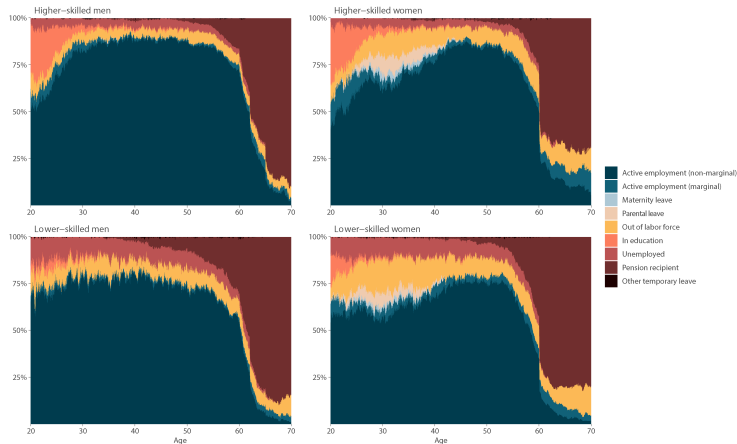
APPENDIX



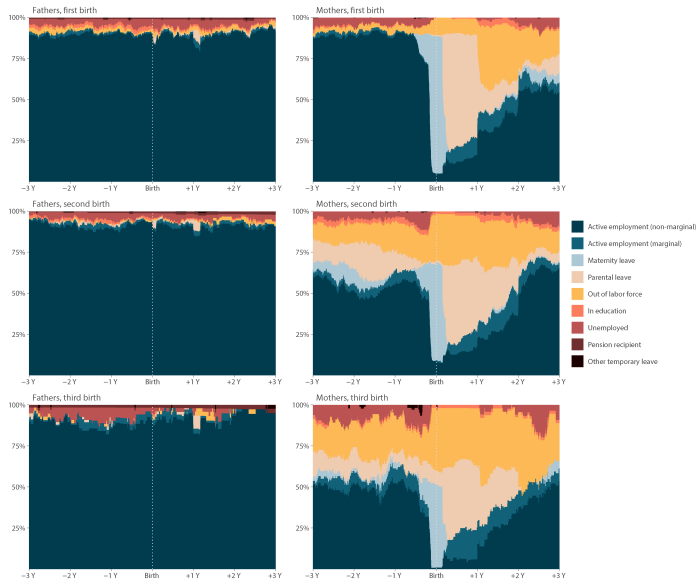
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GENDER -

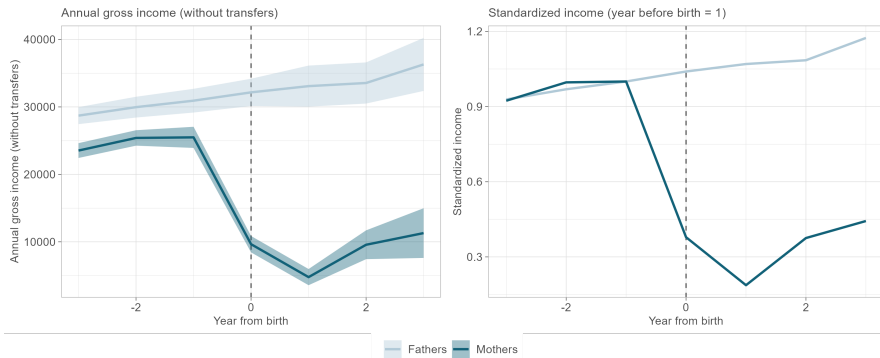
1C)



Source: This graph shows all PIAAC participants (higher-skilled men N = 1,541; higher-skilled women N = 1,247; lower-skilled men N = 936, lower-skilled women N = 1,300); skill level is defined based on PIAAC numeracy proficiency: lower-skilled comprises proficiency levels 0, 1, and 2 (≤ 276 points); higher-skilled comprises proficiency levels 3, 4, and 5 (> 276 points); PIAAC weights are applied. Source: PIAAC and Statistics Austria register-based labour market careers (Registerbasierte Erwerbsverläufe), 2010-2021.



GROSS INCOME WITHOUT TRANSFERS



SHARE SURVEY DATA FOR NUMERACY & LIFE COURSE ANALYSIS

- Survey of Health, Ageing, and Retirement in Europe (SHARE)
Waves 1-9

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- We include 18 European countries
Austria, Belgium, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Netherlands, Poland, Slovenia, Slovakia, Spain and Sweden

SAMPLE CONSTRUCTION & CHARACTERISTICS

- 30,276 children born between 1970 and 2009

[More descriptive statistics](#)

[Occupations](#)

[Statutory leave variables](#)

SAMPLE CONSTRUCTION & CHARACTERISTICS

- 30,276 children born between 1970 and 2009
- To 15,640 mothers
 - born between 1926 and 1967

