

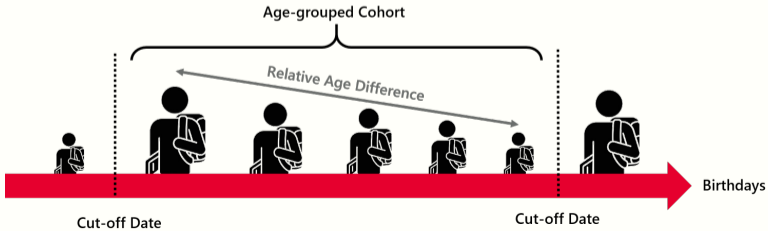
Disadvantaged by Chance? Cut-off Dates for School Enrolment and Their Consequences for Educational Outcomes

ECER 2023 - 28 SES 03 B: *Educational Inequalities from the Multi-level, Intersectional and Life-course Perspectives*

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Relative Age Effects...



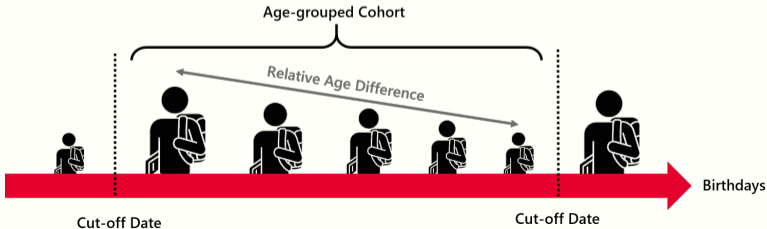
Relative Age Effects...

- ▶ ...refer to differential outcomes resulting from age differences within annual age-grouped cohorts.

Bedard and Dhuey (2006); Baker et al. (2010)

- ▶ ...can be attributed to initial age differences within a cohort that interact with social mechanisms over time.

Hancock et al. (2013); Dhuey et al. (2019)

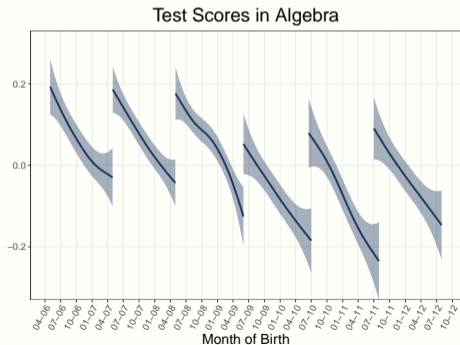
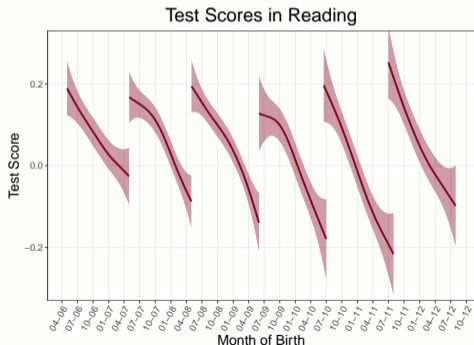


Point of Departure

- Pupils with a relative age advantage outperform their younger peers.

e.g. Bedard and Dhuey (2006); Sprietsma (2010); Peña (2017); Mavilidi et al. (2022)

Relative Age Effect on Test Scores in Third Grade



Generalised Additive Models of Test Scores (WLE) by Birth Cohort with 95% Confidence Intervals. Data: Checks BR NWCH (2015–2020), N = 41'262. Own Calculations.

