The Influence of Siblings on Academic Achievement

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Overview of paper

- Vast literature on returns to parental education (e.g. Black et al., 2005, Oreopoulos et al., 2006, Rosenzweig and Wolpin, 1994)

- Growing evidence on the importance of peers

- Influence of siblings is hard to identify and less well-understood

- Estimate sibling spillovers in reading and math test score achievement for school-going children

  - Exploit assignment of sibling to experienced teacher

Theoretical Mechanisms

- Having a high-achieving older sibling is likely beneficial
    - Older siblings often teach younger siblings (Zajonc and Markus, 1973; Brody, 2004)
    - Help with homework, gains in information, increased motivation, reduction in psychic costs

- Effect of older sibling on younger sibling likely larger than that of younger sibling on older sibling
    - Interaction with a smarter younger sibling can have benefits
    - However, help with studies and role model effects likely less important

- Analyze effects of older siblings and younger siblings separately

Theoretical Mechanisms continued

- Effect of having a high-achieving sibling can be negative

  - Increased envy or reduced self-esteem
  - For example, Lavy et al. (2012) find that girls benefit from having very bright peers in the classroom but boys are negatively affected

- Parents' behavioral response may change investments

  - Reallocation of investments can increase or decrease child achievement depending on whether parents invest efficiently or equitably (Becker and Tomes, 1976; Behrman et al., 1982)

- Sibling spillover estimates include direct and indirect effects

Data and sample of interest

- Use student-teacher matched records from North Carolina public schools (NCERDC), 2007-2012

- Analysis sample

  - Includes children with at least one sibling

  - Enrolled in grades 4-8

  - Exclude twins and any siblings enrolled in the same grade

Identifying Sibling Effects

- Shared inputs and common shocks complicate the identification of sibling effects

    - Siblings have the same parents, household environment, and attend the same schools etc.

- Sibling achievement is strongly correlated

    - Sibling correlation in years of schooling around 0.4-0.5 (Solon et al. 2000; Lindahl 2011) and in test scores around 0.5-0.6 (Nicoletti and Rabe 2013)

Identification Strategy

- This study utilizes the assignment of sibling to a teacher with early career experience as a shock to sibling achievement

  - ▸ Experience is one of the few observable teacher characteristics which affects student achievement
  - ▸ Significant gains to experience in the early years of teaching
  - ▸ I characterize assignment to teacher based on whether he/she has more than one year of experience

- Compare children whose sibling is assigned to teachers with early career experience with those whose sibling is assigned to a teacher without early career experience

  - ▸ Refer to teachers with early career experience as experienced

Teacher assignment is not random

- Teachers are not distributed randomly across different schools

- There is sorting of high-achieving students to teachers with stronger qualifications within schools (Rivkin, Hanushek and Kain 2005)

- Siblings' achievement is strongly correlated so we expect tracking of siblings into similar classes

- The presence of such sorting would lead to upward bias when relating sibling teacher experience to child achievement

Controlling for sorting to teachers
Own and sibling controls

- Control for rich set of observables which predict selection into classes and teachers

- These include student-level controls, class-level controls and school-year controls for the child and the sibling

- Cubic polynomials in prior scores in same subject and other subject, interacted with grade; age dummies, gender, race/ethnicity, special education, limited English, grade repetition, economic disadvantage, grade fixed effects and year fixed effects

- Class- and school-year means of the individual controls; cubics in class- and school-grade mean prior scores, class size

Sibling teacher experience and own teacher experience

	Own read teacher is experienced				
Indicator that older sibling's read teacher is experienced	0.0372***	0.0210***	0.0009	-0.0242***	-0.0001
	(0.0047)	(0.0034)	(0.0033)	(0.0033)	(0.0032)
Mean of dependent variable			0.902		
Observations	92,110	92,110	92,110	92,110	92,110
Child and sibling controls	No	Yes	Yes	Yes	Yes
Child school fixed effects	No	No	Yes	No	No
Child school-by-year fixed effects	No	No	No	Yes	No
Child school-by-grade-by-year fixed effects	No	No	No	No	Yes

Reduced form effects of older sibling teacher experience
Reading effects

	Own reading achievement				
Older sibling's read teacher experience	0.0138***	0.0128**	0.0123*	0.0123*	0.0105
	(0.0063)	(0.0063)	(0.0065)	(0.0073)	(0.008)
Own read teacher experience		0.0468***	0.0425***	0.0411***	0.0486***
		(0.0061)	(0.0063)	(0.0074)	(0.0093)
Observations	92,110	92,110	92,110	92,110	92,110
Child and sibling controls	Yes	Yes	Yes	Yes	Yes
Child teacher experience	No	Yes	Yes	Yes	Yes
Child school fixed effects	No	No	Yes	_	_
Child school-by-year fixed effects	No	No	No	Yes	_
Child school-by-grade-by-year fixed effects	No	No	No	No	Yes

Reduced form effects of older sibling teacher experience
Math effects

	Own math achievement				
Older sibling's math teacher experience	0.0048	0.0038	0.0056	0.0115*	0.0128*
	(0.0062)	(0.0062)	(0.0063)	(0.0066)	(0.0071)
Own math teacher experience		0.0614***	0.0574***	0.0577***	0.0540***
		(0.0065)	(0.0067)	(0.0073)	(0.0089)
Observations	94,255	94,255	94,255	94,255	94,255
Child and sibling controls	Yes	Yes	Yes	Yes	Yes
Child teacher experience	No	Yes	Yes	Yes	Yes
Child school fixed effects	No	No	Yes	No	No
Child school-by-year fixed effects	No	No	No	Yes	No
Child school-by-grade-by-year fixed effects	No	No	No	No	Yes