Variable	Obs	Mean	Std. Dev.	Min	Max	Median
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Age at birth	30,276	27.809	5.357	15	49	27
Mother's year of birth	30,276			1926	1967	1954
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Number of children	30,276	2.655	1.264	1	14	2

More descriptive statistics

Occupations

Statutory leave variables

SAMPLE CONSTRUCTION & CHARACTERISTICS

- 30,276 children born between 1970 and 2009
- To 15,640 mothers
 - born between 1926 and 1967
 - age 50 to 91 at THE time of interview
 - who worked around childbirth
 - who gave birth in the survey country

Variable	Obs	Mean	Std. Dev.	Min	Max	Median
Age at interview	30,276	62.172	6.714	50	91	62
Age at birth	30,276	27.809	5.357	15	49	27
Mother's year of birth	30,276			1926	1967	1954
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[More descriptive statistics](#)[Occupations](#)[Statutory leave variables](#)

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[More descriptive statistics](#)[Occupations](#)[Statutory leave variables](#)

SAMPLE CONSTRUCTION & CHARACTERISTICS

- 30,276 children born between 1970 and 2009
- To 15,640 mothers
 - born between 1926 and 1967
 - age 50 to 91 at THE time of interview
 - who worked around childbirth
 - who gave birth in the survey country
- Mothers can be included several times (depending on their number of children)

Variable	Obs	Mean	Std. Dev.	Min	Max	Median
Age at interview	30,276	62.172	6.714	50	91	62
Age at birth	30,276	27.809	5.357	15	49	27
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More descriptive statistics

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EPLP DATA COLLECTION GUIDELINES

To maintain comparability and consistency, the following criteria apply

- **Parental leave duration**
→ Benefits unrelated to leave take-up are excluded
- **Employed parents only**
→ Policies directed at self-employed parents, unemployed parents, or parents in education are not considered
- **Country-level information**
→ Regional variations within countries are not considered
- **Individual perspective**
→ The dataset distinguishes between the leave available for each parent

EPLP DATA COLLECTION GUIDELINES

- **Widely applicable policies**

→ Special provisions for specific circumstances – such as caesarean sections, premature births, adoptive births, child disability, multiple births, or the death of a parent – are not considered.

- **First birth only**

→ Parental leave policies that differ by birth order are not considered

- **Legislative enactment and retrospective considerations**

→ Retrospective application is excluded

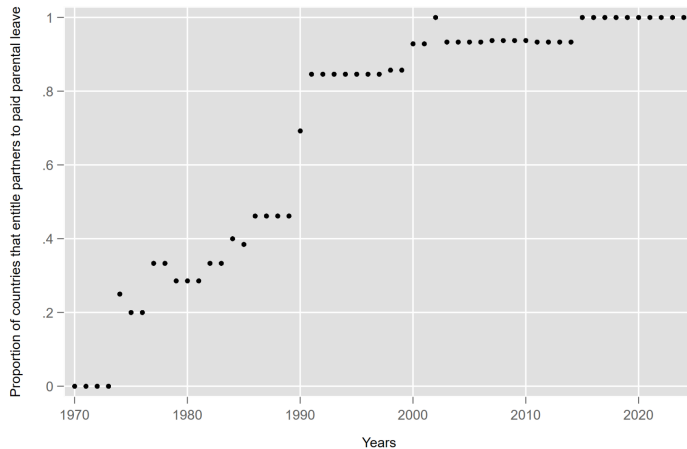
- **Statutory rights only**

→ Leave provisions that are contingent on the other parent waving their right to this leave or not being able to take their leave are excluded

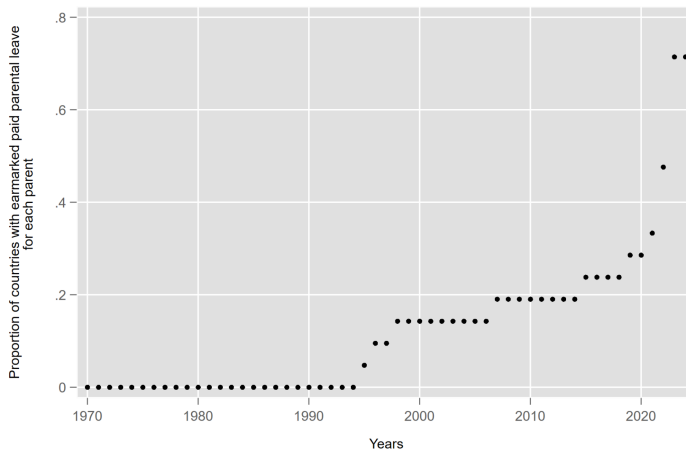
- **Currencies and benefit adjustments**

→ No adjustments for inflation or purchasing power parity are made

ENTITLEMENT OF PARTNERS TO PARENTAL LEAVE



EARMARKED PAID PARENTAL LEAVE



SUMMARY STATISTICS (ALL BIRTHS)

