Does Having an Older Sister Matter?

Sibling Sex, School Achievement, and Parental Investment

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Job Market Paper
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Conducted at QICSS (CRDCN), using Statistics Canada data. Views are the author's own, not those of Statistics Canada.

Motivation

Family composition may shape a child's education

- Research focuses on parents, schools, and peers $\Rightarrow$ less on siblings
- Yet siblings play a role
  - Achievement spills over (Nicoletti & Rabe 2019)
  - Sibling sex affects attainment (Butcher & Case 1994)

Why might the older sibling's sex matter?

- The sister: girls tend to lead in reading, boys in math
- The parents: may invest differently by firstborn sex

Why important: firstborn sex is not chosen, yet may create unequal educational outcomes

Research Question

Does having an older sister, rather than an older brother, affect a second-born child's school achievement and their parents' schooling choices?

What I do:

- link BC school records to parent identifiers to identify siblings
- Compare second-borns with an older sister vs. an older brother
- Outcomes:
  - FSA scores in Grades 4 and 7 (provincial assessments)
  - French immersion enrollment (an optional French-language program)

Research Question

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- Outcomes:
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  - French immersion enrollment (an optional French-language program)

Policy relevance:

- Literacy programs may spill over to younger siblings
- Family composition may influence access to educational programs like French immersion

Some Key Results

Older sister vs. older brother:

- Grade 4 reading +0.023 SD and writing +0.016 SD; lasts to Grade 7
  - For scale only: effects below 0.05 SD are common in education research (Kraft 2023)
- No effect on numeracy
- Larger for boys and less-advantaged families
- Second-born's French immersion enrollment: +1.4–1.5 pp (14–17% of the base rate)
- Reading effect: about one-eighth of the gap between second- and firstborn siblings

Contribution to the Literature

- Sibling sex and attainment: Butcher & Case (1994), Kaestner (1997)
- Sibling sex and achievement
  - Cho (2023), Korea, high school seniors: an older sister raises reading relative to math, similarly for boys and girls
  - Cools (2025), Norway, Grade 10: an older sister raises GPA, similarly across subjects and for boys and girls

  $\Rightarrow$ This paper:
  - Effects already in Grades 4 and 7, on standardized tests by subject
  - In literacy but not numeracy, and larger for boys
- Parental responses to child sex: Lundberg & Rose (2002), Dahl & Moretti (2008)
  $\Rightarrow$ This paper: a schooling choice, enrollment in French immersion

Institutional Setting: British Columbia

Foundation Skills Assessment (FSA)

- Province-wide test in Grades 4 and 7: reading, writing, numeracy
- Standardized within subject, grade, and school year

French immersion

- Optional public program chosen by parents; taught mostly in French
- Entry in kindergarten (early) or Grade 6 (late)
- Linked to better later outcomes, but enrollees are selected (Manuel 2024)
- Enrollment: 8.3% in Grade 4, 11.4% in Grade 7

Data Sources Linkage

BC K–12 administrative records, 1999–2021 (Statistics Canada)

- FSA scores in Grades 4 and 7; French immersion enrollment
- Child and school characteristics

Child–parent key

- Gives each BC child their parents' identifiers
- Used to identify siblings and birth order, and to link some parents to the Census

2016 Census long-form

- Used to link mother's information, such as education

Identifying Siblings Examples

Siblings = children linked to the same parents

1. Drop half-siblings and children linked to 3+ parent identifiers
2. Order siblings by birth date $\Rightarrow$ birth order and family size
3. Keep second-borns in families of 2–5 children
4. Link the three data sources

Sample: 119,910 second-borns Education subsample: 107,750 (weighted)

Raw Gaps by Older Sibling's Sex

Descriptives

	Grade 4			Grade 7		
	Older sister	Older brother	Difference	Older sister	Older brother	Difference
Reading	0.037	0.015	**0.021*****	0.044	0.025	**0.019*****
Writing	0.069	0.052	**0.017*****	0.057	0.039	**0.019*****
Numeracy	0.089	0.090	−0.001	0.061	0.057	0.004
N	58,570	61,340		58,570	61,340	