Previous Research

- ▶ Relative age effects on performance in school prove robust over subjects, education systems, and analytical approaches.

e.g. Smith (2009); Nam (2014); Peña (2017); Thoren et al. (2016)

- ▶ Relatively older pupils are more likely to enter academic rather than vocational programmes at the secondary level.

e.g. Mühlenweg and Puhani (2010); Schneeweis and Zweimüller (2014); Ponzio and Scoppa (2014)

- ▶ Pupils with a relative age disadvantage are more likely to repeat a grade.

e.g. Dicks and Lancee (2018); Jerrim et al. (2022)

- ▶ Relatively younger students are over-referred to special educational needs services and have fewer friends in school.

e.g. Dhuey and Lipscomb (2010); Fumarco and Baert (2019)

Contentious Persistence of RAE in Education

- ▶ RAE still present in secondary education, although smaller effects are found.

e.g. Bedard and Dhuey (2006); Smith (2009); Ponzio and Scoppa (2014)

- ▶ Studies report wage penalties and higher risk of unemployment for individuals that entered school relatively young.

e.g. Schneeweis and Zweimüller (2014); Peña (2017); Solli (2017)

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- ▶ RAE consistently diminish in size and vanish by the end of compulsory education.

e.g. Thoren et al. (2016); Hessen Bjerke et al. (2022); Mavilidi et al. (2022)

- ▶ RAE has no implications for labour market outcomes.

e.g. Dobkin and Ferreira (2010); Nam (2014); Pehkonen et al. (2015)

Research Question

- ▶ **How do relative age effects evolve over different stages in pupils' educational pathways?**
- ▶ **If relative age effects vanish over time, when?**

Setting and Data

The Swiss Case

- ▶ Early tracking, highly stratified, and marked differences in learning outcomes at the end of compulsory schooling
- ▶ Educational System:
 - Kindergarten: 2 years
 - Primary Education: Grades 1-6
 - Lower Secondary Education: Grades 7-9, Tracked
 - Upper Secondary Education

Test Score Data

- ▶ Checks BR NWCH
 - Entire student population of Northwestern Switzerland
 - Mandatory tests in 3rd, 5th, 6th, 8th and 9th grade
- ▶ Standardised test scores in reading, writing and algebra (WLE)
- ▶ Linkage to administrative records for pupil characteristics

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Analytical Approaches

Regression Discontinuity Design (RDD)

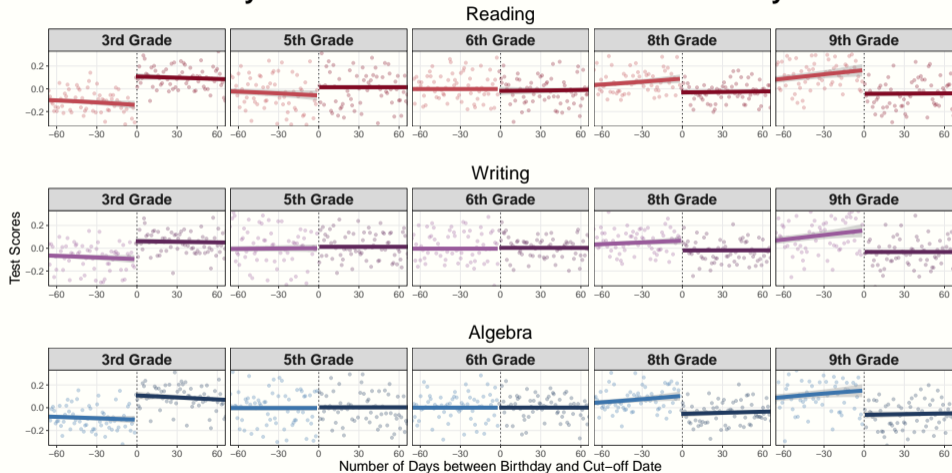
- ▶ Compare pupils born right before and after the cut-off dates (± 60 days)
- ▶ Discontinuity in test scores can be attributed to differences in relative age
- ▶ Problem: early/late school entry and grade skipping/retention
- ▶ Solution: restrict observations to linear school trajectories

Instrumental Variable Approach (IV)

- ▶ Assigned relative age as an instrument for observed age
- ▶ Sufficient correlation between observed and assigned age
- ▶ Exogeneity of the instrument (Season of Birth Effects & joint F-Tests)
- ▶ Potential violation of monotonicity assumption: overestimation