Variable	Obs	Mean	Std. Dev.	Min	Max	Median
Outcome						
Numeracy score	30,276	2.498	0.99	0	4	3
Statutory leave duration (weeks)						
Maximum available to mothers	30,276	37.017	35.612	9	214.714	26
Maximum maternity leave	30,276	16.374	5.214	6	43	16
Maximum parental leave	30,276	20.643	35.952	0	186.714	0
Statutory leave benefits						
Flat rate amount (current USD)	26,191	129.918	543.763	0	7172.655	0
Replacement rate level	30,076	0.174	0.354	0	1	0
Mother's characteristics						
Age at interview	30,276	62.172	6.714	50	91	62
Age at birth	30,276	27.809	5.357	15	49	27
Mother's year of birth	30,276			1926	1967	1954
Child's year of birth	30,276			1970	2009	1980
Number of children	30,276	2.655	1.264	1	14	2
> High school level (%)	30,276	0.279		0	1	0

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EXPLANATORY VARIABLE: STATUTORY MATERNAL LEAVE DURATION

The maximum paid leave duration that a mother can take in a given country at a given year

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- Eligibility: Employed parents

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The maximum paid leave duration that a mother can take in a given country at a given year

- **Maternity leave (before and after birth) + paid parental leave**
- Individual perspective: maximum available to ONE parent (mother)
- Eligibility: Employed parents
- Policy applicable to first child
- No special provisions for specific circumstances (premature birth, cesarean, multiple births, . . .)

STATUTORY LEAVE VARIABLES

Variable	Obs	Mean	Std. Dev.	Min	Max	Median
Parental leave scheme (%)	30,276	0.415		0	1	0
Non-null parental leave duration (weeks)	12,556	49.775	40.825	6	186.714	38.571
Flat rate (%)	12,556	0.552		0	1	1
Replacement rate (%)	12,556	0.527		0	1	1
Non-null flat rate amount (current USD)	2,840	1198.126	1203.059	13.544	7172.655	726.294
Non-null replacement rate level	6,415	0.818	0.251	0.3	1	0.9

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OCCUPATIONS

Occupation type	Skill level	Obs	% in sample
Armed forces occupations	Low	16	0.08
Managers	High	743	3.59
Professionals	High	4,799	23.17
Technicians	High	2,496	12.05
Clerical support workers	Low	3,189	15.40
Service and sales workers	Low	3,948	19.06
Skilled agricultural workers	Low	1,040	5.02
Craft and related trades workers	Low	1,669	8.06
Plant and machine operators	Low	809	3.91
Elementary occupations	Low	2,000	9.66

Classification between high and low: Pertold-Gebicka, 2020

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SUMMARY STATISTICS (FIRST BIRTH)

Variable	Obs	Mean	Std. Dev.	Min	Max	Median
Outcome						
Numeracy score	12,257	2.546	0.972	0	4	3
Statutory leave duration (weeks)						
Maximum available to mothers	12,257	34.496	33.315	9	214.714	18
Maximum maternity leave	12,257	16.331	5.118	6	43	16
Maximum parental leave	12,257	18.165	33.874	0	186.714	0
Statutory leave benefits						
Flat rate amount (current USD)	10,832	113.508	503.236	0	7172.655	0
Replacement rate level	12,156	0.161	0.342	0	1	0
Mother's characteristics						
Age at interview	12,257	61.079	6.003	50	88	61
Age at birth	12,257	25.296	4.781	15	49	24
Mother's year of birth	12,257		6.074	1929	1967	1954
Child's year of birth	12,257		6.719	1970	2008	1979
Number of children	12,257	2.129	0.955	1	13	2
> High school level (%)	12,257	0.293		0	1	0

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MECHANISMS: INDIVIDUAL LEAVE DURATION (ILD)

Measuring career breaks: ILD is derived from the question: *"How long did you stop working for?"*

- Captures the actual length of a mother's career break (not just formal leave).
- Response categories:
 - Less than a month
 - 1–3 months
 - 3–6 months
 - 6–12 months
 - 1–3 years
 - More than 3 years (returned later)
- For breaks 1 year: mothers report the year they returned to work
- All values are transformed into a continuous measure:
 - Midpoints used for shorter categories (e.g., 4.5 months for "3–6 months")
 - Responses converted weeks

ESTIMATED 2-WAY-FIXED-EFFECT MODEL

$$Skills_m = \alpha_0 + \alpha_1 SLD_{c,k} + \alpha_2 X_{c,m} + \alpha_3 W_{c,k} + \sum_{t=1970}^{2009} \alpha_t Cohort_t + \sum_{k=1}^{18} \alpha_k Country_k + \mu_{c,m,k,t}$$

- $SLD_{c,k}$: statutory leave duration in country k in the year that child c was born (in weeks)
- $X_{c,m}$: vector of control variables at the mother's level (mother's age at birth)
- $W_{c,k}$: vector of control variables at the country-year level (benefits)
- $Skills_m$: skill score of mother m
- $Cohort_t$ and $Country_k$: birth cohort of mother m and country of birth of child c

