Emergent Disparities in Early Childhood:
Assessing the Gender Gap in Mental and Motor Scores at 9 and 24 Months

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Abstract

The gaps between boys and girls in educational achievement, as measured by standardized tests, are well documented. Yet, very few studies have investigated when these gender gaps emerge, how they change over the life course or what factors are associated with the differences in boys and girls cognitive skills. Using the Early Childhood Longitudinal Study – Birth Cohort (ECLS-B) for infants aged 9 through 24 months, we explore gender gaps in cognitive development at the very earliest stages of life and investigate the environmental factors that may contribute to cognitive differences by gender. We find that gender gaps in cognitive ability emerge well before children enter school. As early as 9 months of age, females have small but significant advantages on measures of mental and motor skills. These gaps increase over time with the greatest effect for children with low birth weight and socio-economic status.

Extended Abstract

The gaps between boys and girls in educational achievement, as measured by standardized tests, are well documented. We know that boys surpass girls in tests of math and science, while girls outperform boys on tests of verbal skills and reading. Yet, very few studies have investigated when these gender gaps emerge, how they change over the life course or what factors are related to the differences in boys and girls cognitive skills.

Using a new nationally-representative sample of very young children, we explore gender gaps in cognitive development at the very earliest stages of life, from 9 months to two years of age, and investigate the environmental factors that may contribute to cognitive differences by gender. Specifically, we use the Early Childhood Longitudinal Study – Birth Cohort (ECLS-B) for infants aged 9 through 24 months to examine how the female and male infants compare in their cognitive and motor skills and how gender differences in these skills change over the first two years of life. We pay particular attention to how low-birth weight (LBW) and family socioeconomic status (SES) help or hinder young boys and girls in development. Importantly, we find that gender gaps in cognitive ability emerge well before children enter school. As early as 9 months of age, females have small but significant advantages on measures of mental and motor skills.

In order to examine how gender gaps in cognitive and motor skills change over time, we will examine interactions between gender, race, socio-economic status and birth weight on mental and motor skills during the first two years of development. This study will yield a comprehensive analysis of the factors contributing to gender differences in cognitive and motor development at this very early stage in the life course with the best nationally-representative data to date. Furthermore, documenting gender differences in the first two years of development will yield considerable theoretical implications for debates on gender and educational outcomes.

Gender Gap in Achievement

The gap between boys and girls in educational achievement, measured by standardized tests, has been central in studies of gender differences in cognitive ability. Boys surpass girls in tests of math and science, while girls outperform boys on tests of verbal skills and reading (Downey and Vogt Yuan 2005; Hedges and Nowell 1995; Hyde, Fennema, and Lamon 1990). Although boys have long maintained an advantage on standardized math tests they exhibit more variability in their test scores (Hedges and Nowell 1995; Nowell and Hedges 1998). But boys do not enjoy an advantage in grades. Girls have consistently received higher grades in all school subjects since the 1950's (Alexander and Eckland 1974). Moreover, in reading and tests of verbal skills, girls far surpass boys (Downey and Vogt Yuan 2005) and the gap favoring girls on reading tests are much larger than those favoring boys on math tests. On standardized tests, however, girls generally score lower on proficiency tests such as the SAT (College Board 2006). Other evidence suggests that females are advantaged in terms of their long-term memory, rapid memory recall, fine motor skills, perceptual speed and vocabulary skills while boys have higher gross motor skills, spatial intelligence, and mechanical reasoning (Halpern 1997; Feingold 1988; Huttenlocher et al. 1991).

Early Childhood Cognition

Because the vast majority of studies examine these gender differences in abilities with school age children, little prior research has addressed the question of the origins of these gender differences, when they emerge, or the factors that might mediate these gender differences. While research on school-age children finds clear differences in academic ability and proficiency among boys and girls, less research has examined gender differences at earlier ages. Research confirms that health problems at birth, like low birth weight or environmental factors such as living in poverty are critical for children's later cognitive outcomes (Conley, Strully, and Bennett 2003; Guo and Harris 2000). Children born with low and very-low birth weight, which is often correlated with living in poverty, face both short-term and long-term health consequences that may negatively affect development. For example, low and very low birth weight children score lower in tests of cognitive abilities in childhood (Boardman, Powers, Padilla, and Hummer 2002) and their cognitive deficiencies tend to become greater over time (Bennett 1988).