Results: RDD (I)

Discontinuity in Test Scores around the Cut-off Date by Grade



Results: RDD (II)

	3rd Grade	5th Grade	6th Grade	8th Grade	9th Grade
Reading	0.312 *** (0.035)	0.142 ** (0.046)	0.055 (0.040)	-0.053 (0.037)	-0.107 (0.055)
Observations	11569	5771	8296	9809	4516
R2	0.169	0.192	0.133	0.117	0.083
Writing	0.203 *** (0.037)	0.074 (0.047)	0.116 ** (0.039)	0.078 * (0.032)	-0.049 (0.050)
Observations	10246	5732	8275	11020	4544
R2	0.139	0.171	0.156	0.135	0.122
Algebra	0.228 *** (0.036)	0.108 * (0.049)	0.066 (0.039)	-0.089 * (0.036)	-0.124 * (0.055)
Observations	11580	5771	8278	9818	4536
R2	0.106	0.123	0.096	0.102	0.067

Notes: * $p < 0.05$, ** $p < 0.01$; *** $p < 0.001$. OLS coefficients for being born up to 60 days after cut-off.

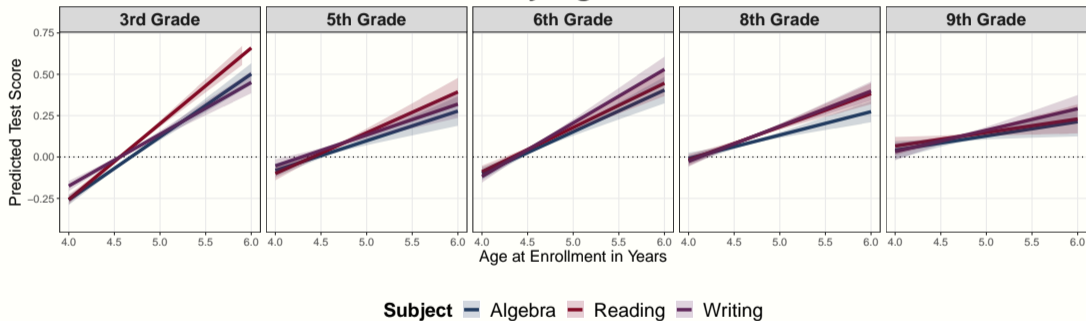
Robust SE in parentheses. Models control for sex, migration background, parental income, single-parent household, living area per capita and canton (not shown).

Models allow for separate slopes of the running variable before and after cut-off.

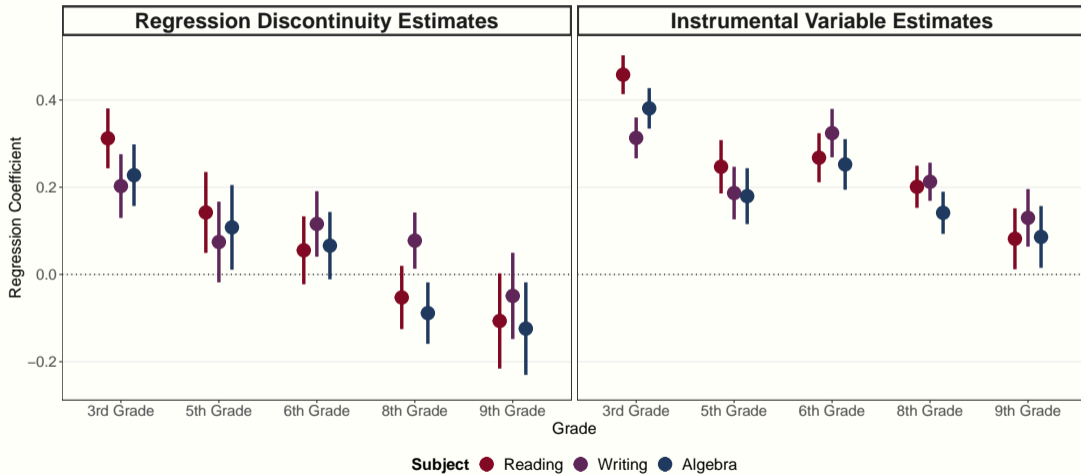
Models are robust over different bandwidths, non-parametric estimation, matched samples and subgroups.