Standard errors are corrected for clustering at the mother's level

ROBUSTNESS ANALYSES

- **Additional covariates**

Controls

- Age at interview
- Number of children
- Country-specific birth cohort linear trend
- Interacted flat and replacement rates

- **Other checks**

- Leave out each country
- Reweighting countries
- First vs. last numeracy score

ROBUSTNESS ANALYSES

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- Age at interview
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- **Other checks**

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Falsification & placebo tests

Falsification tests

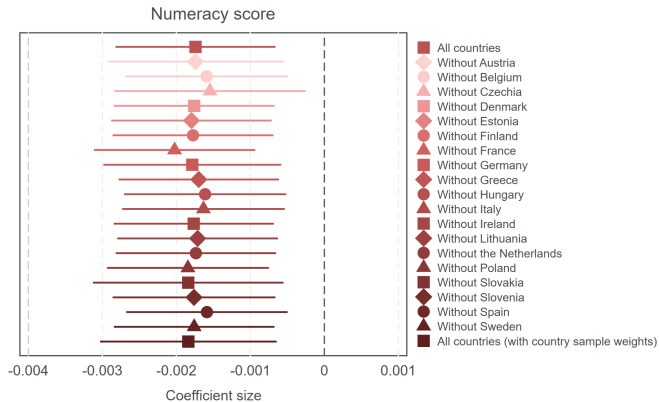
- Mothers not employed around the time of birth
- Alternative outcomes: proxies of skills in childhood

ROBUSTNESS CHECKS

	Numeracy score				
	(1)	(2)	(3)	(4)	(5)
SLD in weeks	-0.0017*** (0.0006)	-0.0015*** (0.0005)	-0.0019*** (0.0006)	-0.0017*** (0.0006)	-0.0017*** (0.0006)
Baseline covariates					
Country dummies	Yes	Yes	Yes	Yes	Yes
Mother's birth cohort dummies	Yes	Yes	Yes	Yes	Yes
Mother's age at birth	Yes	Yes	Yes	Yes	Yes
Benefits	Yes	Yes	Yes	Yes	Yes
Additional covariates					
Mother's age at interview	Yes	No	No	No	No
Number of children	No	Yes	No	No	No
Country-specific cohort linear trends	No	No	Yes	No	No
Interacted benefits	No	No	No	Yes	No
Alternative outcome					
Last observed numeracy score as outcome	No	No	No	No	Yes
Outcome mean	2.4883	2.4883	2.4883	2.4883	2.4985
Coefficient size for SLD in years	3.5%	3.1%	3.9%	3.9%	3.6%
N	25,991	25,991	25,991	25,991	2.4985

Notes: Columns 1 to 4 report results including one additional covariate at a time. Column 5 shows results taking the last observed numeracy score as an outcome instead of the first observation. Standard errors corrected for individual clustering in parentheses. *

ROBUSTNESS CHECKS



FALSIFICATION TESTS

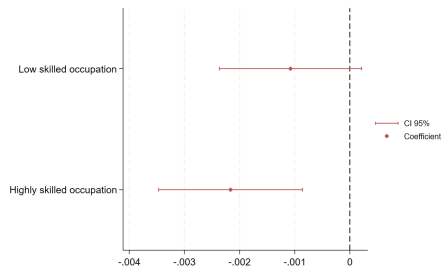
	Numeracy score	Pre-birth skill proxy	
		Mother rates her numeracy skills at least equal to her peers'	Mother rates her literacy skills at least equal to her peers'
		when aged 10	when aged 10
SLD in weeks	-0.0020 (0.0022)	0.0002 (0.0005)	0.0005 (0.0005)
Covariates			
Country dummies	Yes	Yes	Yes
Mother's birth cohort dummies	Yes	Yes	Yes
Mother's age at birth	Yes	Yes	Yes
Benefits	Yes	Yes	Yes
Placebo sample			
Non-working mothers at time of birth	Yes	No	No
Outcome mean	2.0512	2.6871	2.4877
N	6,255	21,700	21,706

Notes: Standard errors corrected for individual clustering in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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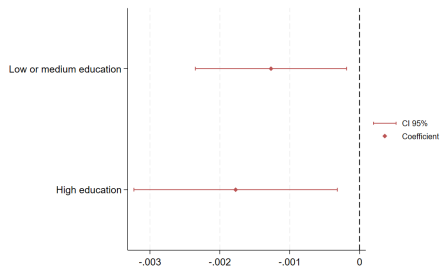
HETEROGENEITIES

HETEROGENEITY BY OCCUPATION TYPE



- **Highly skilled job:** ISCO 1-3 (Skill level 3 or 4)
Professionals, Managers, Technicians
N= 11,722
Average numeracy score= 2.643
- **Low skilled job:** ISCO 4-9 and 0 (Skill level 1 or 2)
Other occupations
N= 12,655
Average numeracy score= 2.364