Reduced form effects of younger sibling teacher experience
Reading effects

	Own reading achievement				
Younger sibling's read teacher experience	-0.0059	-0.0063	-0.0071	-0.0091	-0.0072
	(0.0061)	(0.006)	(0.0061)	(0.0063)	(0.0066)
Own read teacher experience		0.0272***	0.0252***	0.0273***	0.0259***
		(0.0066)	(0.0067)	(0.0071)	(0.0086)
Observations	84,565	84,565	84,565	84,565	84,565
Child and sibling controls	Yes	Yes	Yes	Yes	Yes
Child teacher experience	No	Yes	Yes	Yes	Yes
Child school fixed effects	No	No	Yes	No	No
Child school-by-year fixed effects	No	No	No	Yes	No
Child school-by-grade-by-year fixed effects	No	No	No	No	Yes

Reduced form effects of younger sibling teacher experience
Math effects

	Own math achievement				
Younger sibling's math teacher experience	-0.0079	-0.0088	-0.0091	-0.0052	-0.0064
	(0.0057)	(0.0057)	(0.0057)	(0.0059)	(0.0061)
Own math teacher experience		0.0603***	0.0555***	0.0570***	0.0631***
		(0.0069)	(0.0071)	(0.0072)	(0.0087)
Observations	89,062	89,062	89,062	89,062	89,062
Child and sibling controls	Yes	Yes	Yes	Yes	Yes
Child teacher experience	No	Yes	Yes	Yes	Yes
Child school fixed effects	No	No	Yes	No	No
Child school-by-year fixed effects	No	No	No	Yes	No
Child school-by-grade-by-year fixed effects	No	No	No	No	Yes

Summary of sibling effects

- Older sibling's assignment to an experienced teacher is beneficial

  - Associated with a 0.011-0.012 SD improvement in child's reading test score

  - Spillover effects in math are smaller and lack statistical significance

- Younger sibling's assignment to an experienced teacher does not have a significant effect on child's reading or math achievement

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- Pattern of results in line with discussion of theoretical mechanisms

- Consistent with past studies which also find evidence for spillovers only from older siblings to younger siblings

  - Years of schooling, high school graduation, school subject choice etc.

Sibling effects and potential mechanisms

- Pattern of results suggests learning spillovers and role model effects are important

- Parental reallocation of inputs unlikely to be important mechanism as its not clear why it would be present from older to younger siblings and not vice versa

- Stronger evidence for spillovers in reading than math

  - Past literature finds that school inputs are more effective at raising math achievement

  - Family is likely more important determinant of reading achievement

    - Reading affected by help with studies but also regular interaction and exposure to sibling's vocabulary

Heterogeneity by economic disadvantage

- Explore differences in sibling effects across children from relatively advantaged or disadvantaged households

  - Analyze effects separately by economic disadvantage status - a measure of free/reduced price lunch eligibility

- Past studies have found larger sibling effects in disadvantaged households

- Older sibling's achievement can matter more in disadvantaged households

- Parents in disadvantaged households likely face resource and time constraints which limit the role of a parental investment response

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Heterogeneity in sibling effects by economic disadvantage

	Economically disadvantaged		Not Economically disadvantaged	
	Reading teacher	Math teacher	Reading teacher	Math teacher
Older sibling's teacher experience	0.0155*	0.0016	0.0060	0.0071
	(0.0092)	(0.0083)	(0.0088)	(0.0094)
Own teacher experience	0.0557***	0.0574***	0.0278***	0.0558***
	(0.0087)	(0.0089)	(0.0095)	(0.0095)
Observations	43,660	44,398	48,411	49,837

Heterogeneity by sibling gender match

- Analyze effects for same-gender siblings and different-gender siblings

- Sibling effects can be stronger for same gender siblings

  - Same gender siblings interact more frequently (Bossard and Boll, 1956)

  - They partake in similar interests and activities (Bank and Kahn, 2003)

  - Role model effects are likely stronger

Heterogeneity in sibling effects by gender match

	Same gender siblings		Different gender siblings	
	Reading teacher	Math teacher	Reading teacher	Math teacher
Older sibling's teacher experience	0.0187**	0.0088	0.0072	-0.0003
	(0.0087)	(0.0089)	(0.0095)	(0.0088)
Own teacher experience	0.0462***	0.0617***	0.0392***	0.0518***
	(0.0093)	(0.0091)	(0.0086)	(0.0097)
Observations	46,403	47,426	45,668	46,809

Summary

- Older sibling reading teacher experience increases child reading score by 0.011-0.012 SD

  ▶ Roughly 30% of the own teacher experience effect on reading test score

- Weaker evidence that older sibling math teacher experience increases child math score

- Younger sibling teacher experience is not significantly related to reading or math achievement

- Pattern of results suggests that direct sibling effects play a more important role than indirect parental effects

Conclusion and implications

- Document sibling spillovers in academic achievement for school going children

  - Highlights how family characteristics interact with school inputs to create learning

- Access to school-based inputs, such as experienced teachers, has signficant benefits for students and their younger siblings

  - Due to these spillovers, the return to education may be larger than previously estimated

  - Can reinforce inequality due to differential access to high quality schools

- Larger spillovers for children from disadvantaged families suggests schools can play important role in closing socioeconomic gaps in achievement