- Before any controls: second-borns with an older sister score about 0.02 SD higher in reading and writing
- No gap in numeracy

Empirical Strategy

For second-born child i, separately by subject and grade:

$$Y_i = \alpha + \beta\,\text{FirstbornGirl}_i + \mathbf{X}_i'\gamma + \delta_{\text{district}} + \lambda_{\text{school year}} + \varepsilon_i$$

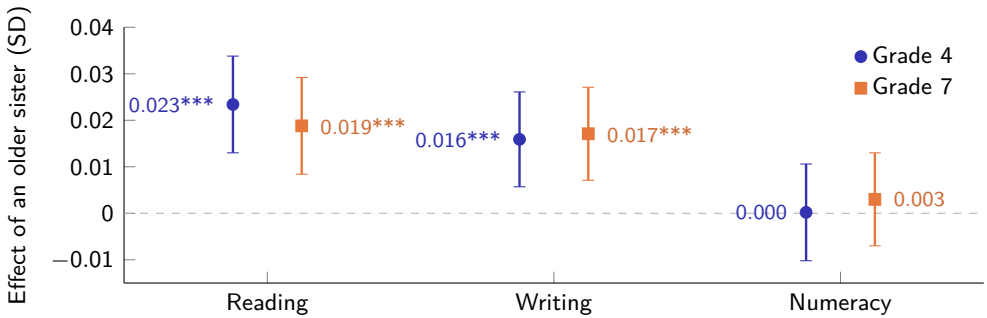
- Y_i: standardized FSA score, or French immersion (LPM)
- FirstbornGirl_i: older sister (1) vs. older brother (0)
- $\mathbf{X}_i$: child, school, and family controls
- δ_{district}, $\lambda_{\text{school year}}$: district and school-year fixed effects
- Standard errors clustered by family
- Family size and spacing excluded (respond to firstborn sex); robust to adding them

Identification

- Balance test
  - Firstborn sex is unrelated to second-born sex and mother's characteristics
- Selection
  - Firstborn sex is unrelated to linkage and FSA participation
- Fertility responds, as expected
  - Firstborn girl: slightly larger families and longer birth spacing
  - Estimates barely change when these are controlled for

▸ Balance ▸ Selection

Main Results: Gains in Literacy



- Grade 4: reading +0.023 SD and writing +0.016 SD; both persist to Grade 7
- Numeracy: no effect

▸ Table

Main Results: French Immersion

	Outcome: enrolled in French immersion (0/1)			
	Grade 4		Grade 7	
	(1)	(2)	(3)	(4)
Older sister	0.0128***	0.0138***	0.0153***	0.0155***
	(0.0016)	(0.0015)	(0.0018)	(0.0018)
Controls and district FE	No	Yes	No	Yes
Mean of dep. var.	0.083	0.083	0.114	0.114
R^2	0.005	0.064	0.004	0.063
N	119,910	119,910	119,910	119,910

- An older sister raises enrollment by 1.4 to 1.5 pp: 17% and 14% of the base rate
- Consistent with different schooling choices, but does not show why

Heterogeneity: Grade 4 Reading

Specification

Outcome: Grade 4 reading score (SD)

	Second-born		Mother's education		Family	
	Boys	Girls	Below bachelor's	Bachelor's+	Single	Two-parent
Older-sister effect	0.040***	0.007	0.047***	−0.006	0.053***	0.019***
	(0.008)	(0.007)	(0.014)	(0.020)	(0.016)	(0.006)
Difference	−0.033***		−0.054**		−0.034**	
	(0.011)		(0.024)		(0.017)	

- Larger for younger brothers
- Larger in families with fewer resources
- Family structure is measured after treatment: descriptive only
- No systematic differences in writing or numeracy

Magnitude Specification

	Reading		Writing		Numeracy	
	Gr. 4	Gr. 7	Gr. 4	Gr. 7	Gr. 4	Gr. 7
Second-born gap (family FE)	−0.184***	−0.178***	−0.071***	−0.072***	−0.028***	−0.052***