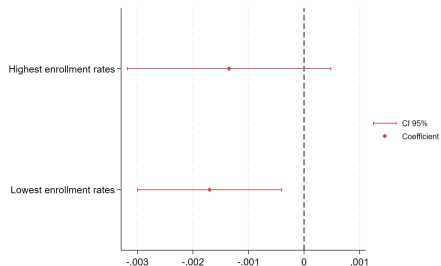
HETEROGENEITY BY EDUCATION LEVEL



- Low or medium education
≤ High school degree
N= 21,823
Average numeracy score= 2.365
- High education
> High school degree
N= 8,453
Average numeracy score= 2.840

HETEROGENEITY BY CHILDCARE ENROLLMENT RATE

Enrollment rates in early childhood education and care services in 2022, 0- to 2-year-olds (OECD 2024)



- **Highest enrollment rates:**

BE, DE, DK, ES, FI, FR, NL, SI, SE

N= 14,649

Average numeracy score= 2.510

- **Lowest enrollment rates:**

AT, CZ, EE, GR, IE, IT, LT, PL, SK

N= 14,155

Average numeracy score= 2.481

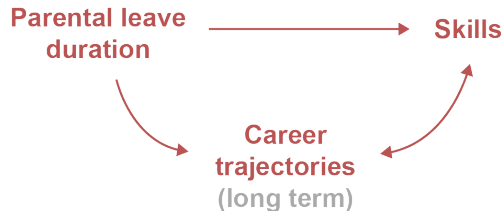
MECHANISMS

SHORT- AND LONG-TERM MECHANISMS (FIRST BIRTH ONLY)

- Leave take-up: Statutory leave duration (SLD) vs. Individual leave duration (ILD)
- Fertility, following the first birth
- Career trajectories after the first birth

SHORT- AND LONG-TERM MECHANISMS (FIRST BIRTH ONLY)

- Leave take-up: Statutory leave duration (SLD) vs. Individual leave duration (ILD)
- Fertility, following the first birth
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STATUTORY LEAVE DURATION AND INDIVIDUAL LEAVE DURATION

	Individual leave duration in weeks
SLD in weeks	0.7663*** (0.1932)
Country dummies	yes
Child's birth cohort dummies	yes
Age at birth	yes
Benefits	yes
N	10,113

Note: Leave durations in weeks. Standard errors corrected for individual clustering in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

STATUTORY LEAVE DURATION AND INDIVIDUAL LEAVE DURATION

SLD in weeks	Individual leave duration in weeks
	0.7663*** (0.1932)
Country dummies	yes
Child's birth cohort dummies	yes
Age at birth	yes
Benefits	yes
N	10,113

Note: Leave durations in weeks. Standard errors corrected for individual clustering in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Compliers are more likely

- from younger cohorts
- < 30 years old
- higher educated

FERTILITY FOLLOWING THE FIRST BIRTH

	Number of children	Number of children	Number of children
	OLS	Poisson	Negative binomial
SLD in weeks	0.0001 (0.0008)	-0.0002 (0.0004)	-0.0001 (0.0004)
Country dummies	yes	yes	yes
Child's birth cohort dummies	yes	yes	yes
Age at birth	yes	yes	yes
Benefits	yes	yes	yes
N	10,731	10,731	10,731

Applies to employment after the first birth. Standard errors corrected for individual clustering in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

PATHWAYS

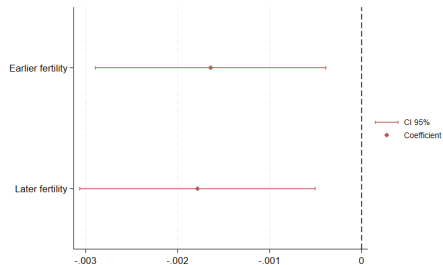
Mechanisms

	Duration of leave take-up		Fertility	Career trajectories				
	Individual leave duration (in weeks)	Individual leave duration (in years)	Number of children	Employment (in years)	Unemployment (in years)	Home-making (in years)	Share of part-time employment	Shift to lower skilled job (binary)
SLD (in weeks)	0.6503*** (0.1757)	0.0125*** (0.0034)	0.0004 (0.0008)	-0.0308*** (0.0060)	-0.0002 (0.0027)	0.0157*** (0.0045)	-0.0000 (0.0003)	-0.0002 (0.0002)
Covariates								
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother's birth cohort dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother's age at birth	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Benefits	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample selection								
First birth only	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Outcome mean	89.3904	1.7125	2.1264	28.9811	0.5767	2.3501	0.1904	0.0743
Result for +1 SLD year	+34 weeks	+34 weeks	X	-84 weeks	X	+43 weeks	X	X
N	9,963	9,963	9,963	9,963	9,963	9,963	9,963	9,963