Some evidence indicates that male infants are more negatively impacted by low birth weight than female infants. They are more likely to develop handicaps like cerebral palsy and mental retardation. Although studies suggest that girls are more likely to be born with lower birth weight than boys, on average female infants are smaller than male infants. Therefore, they are less susceptible to problems associated with low birth weight (Conley, Strully and Bennett 2003).

Like birth weight, low socioeconomic status also diminishes cognitive development. In addition to increasing the incidence of low birth-weight births, low SES is linked to lower cognitive development in children (Farkas 2003, Guo and Harris 2000). This effect of poverty is most likely due to unmeasured affects of poverty on child nutrition, pre- and post-natal care as well as child rearing resources (Rouse, Brooks-Gunn and McLanahan 2005).

Research Questions/Hypothesis

Building on such research, we examine how the factors of low-birth weight and family socioeconomic status affect boys' and girls' cognitive outcomes in the first two years of life. We hypothesize that girls are more resilient to factors negatively affecting cognition, and we expect that this female advantage grows over the first 24 months of life. By analyzing processes that may account for gender differences in abilities, we hope to add to debates regarding later cognitive outcomes by gender. As we develop this study, we will consider the impact of these differences on child readiness for educational institutions and the possible role of schooling in channeling and possibly ignoring these early differences.

Data

Sample

We analyze data from the Early Childhood Longitudinal Study Birth Cohort (ECLS-B), a nationally representative sample of 10,688 children born in the year 2001 containing information collected from birth certificates, child assessments and caretaker interviews. Descriptive statistics are reported in Table 1. The age of assessment ranges from 8 to 12 months with the majority of the sampled assessed at 9 months (34.7%). The sample includes children from a diverse socioeconomic and racial/ethnic background. The study over samples Asian/Hawaiian/Pacific Islanders (11.6%), American Indian or Alaska Native (2.7%) as well as twins (15.2%) and children with low and very-low birth weights (15.5 % and 10.8% respectively). Data were first collected on children at approximately 9 months. The ECLS-B resurveyed infants at 24 months, using the same measures of cognitive ability. The second wave of the ECLS-B was recently released in September 2006 for restricted-use. We will link these second wave data to the first wave and model how children's cognitive skills and gender differences in cognitive skills have changed from over the approximately 15 month period between the ages of 9 months and two years. Preliminary cognitive and motor mean scores are provided in Table 2. Initial examination of the mean scores across birth weight and race suggest meaningful distinctions by gender.

TABLE 2 ABOUT HERE

The ECLS-B includes information on the children, their parents, and childcare providers, as well as the children's cognitive, social and physical development. The study asks extensive questions of both mothers and fathers, including their role in the childrens' lives. The ECLS-B is a unique dataset in that it follows the progression of children throughout childhood prospectively, using broad and various measures of child development outcomes.

Using the ECLS-B is beneficial for this study because never has such a complete, nationally representative sample of infants been used to explore how cognitive abilities develop and change over the life course. Previous data collection efforts have either limited samples to at-risk populations of children or excluded such populations. For example, the National Institute of Child Health and Human Development Study of Early Child Care (NICHD-SECC) is widely used to explore issues related to early childhood development, but it is limited to mothers over the age of 18 or children born with health problems.

Bayley Method

We use the Bayley Short Form-Research Edition (BSF-R) to measure infants' cognitive abilities. The BSF-R is an abbreviated version of the widely-used Bayley Mental Development Index developed for the ECLS-B. The BSF-R measures infants' mental skills in five specific areas: exploring objects, exploring objects with purpose, babbling, problem solving skills and communicating with words.