Results: IV

Predicted Test Scores by Age at Enrolment and Grade



Comparison of the Results



Limitations & Conclusions

► **Limitations**

- No information on early/late enrollment or grade skipping/retention
- The data does not (yet) allow creating a panel structure
- Violated monotonicity assumption (IV) vs. restricted sample (RD)
- Epistemological problem (relative age vs. age at enrolment vs. age at test)

► **Conclusions**

- The two complementary approaches draw a nuanced picture of RAE
- RAE diminish over the course of compulsory schooling
- RAE are likely in play when pupils enter tracked secondary education
- Institutional features might compel relatively young students to repeat a grade

Thank you for your attention!

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For more information on the PIONEERED project, see www.pioneered-project.eu.

Overview of Analytical Samples

	Number of observations in the original Checks data (2015-2020)	Number of observations without duplicates and observations with missing birth dates	Number of observations without missing enrolment dates that entered school +/- 1 year around the eligibility window	Number of observations with no missing information on all covariates (IV samples)	Number of observations born +/- 60 days around the cut-off date with linear school careers (RD samples)
3rd Grade	77,006	72,210	50,804	45,495	11,639
5th Grade	27,258	26,964	26,644	23,475	5,858
6th Grade	46,274	42,266	39,943	33,575	8,364
8th Grade	69,057	68,361	60,767	48,934	11,135
9th Grade	33,816	33,538	27,151	21,278	4,585

Record Linkage

Source:	Checks	STATPOP	STATPOP Parent	GWS	ZAS Parent
Years:	2015	2015	2015	2015	2011 – 2015
	2016	2016	2016	2016	2012 – 2016
	2017	2017	2017	2017	2013 – 2017
	2018	2018	2018	2018	2014 – 2018
	2019	2019	2019	2019	2015 – 2019
	2020	2020	2020	2020	2016 – 2020
Variable:	Canton	Day of Birth			
	Year	Sex			
	Grade	State of birth	State of Birth	Living Area	Income
	Language at Home	Type of Household Persons in Household			
Link ID:	Pseudo ID	Pseudo ID			
		ID Mother	ID Mother	Building ID	ID Mother
		ID Father	ID Father	Dwelling ID	ID Father
		Building ID Dwelling ID			

Results: IV

		3rd Grade	5th Grade	6th Grade	8th Grade	9th Grade
Reading	Age at Enrolment	0.458 *** (0.023)	0.247 *** (0.031)	0.268 *** (0.029)	0.201 *** (0.025)	0.082 * (0.036)
	Observations	45110	23039	33215	42628	20956
	R2	0.124	0.164	0.112	0.094	0.092
Writing	Age at Enrolment	0.313 *** (0.024)	0.187 *** (0.031)	0.324 *** (0.028)	0.213 *** (0.022)	0.130 *** (0.034)
	Observations	39729	22850	33109	48386	21060
	R2	0.116	0.168	0.119	0.107	0.106
Algebra	Age at Enrolment	0.381 *** (0.024)	0.180 *** (0.033)	0.252 *** (0.030)	0.141 *** (0.025)	0.086 * (0.036)
	Observations	45131	23039	33155	42666	21020
	R2	0.061	0.090	0.058	0.079	0.068

Notes: * $p < 0.05$, ** $p < 0.01$; *** $p < 0.001$. Reduced form estimates from 2SLS regressions with robust SE in parentheses. The models report the results from IV regression where assigned age was used as an instrument for the observed age. Controls not shown.