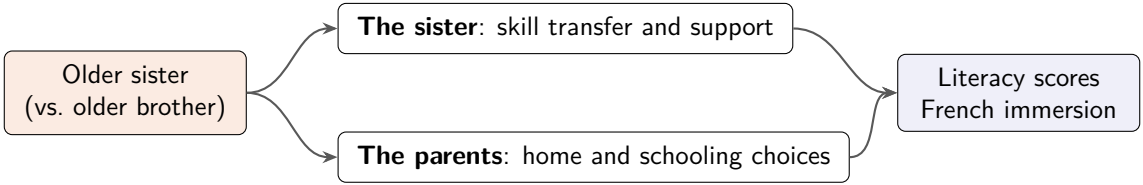
- Older-sister effect, Grade 4 reading: 0.023 SD
- About one-eighth of the second-born gap (0.023 vs. 0.184 SD)
- Gap in line with the literature: about 0.2 SD in IQ (Black et al. 2011); second-born boys score lower in reading (Breining et al. 2020)
- Scale comparison only: across vs. within families

Robustness

- Fertility controls: estimates barely move — Table
- Specification: stable from FE only to full controls — Table
- Sample definition: grade-specific, two-child, two-parent linkage — Table
- Maternal controls: education and age at first birth — Table

Reading, writing, and French immersion effects hold in every check; numeracy stays at zero.

Possible Channels



Minor role: fertility. Not observed: rivalry, caregiving, role modeling.

Suggestive evidence using firstborn outcomes by sex:

- Sisters ahead in literacy, not numeracy $\Rightarrow$ sister route
- Sisters more often in French immersion $\Rightarrow$ the younger child may follow her
- Neither $\Rightarrow$ parents or other channels

Conclusion

Does an older sister matter for school achievement?

- Yes: reading and writing scores rise by about 0.02 SD in Grades 4 and 7; numeracy does not change

Does it matter beyond test scores?

- Yes: French immersion enrollment rises by 14–17%

Why?

- Consistent with both sibling interactions and family decisions; separating them is next

Policy relevance

- Literacy programs may spill over to siblings; support may matter most for boys in less-advantaged families
- School choice: access to French immersion may depend on family composition

Thank you

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Main Results: Test Scores

Back

	Reading		Writing		Numeracy	
	Gr. 4	Gr. 7	Gr. 4	Gr. 7	Gr. 4	Gr. 7
Without controls						
Older sister	0.022***	0.019***	0.017***	0.019***	0.000	0.004
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
R^2	0.001	0.001	0.001	0.000	0.001	0.001
With controls						
Older sister	0.023***	0.019***	0.016***	0.017***	0.000	0.003
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
R^2	0.108	0.106	0.135	0.168	0.120	0.166
N	119,910					

- Estimates barely move when controls are added, while the R^2 rises sharply

Balance and fertility

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	Coef.	SE	p	N
Panel A: Child and family characteristics				
Second-born female	0.0012	0.0029	0.671	119,910
Public school, Grade 4†	−0.0010	0.0020	0.610	119,910
Public school, Grade 7†	0.0006	0.0020	0.772	119,910
Ever diagnosed with a disability†	−0.0016	0.0019	0.399	119,910
Mother has bachelor's or above	−0.0013	0.0058	0.822	107,750
Mother's age at first birth	0.0376	0.0596	0.528	107,750
Mother's age at second birth	0.0324	0.0604	0.592	107,750
Panel B: Fertility and family composition				
Birth spacing (months)	0.3991	0.1367	0.004	119,910
Family size = 2	−0.0212	0.0026	<0.001	119,910
Family size = 3	0.0166	0.0024	<0.001	119,910
Family size = 4	0.0035	0.0013	0.006	119,910

† Measured after treatment. Mother's variables: Education subsample, weighted.