Since the BSF-R is a new psychometric measure of ability and has only been utilized in the ECLS-B, there is no direct evidence in correlation between test scores and actual cognition or later life outcomes although there is some evidence that there is a reliable relationship with Stanford-Binet and IQ (see Fryer and Levitt 2006). Nonetheless, the Bayley Mental Development Index from which the test is derived is highly reputable (Bayley 1993).

Preliminary Findings

We use OLS regression in our initial models of cognitive and motor scores and report results in Table 3. Moving from model 1 to model 7, the coefficient for female mental scores is resilient to the addition of variables known to affect cognitive development (see Rouse, Brooks-Gunn, and McLanahan 2005). The coefficient for female remains positive and significant, despite controls for age of assessment (model 2); birth weight (model 3); socio-economic status (model 4); race and urbanicity (model 5); family arrangement and sibling size (model 6); and parental interaction score, parenting style and maternal employment (model 7a). Therefore, being female is associated with an increase in the mental score by .793, representing nearly 1 developmental week ahead of boys[2]. This is relatively modest considering 5 days represents nearly 2% of the infants' lifetime. However, preliminary analysis of gender differences at 2 years suggests a growing gender gap that is statistically significant controlling for numerous developmental factors.

TABLE 3 ABOUT HERE

In the coming months, we will examine additional environmental factors that emerge as well as consider the interaction effects of birth weight, socio-economic status and race to untangle the processes that account for this emerging trend. The final model for motor scores (Table 3, model 7b) shows a similar positive and significant coefficient for females, although the coefficient only approaches significance and is less robust.

Expected Findings and Implications

Aside from the apparent growth in the gender gap based on our preliminary findings we expect to find important interaction effects by gender and birth weight, socio-economic status and race. Using an exploratory approach, we expect that several environmental factors such as parental involvement and interaction may contribute partially to the growing gap between males and females. Our findings should be relevant to current debates regarding gender differences in test performances and education attainment by uncovering the emergent differences that may set the stage for later educational disparities.

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[2] 4.185 age coefficient = 0.1395 increase in score per day. 0.1295 / the female advantage of .793= 5.68 days ahead.

Table 1. Percentage Distribution of Child and Family Characteristics at about 9 Months: 2001

		Mean	SD	Range
Infant Development				
Mental Scale Score		77.3	7.4	54-113
Motor Scale Score		56.5	6.8	31-80
Demographics				
Age of Assesment	%			
8 Months		18.4		
9 Months		34.7		
10 Months		20.9		
11 Months		10.4		
12 Months		15.6		
Race	%			
White		41.6		
Black		15.9		
Hispanic		20.5		
Asian		11.6		
Native American		2.7		
Other Categories		7.3		
Family Characteristics				
Family Structure	%			
Two Biological Parents		77.5		
Single Biological Parent		20.7		
Biological Parent and Other Parent		1		
Other Parent Type		0.8		
Socio-Economic Status Quintiles:	%			
1st Quintile (lowest)		19.7		
2nd Quintile		20		
3rd Quintile		19.5		
4th Quintile		18.6		
5th Quintile (highest)		22.1		
Poverty Status (below poverty threshold)		24.4		
Mother's Age	%			
Less than 20		7.5		
20 to 24		24.4		
25 to 29		24		
30 to 34		25.4		
35 to 39		14.5		
40 or more		4.2		
Number of Siblings		1	1.1	0-6
Prenatal				
Birthweight	%			
Normal Birthweight (more than 5.5 pounds)		73.7		
Moderately Low Birthweight (more than 3.3 to 5.5 pounds)		15.5		
Very Low Birthweight (3.3 pounds or less)		10.8		

Source: National Center for Education Statisitics. Early Childhood Longitudinal Study, Birth Cohort.

Table 2. Change in Mean Bayley Short-Form Scores by Gender, Race, Birthweight and Socio-economic Status from 9 to 24 Months, ECLS-B.