Results: IV (Test Scores in Reading)

	3rd Grade	5th Grade	6th Grade	8th Grade	9th Grade
Intercept	-2.376 *** (0.109)	-1.384 *** (0.150)	-1.516 *** (0.139)	-1.181 *** (0.121)	-0.452 ** (0.175)
Age at Enrolment (in years)	0.458 *** (0.023)	0.247 *** (0.031)	0.268 *** (0.029)	0.201 *** (0.025)	0.082 * (0.036)
Sex – ref. = Female					
Male	-0.135 *** (0.009)	-0.101 *** (0.012)	-0.186 *** (0.010)	-0.193 *** (0.009)	-0.256 *** (0.013)
Migration Background - ref. = Native					
Second Generation	-0.068 * (0.030)	0.039 (0.035)	-0.014 (0.030)	-0.004 (0.024)	-0.003 (0.035)
First Generation	0.056 ** (0.019)	0.125 *** (0.022)	0.101 *** (0.019)	0.092 *** (0.016)	0.077 ** (0.024)
Language spoken at home – ref. = German					
Foreign Language	-0.493 *** (0.013)	-0.532 *** (0.018)	-0.420 *** (0.016)	-0.386 *** (0.015)	-0.366 *** (0.023)
Mean Income Decile	0.071 *** (0.002)	0.079 *** (0.002)	0.078 *** (0.002)	0.077 *** (0.002)	0.060 *** (0.003)
Household Composition: ref. = Both Parents					
Single Parent	-0.148 *** (0.015)	-0.135 *** (0.019)	-0.143 *** (0.016)	-0.125 *** (0.014)	-0.099 *** (0.022)
Area per Capita	0.005 *** (0.000)	0.004 *** (0.000)	0.004 *** (0.000)	0.004 *** (0.000)	0.003 *** (0.000)
Observations	45110	23039	33215	42628	20956
R2 Adjusted	0.124	0.164	0.112	0.094	0.092
AIC	121879.9	60713.6	89038.4	114808.8	56577.3

Results: IV (Test Scores in Algebra)

	3rd Grade	5th Grade	6th Grade	8th Grade	9th Grade
Intercept	-2.147 *** (0.114)	-1.203 *** (0.157)	-1.579 *** (0.143)	-1.025 *** (0.121)	-0.694 *** (0.178)
Age at Enrolment (in years)	0.381 *** (0.024)	0.180 *** (0.033)	0.252 *** (0.030)	0.141 *** (0.025)	0.086 * (0.036)
Sex – ref. = Female					
Male	0.203 *** (0.009)	0.121 *** (0.013)	0.134 *** (0.011)	0.028 ** (0.009)	0.037 ** (0.013)
Migration Background - ref. = Native					
Second Generation	0.039 (0.032)	0.117 ** (0.036)	0.025 (0.030)	0.069 ** (0.023)	0.048 (0.035)
First Generation	0.013 (0.020)	0.091 *** (0.023)	0.027 (0.020)	0.061 *** (0.016)	0.073 ** (0.025)
Language spoken at home – ref. = German					
Foreign Language	-0.216 *** (0.013)	-0.238 *** (0.018)	-0.209 *** (0.016)	-0.245 *** (0.015)	-0.251 *** (0.024)
Mean Income Decile	0.075 *** (0.002)	0.082 *** (0.003)	0.074 *** (0.002)	0.084 *** (0.002)	0.070 *** (0.003)
Household Composition: ref. = Both Parents					
Single Parent	-0.211 *** (0.015)	-0.169 *** (0.020)	-0.206 *** (0.016)	-0.204 *** (0.014)	-0.214 *** (0.022)
Area per Capita	0.003 *** (0.000)	0.003 *** (0.001)	0.004 *** (0.000)	0.003 *** (0.000)	0.003 *** (0.000)
Observations	45110	23039	33215	42628	20956
R2 Adjusted	0.124	0.164	0.112	0.094	0.092
AIC	121879.9	60713.6	89038.4	114808.8	56577.3