Applies to trajectories after the first birth. Standard errors corrected for individual clustering in parentheses

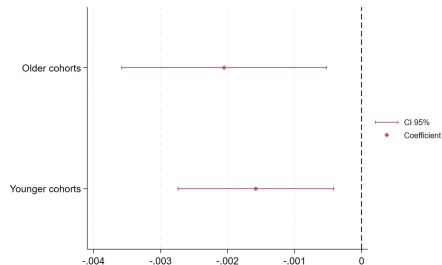
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

HETEROGENEITY BY AGE AT FIRST BIRTH



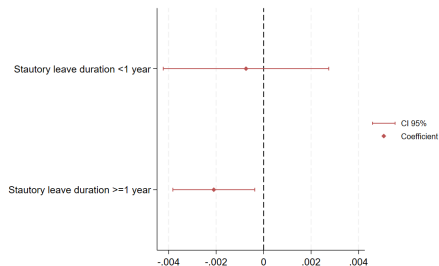
- Early fertility
15-24 years old
N= 14,006
Average numeracy score= 2.439
- Late fertility
25-49 years old
N=11,624
Average numeracy score= 2.647

HETEROGENEITY BY MOTHER'S BIRTH COHORT



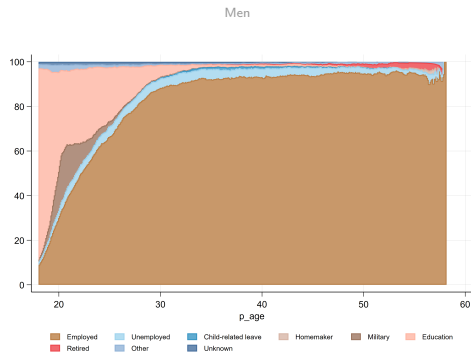
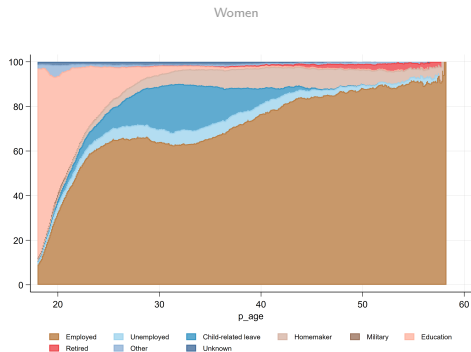
- Oldest cohorts
1926-1954
N= 16,833
Average numeracy score= 2.466
- Youngest cohorts
1955-1967
N= 13,443
Average numeracy score= 2.538

HETEROGENEITY BY STATUTORY LEAVE LENGTH

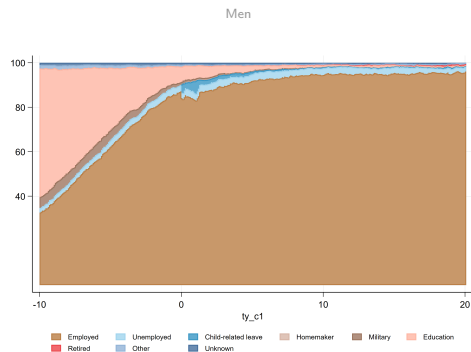
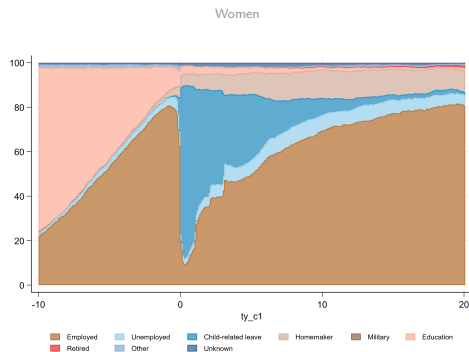


- Statutory leave duration ≤ 1 year
N= 23,496
Average numeracy score= 2.462
- Statutory leave duration ≥ 1 year
N= 6,780
Average numeracy score= 2.624

The life course according to the German National Educational Panel Study



Employment in the years around the first birth according to German National Educational Panel Study



NEPS: NUMERACY SKILLS

Sample Item 4: Nebenwirkung

Ein Pharmazie-Unternehmen hat ein neues Mittel gegen Kopfschmerzen entwickelt. In einer Studie wurden zwei häufige Nebenwirkungen entdeckt: Juckreiz und Übelkeit. In der folgenden Tabelle ist die Anzahl der Versuchspersonen angegeben.

		Übelkeit	
		Ja	Nein
Juckreiz	Ja	50	70
	Nein	40	100

Aufgabe 1:

Sind die folgenden Aussagen über das Ergebnis der Studie korrekt?

Bitte kreuzen Sie in jeder Zeile die richtige Antwort an!