Selection into the sample

Back

	Coef.	SE	p	N
FSA record in at least one grade	−0.0020	0.0012	0.098	279,430
FSA record, Grade 4	−0.0026	0.0014	0.055	279,430
FSA record, Grade 7	−0.0014	0.0017	0.431	279,430
FSA record, both grades	−0.0020	0.0018	0.270	279,430
Complete participation, Grade 4	0.0007	0.0017	0.706	236,540
Complete participation, Grade 7	0.0013	0.0020	0.520	198,530
Merged into the main sample	0.0003	0.0019	0.865	281,600
Parent Census identifier available	−0.0002	0.0011	0.851	281,600

Heterogeneity specification

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For each subject and grade:

$$Y_i = \alpha + \beta_1 \,\text{FirstbornGirl}_i + \rho\, Z_i + \beta_2 \,(\text{FirstbornGirl}_i \times Z_i) + \mathbf{X}_i'\gamma + \delta_{\text{district}} + \lambda_{\text{school year}} + \varepsilon_i$$

- Z_i: second-born female; mother has a bachelor's degree or above; two-parent family
- β_1: effect for the reference group ($Z_i = 0$: boys, mothers without a degree, single-parent families)
- β_2: difference in the effect for the other group; $\beta_1 + \beta_2$: effect for $Z_i = 1$
- Mother's education: Education subsample, weighted
- Family structure is measured after treatment, so that split is descriptive

Heterogeneity, all outcomes

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	Reading		Writing		Numeracy	
	Gr. 4	Gr. 7	Gr. 4	Gr. 7	Gr. 4	Gr. 7
By sex of the second-born						
FirstbornGirl	0.0395***	0.0281***	0.0184**	0.0233***	−0.0045	0.0057
× Second-born female	−0.0327***	−0.0187*	−0.0049	−0.0125	0.0095	−0.0055
By mother's education (Education subsample)						
FirstbornGirl	0.0471***	0.0217	0.0078	0.0252*	0.0098	0.0008
× Mother bachelor's+	−0.0536**	0.0023	0.0152	−0.0285	−0.0266	−0.0016
By family structure						
FirstbornGirl	0.0533***	0.0353**	0.0112	0.0045	0.0206	0.0183
× Two-parent family	−0.0340**	−0.0187	0.0054	0.0143	−0.0232	−0.0174

SEs omitted for space; see paper. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Birth order (family fixed effects) Back

	Reading		Writing		Numeracy	
	Gr. 4	Gr. 7	Gr. 4	Gr. 7	Gr. 4	Gr. 7
Two-child sample ($N = 183{,}210$)						
Second born	−0.1844***	−0.1777***	−0.0705***	−0.0716***	−0.0275***	−0.0517***
Three-child sample ($N = 47{,}400$)						
Second born	−0.1971***	−0.1657***	−0.0869***	−0.0792***	−0.0415***	−0.0371***
Third born	−0.3454***	−0.2862***	−0.1723***	−0.1446***	−0.0971***	−0.1136***

Family, school-year, and district FE with within-family controls. *** $p < 0.01$.

Fertility controls

Back

	Reading		Writing		Numeracy		French imm.	
	Gr. 4	Gr. 7	Gr. 4	Gr. 7	Gr. 4	Gr. 7	Gr. 4	Gr. 7
(1) Baseline	0.023***	0.019***	0.016***	0.017***	0.000	0.003	0.014***	0.016***
(2) + Birth spacing	0.023***	0.019***	0.016***	0.017***	0.001	0.003	0.014***	0.016***
(3) + Family size	0.024***	0.020***	0.017***	0.018***	0.001	0.004	0.014***	0.016***
(4) + Both	0.024***	0.020***	0.017***	0.018***	0.002	0.004	0.014***	0.016***

$N = 119{,}910$. Family size: indicators for 3, 4, 5 children. Standard errors in the paper; clustered at the family level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Fixed effects, controls, and clustering

Back

	Reading		Writing		Numeracy	
	Gr. 4	Gr. 7	Gr. 4	Gr. 7	Gr. 4	Gr. 7
(A) School-year FE only	0.022***	0.019***	0.017***	0.019***	0.000	0.004
(B) + District FE	0.022***	0.019***	0.016***	0.017***	−0.001	0.002
(C) + Controls (main)	0.023***	0.019***	0.016***	0.017***	0.000	0.003
(D) Main, school-clustered SEs	0.023***	0.019***	0.016***	0.017***	0.000	0.003
R^2 (A)	0.001	0.001	0.001	0.000	0.001	0.001
R^2 (C)	0.108	0.106	0.135	0.168	0.120	0.166