	Bayley Mental Scores			Bayley Motor Scores		
	9 Months	24 Months	Gain	9 Months	24 Months	Gain
Total						
Female	75.13	127.28	52.15	54.60	81.10	26.50
Male	74.57	123.84	49.27	54.55	80.49	25.94
	.57	3.44	2.87	.05	.60	.55
Birthweight						
Normal						
Female	76.84	128.94	52.09	56.13	81.86	25.73
Male	76.18	125.40	49.22	56.04	81.24	25.19
	.66	3.53	2.87	.08	.62	.54
Low						
Female	72.58	125.00	52.42	52.54	80.17	27.63
Male	71.74	121.42	49.69	52.30	79.43	27.12
	.85	3.58	2.73	.24	.74	.51
Very Low						
Female	67.74	119.55	51.81	47.77	77.36	29.59
Male	66.49	115.34	48.85	46.50	76.37	29.87
	1.25	4.21	2.96	1.27	.98	-.29
Race						
White						
Female	74.82	129.57	54.75	53.82	80.99	27.17
Male	74.36	125.97	51.62	53.54	80.34	26.80
	.47	3.60	3.13	.28	.65	.38
Black						
Female	74.14	123.56	49.42	55.14	81.63	26.49
Male	73.13	120.68	47.55	54.98	80.69	25.71
	1.02	2.89	1.87	.16	.94	.78

Table 3. OLS Regression BSF-R Mental and Motor Scores, ECLS-B.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7a	Model 7b[t]
Female	.695 ***	.761 ***	.808 ***	.813 ***	.816 ***	.731 ***	.793 ***	.199 *
	(.172)	(.109)	(.106)	(.106)	(.106)	(.094)	(.101)	(.100)
Age in Months		4.235 ***	4.278 ***	4.281 ***	4.274 ***	4.231 ***	4.185 ***	3.341 ***
		(.040)	(.039)	(.039)	(.039)	(.034)	(.037)	(.037)
Low Birthweight			-3.027 ***	-2.998 ***	-2.968 ***	-2.999 ***	-2.882 ***	-3.394 ***
			(.168)	(.168)	(.168)	(.146)	(.160)	(.158)
SES				.156 ***	.241 ***	.200 **	.048	-.047
				(.038)	(.048)	(.043)	(.049)	(.048)
Mother's Age					-.231 ***	-.094 *	-.130 *	-.255 ***
					(.048)	(.046)	(.051)	(.050)
Black (ref. White)					-.291	-.104	.098	1.401 ***
					(.171)	(.159)	(.174)	(.171)
Hispanic					-.294 *	-.275 *	-.005	-.087
					(.147)	(.128)	(.141)	(.139)
Asian					-.988 **	-1.066 ***	-.772 *	.550
					(.353)	(.283)	(.322)	(.318)
Native American					-.412	-.315	.000	.264
					(.763)	(.699)	(.739)	(.727)
Other Race					-.369	-.330	-.395	.590 *
					(.279)	(.250)	(.270)	(.266)
Rural (ref. Urban)					.676 ***	.755 ***	.740 ***	.455 **
					(.157)	(.143)	(.152)	(.150)
Suburban					.065	.036	.092	.469 **
					(.168)	(.149)	(.160)	(.157)
Biological Parents						.112	.264	-.081
						(.132)	(.144)	(.142)
Sibling Size						-.325 ***	-.346 ***	-.138 **
						(.047)	(.052)	(.051)
Parental Involvemnt							.409 ***	.249 ***
							(.055)	(.054)
Parent Score							.124 ***	.026 *
							(.012)	(.012)
Authoritarian Parenting							-.020	-.105 *
							(.051)	(.050)
Mother Employed							.245 *	.226 *
							(.110)	(.108)
Constant	76.94 ***	33.59 ***	36.41 ***	35.87 ***	36.43 ***	36.74 ***	33.26 ***	26.45 ***
	(.120)	(.412)	(.433)	(.453)	(.474)	(.424)	(.676)	(.666)
N	10193	10192	10153	10152	10075	10073	8213	8194
d.f.	1	2	3	4	12	14	18	18

[t]Motor Scores as measured by BSF-R

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