	Ja	Nein
Bei der Hälfte der teilnehmenden Personen trat zumindest eine Nebenwirkung auf, denn 50 ist die Hälfte von 100.	☐	☐
Übelkeit trat seltener auf als Juckreiz, denn 50+40 ist kleiner als 50+70.	☐	☐
Bei etwa 53% der teilnehmenden Personen wurde mindestens eine Nebenwirkung beobachtet, denn $(50+40+70)/3 \approx 53\%$.	☐	☐
Bei mehr als die Hälfte der teilnehmenden Personen, bei denen Übelkeit auftrat, wurde auch Juckreiz festgestellt, denn $50/90 > 50\%$.	☐	☐

NEPS DATA STRUCTURE: TEST PAIRS

	t₁	t₂
Mathematical skills	2010/11	2016/17
Reading skills	2010/11	2016/17
	2012/13	2016/17
ICT skills	2012/13	2021/22
Scientific skills	2012/13	2021/22

NEPS: SUMMARY STATISTICS

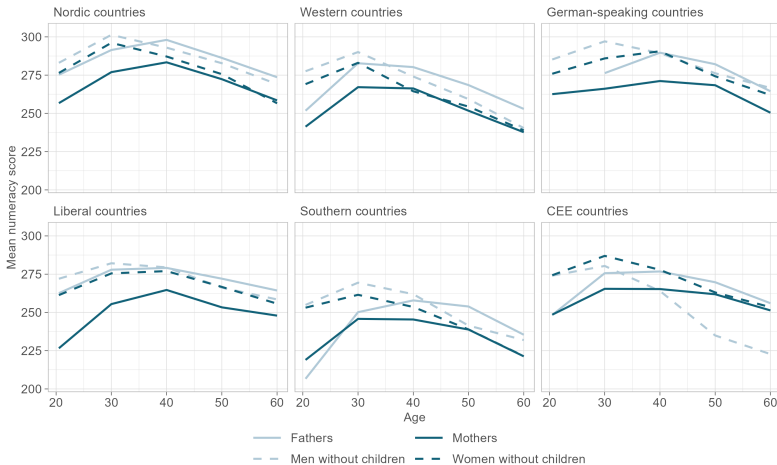
Variable	Obs	Mean	Std. Dev.	Min	Max	P50
Skills t1	538	.164	1.293	-3.024	4.36	.04
Skills t2	538	.179	1.08	-2.797	3.74	.065
Leave duration (in months)	538	12.758	12.36	0	67	11
Age at first birth	538	28.032	4.445	18.667	42.083	27.25
Age at t1	538	26.876	5.903	19	42.167	25.583
Age at t2	538	32.592	5.691	25.083	47.75	31.333
Low education	538	.022	.148	0	1	0
Medium education	538	.636	.482	0	1	1
High education	538	.342	.475	0	1	0
Number of children	538	1.959	.744	1	3	2
No birth between t1 and t2	538	.524	.5	0	1	1
1st birth between t1 and t2	538	.322	.468	0	1	0
2nd birth between t1 and t2	538	.154	.362	0	1	0
Migration background (yes/no)	538	.082	.274	0	1	0
SC5 (yes/no)	538	.53	.5	0	1	1
Survey year t1	538	2010.989	.601	2010	2013	2011
Survey year t2	538	2016.574	.495	2016	2017	2017

LEAVE DURATION AND SKILL CHANGES IN NEPS

	Δ Numeracy Skills	Δ Literacy Skills
Leave duration	0.029** (0.014)	0.010 (0.015)
Leave duration $\times$ Leave duration	-0.000 (0.000)	-0.000 (0.000)
Additional controls	Yes	Yes
Mean Y	-0.08	0.04
N	238	300

Note: The table reports results from an OLS regression of the difference in skills between t2 and t1 on leave duration. Control variables include skill level at t1, age at t1, birth cohort of the mother, number of children, employment or education status at t1, survey cohort, and the time between t1 and t2. Weights are applied; standard errors are clustered at the individual level and reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

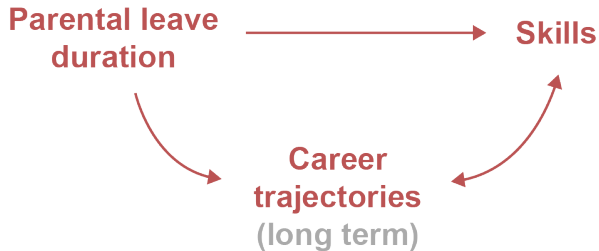
SKILL LEVELS OF PARENTS IN DIFFERENT EUROPEAN REGIONS



Source: Authors' calculations based on PIAAC data

THE SHORT RUN

COGNITIVE SKILLS ALONG THE LIFE COURSE



German National Educational Panel Study (NEPS)

Ongoing multi-cohort longitudinal survey on competence development over the life course

German National Educational Panel Study (NEPS)

Ongoing multi-cohort longitudinal survey on competence development over the life course