Subgroup Analyses for Reading (IV)

		Females	Males	German	Foreign Language	Lower Income	Upper Income
3rd Grade	Age at Enrolment	0.461 *** (0.031)	0.453 *** (0.033)	0.523 *** (0.028)	0.318 *** (0.037)	0.401 *** (0.032)	0.513 *** (0.032)
	Observations	22103	23007	30932	14178	22494	22616
	R2	0.141	0.105	0.009	0.052	0.083	0.024
5th Grade	Age at Enrolment	0.260 *** (0.042)	0.232 *** (0.045)	0.303 *** (0.039)	0.134 ** (0.050)	0.190 *** (0.042)	0.286 *** (0.045)
	Observations	11336	11703	15579	7460	11330	11709
	R2	0.170	0.158	0.018	0.083	0.124	0.029
6th Grade	Age at Enrolment	0.250 *** (0.039)	0.287 *** (0.042)	0.282 *** (0.035)	0.236 *** (0.050)	0.213 *** (0.040)	0.318 *** (0.042)
	Observations	16324	16891	23917	9298	16335	16880
	R2	0.123	0.090	0.016	0.048	0.071	0.005
8th Grade	Age at Enrolment	0.170 *** (0.033)	0.232 *** (0.037)	0.215 *** (0.028)	0.149 ** (0.048)	0.204 *** (0.035)	0.195 *** (0.035)
	Observations	20905	21723	33775	8853	20981	21647
	R2	0.106	0.069	0.024	0.064	0.044	0.005
9th Grade	Age at Enrolment	0.101 * (0.047)	0.060 (0.054)	0.112 ** (0.040)	-0.064 (0.079)	0.062 (0.051)	0.111 * (0.051)
	Observations	10191	10765	17589	3367	10355	10601
	R2	0.090	0.070	0.051	0.086	0.064	0.035

Subgroup Analyses for Algebra (IV)

		Females	Males	German	Foreign Language	Lower Income	Upper Income
3rd Grade	Age at Enrolment	0.379 *** (0.032)	0.379 *** (0.035)	0.417 *** (0.029)	0.301 *** (0.043)	0.358 *** (0.035)	0.402 *** (0.032)
	Observations	22116	23015	30936	14195	22501	22630
	R2	0.066	0.036	0.027	0.055	0.011	0.000
5th Grade	Age at Enrolment	0.232 *** (0.045)	0.125 ** (0.046)	0.213 *** (0.039)	0.115 * (0.058)	0.117 * (0.047)	0.220 *** (0.044)
	Observations	11315	11724	15586	7453	11315	11724
	R2	0.077	0.099	0.042	0.070	0.036	-0.001
6th Grade	Age at Enrolment	0.243 *** (0.042)	0.262 *** (0.042)	0.252 *** (0.034)	0.255 *** (0.058)	0.229 *** (0.044)	0.273 *** (0.040)
	Observations	16259	16896	23859	9296	16314	16841
	R2	0.062	0.040	0.023	0.033	0.017	-0.021
8th Grade	Age at Enrolment	0.114 *** (0.033)	0.168 *** (0.036)	0.127 *** (0.028)	0.197 *** (0.054)	0.176 *** (0.036)	0.104 ** (0.033)
	Observations	20914	21752	33795	8871	21008	21658
	R2	0.091	0.066	0.047	0.048	0.005	0.002
9th Grade	Age at Enrolment	0.072 (0.049)	0.100 + (0.054)	0.109 ** (0.040)	-0.021 (0.087)	0.119 * (0.054)	0.065 (0.049)
	Observations	10206	10814	17643	3377	10383	10637
	R2	0.079	0.057	0.041	0.070	0.010	0.017