$N = 119{,}910$. Standard errors in the paper. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Sample definition

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	Reading		Writing		Numeracy		French imm.		
	Gr. 4	Gr. 7	Gr. 4	Gr. 7	Gr. 4	Gr. 7	Gr. 4	Gr. 7	*N*
(1) Baseline	0.023***	0.019***	0.016***	0.017***	0.000	0.003	0.014***	0.016***	119,910
(2) Grade-specific	0.025***	0.019***	0.019***	0.018***	0.002	0.005	0.016***	0.014***	varies[a]
(3) Two-child families	0.026***	0.030***	0.020***	0.017***	0.000	0.006	0.016***	0.020***	85,300
(4) Two-parent linkage	0.020***	0.017***	0.017***	0.019***	−0.003	0.001	0.015***	0.017***	105,490

[a] 174,760 in Grade 4; 138,330 in Grade 7. Standard errors in the paper. (2) each grade on second-borns with a valid assessment in that grade. (3) family size may respond to firstborn sex. (4) children matched to two parent identifiers. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

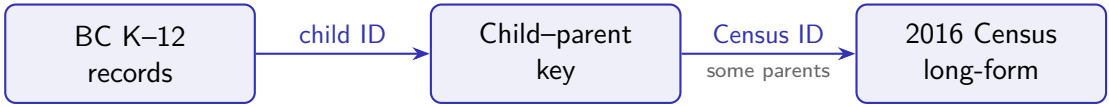
Maternal background controls

Back

	Reading		Writing		Numeracy		French imm.		
	Gr. 4	Gr. 7	Gr. 4	Gr. 7	Gr. 4	Gr. 7	Gr. 4	Gr. 7	N
(1) Main sample	0.023***	0.019***	0.016***	0.017***	0.000	0.003	0.014***	0.016***	119,910
Education subsample (weighted)									
(2) Baseline controls	0.030***	0.022*	0.012	0.016	0.001	0.000	0.018***	0.017***	107,750
(3) + Mother's education	0.031***	0.022**	0.012	0.017	0.002	0.000	0.019***	0.017***	107,750
(4) + Age at first birth	0.030***	0.022*	0.012	0.016	0.002	0.000	0.019***	0.017***	107,750

Standard errors in the paper. Controls added cumulatively. Writing estimates are similar in size but imprecise in the smaller subsample. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Linkage Back



Scores, French immersion

Same parents ⇒ siblings
Birth dates ⇒ birth order

Mother's education and age at first birth

Identifying Siblings: Example

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Child	Parent 1	Parent 2	
A	P1	P2	} siblings
B	P1	P2	
C	P3	–	} siblings
D	P3	–	
E	P4	P5	} half-siblings: excluded
F	P4	P6	
G	P7	P8	} 3+ parents: excluded
G	P9	–	

Illustrative records in the format of the child–parent key. Siblings are then ordered by birth date.

Descriptive Statistics

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	Main sample	Education subsample
Firstborn female	0.488	0.485
Second-born female	0.494	0.489
Two-child families	0.711	0.714
Two-parent family	0.880	0.893
Birth spacing (months)	41.8	41.5
ESL, Grade 4	0.173	0.169
French immersion, Grade 4	0.083	0.084
French immersion, Grade 7	0.114	0.117
N	119,910	107,750 (weighted)

- The two samples look similar

Birth-Order Specification

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For child i in family f, separately by subject and grade:

$$Y_i = \alpha + \beta_2 \,\text{SecondBorn}_i + \beta_3 \,\text{ThirdBorn}_i + \mathbf{X}_i'\theta + \phi_f + \delta_{\text{district}} + \lambda_{\text{school year}} + \varepsilon_i$$

- ϕ_f: family fixed effects $\Rightarrow$ compares siblings within the same family; absorbs family size and parental background
- β_2, β_3: gap relative to the firstborn
- $\mathbf{X}_i$: characteristics that vary across siblings (sex, disability, ESL, school changes, public school)
- Two-child sample: first two children (β_3 omitted); three-child sample: first three children
- Descriptive: birth order is not randomly assigned