- Comparable with PIAAC (Carstensen et al. 2017, Lechner et al. 2021)
- Representative sample (in theory...)
- Tested skills (numeracy, literacy, ICT, scientific skills, ...)
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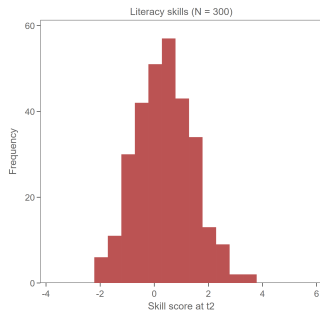
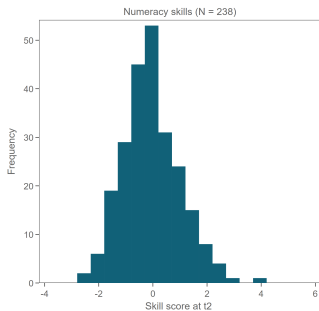
Ongoing multi-cohort longitudinal survey on competence development over the life course

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- were on leave no longer than 7 years
- were tested no later than 7 years after giving birth (t_2)

NUMERACY AND LITERACY IN NEPS



SIMPLE EQUATION

The change in skill scores between t_1 and t_2 : $\Delta\text{Skills} = \text{Skill score at } t_2 - \text{Skill score at } t_1$

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Control variables in X_i :

- Age at t_1
- Birth cohort (of parent)
- Employment status at t_1 (employed vs. in education)
- The number of children
- Survey cohort
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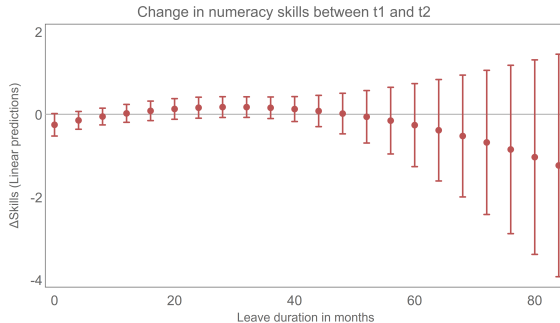
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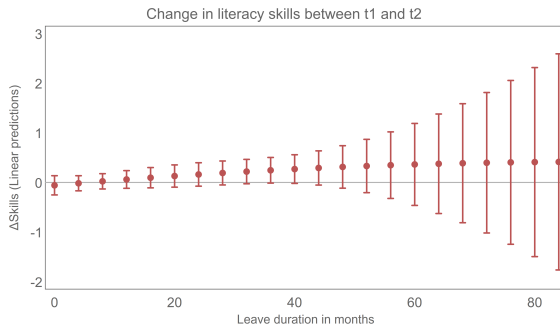
Control variables in robustness checks: migration status (born outside of Germany yes/no) and $\Delta\text{Education}_i$

CHANGE IN NUMERACY SKILLS BY LEAVE DURATION



Note: This figure displays predicted changes in numeracy skills between t1 and t2 by leave duration, based on an OLS regression of the difference in skills between t2 and t1 on leave duration (in months) and its square. The regression includes control variables for skill level at t1, age at t1, birth cohort of the mother, number of children, employment vs. education at t1, survey cohort, and the time between t1 and t2. The measurement at t2 occurs at most five years after childbirth. $N = 221$; Weights are applied; standard errors are clustered at the individual level. Vertical lines indicate 95% confidence intervals.

CHANGE IN LITERACY SKILLS BY LEAVE DURATION



Note: This figure displays predicted changes in literacy skills between t1 and t2 by leave duration, based on an OLS regression of the difference in skills between t2 and t1 on leave duration (in months) and its square. The regression includes control variables for skill level at t1, age at t1, birth cohort of the mother, number of children, employment vs. education at t1, survey cohort, and the time between t1 and t2. The measurement at t2 occurs at most five years after childbirth. $N = 282$; Weights are applied; standard errors are clustered at the individual level. Vertical lines indicate 95% confidence intervals.

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- **Parental leave:** extended time spent caregiving and adjusting to new responsibilities – shape or reinforce traits?
- **“Big Five” personality traits** (measured on a scale from 1 to 5)
 - Extraversion
 - Agreeableness
 - Conscientiousness
 - Neuroticism
 - Openness

NON-COGNITIVE SKILLS

	"Big 5" personality traits				
	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness
SLD in weeks	-0.0014 (0.0017)	-0.0015 (0.0017)	-0.0005 (0.0017)	0.0005 (0.0021)	0.0035** (0.0017)
Country dummies	yes	yes	yes	yes	yes
Child's birth cohort dummies	yes	yes	yes	yes	yes
Age at birth	yes	yes	yes	yes	yes
Benefits	yes	yes	yes	yes	yes
Outcome mean	3.424	3.661	4.039	2.654	3.4082
Coefficient size	X	X	X	X	5.4%
N	2,875	2,875	2,875	2,875	2,875

Standard errors corrected for individual clustering in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$