

**Within-and Between-school Contributions to Black-White Test Score Gap Changes during
School and Summer Vacation:
Evidence of the Effects of Differential School Quality by Race**

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Background

Scholars have argued that schools serve as “equalizers” because test score gaps generally grow more during the school year than the summer (Downey, von Hippel, & Broh, 2004). However, the Black-White gap is an exception: analyses using the ECLS-K:99 showed the Black-White gap grew during the school year but not the summer; this finding was largely replicated in recent analyses of the ECLS-K:2011 (Quinn, Cooc, McIntyre, & Gomez, 2016). Researchers probing these results have concluded that differential school quality by race explains this pattern. Analyzing the ECLS-K:99, Condrón (2009) concluded that while non-school factors were primarily responsible for gap-growth by social class, school factors associated with race were responsible for growth in the (SES-adjusted) Black-White gap. Similarly, using the ECLS-K:2011, Quinn (2015) concluded from gap decompositions that Black-White reading gap-growth over kindergarten was likely a result of differential school quality by race.

Combing within vs. between-school gap decompositions with seasonal analyses will provide stronger evidence of the types of mechanisms behind observed gap patterns. For example, while the Black-White reading gap widens primarily between schools over K, this could be due to non-school factors. If gaps continue to widen between-schools over the summer, this would suggest that non-school factors are responsible for between-school widening during school; however, if gaps narrow or do not change between-schools over the summer, this would suggest that differential school quality by race is responsible for the between-school gap widening over the school year.

In this study, I ask: To what extent do Black-White test score gaps change within versus between schools over the school year and summer, from K to grade 2?

Methods

I use data from the ECLS-K:2011, a nationally-representative longitudinal study. All students were tested in the fall and spring of K and spring of 1st and 2nd; I use only data from students who also were randomly selected for additional fall testing in 1st and 2nd (~30% subsample), and who attended schools with a nine-month calendar. My outcomes are wave-standardized math/reading theta scores from fall of K through spring of second.

I apply a decomposition method developed by Reardon (2008), and expanded on by Page, Murnane, and Willett (2008). Reardon decomposes the gap (or gap change) into three portions: 1) unambiguously within-school, 2) unambiguously between-school, and 3) ambiguous. Combining the ambiguous portion with the unambiguously within-school portion yields the school-fixed effects decomposition; combining the ambiguous portion with the unambiguously between-school portion yields a decomposition proposed by Hanushek and Rivkin (2006) that weights gap components to account for segregation. I present all three gap components, but, following Reardon (2008), prefer the HR decomposition for substantive reasons.

The decomposition is performed by first fitting models of the form:

$$(1) \quad \Delta Y_{is} = \beta_0 + \beta_1(B_{is}) + \beta_2(\bar{B}_s) + \beta_3(SES_{is}) + \beta_4(\overline{SES}_s) + \sum(\beta_k C_{is} + \beta_l \bar{C}_s) + \epsilon_{is}$$

where ΔY_{is} is the change in z-score (adjusted for test reliability) over a given period of time (K school year, post-K summer, grade 1, post-grade 1 summer, or grade 2) for student i in school s , B_{is} is an indicator that the student is Black, \bar{B}_s is the mean of B_{is} for school s (i.e., the proportion of students attending school s who are Black), SES_{is} is student i 's value on an SES composite (parental income, education, and occupational prestige), \overline{SES}_s is the mean SES of students in school s , and $\sum(\beta_k C_{is} + \beta_l \bar{C}_s)$ represents a vector of student-level predictors and their school-level means; predictors include race indicators for Hispanic, Asian, and other race; an indicator for whether student i was a first-time kindergartener; student i 's age at the time of the fall K

assessment. The estimated total unadjusted change in the Black-White gap ($\Delta \hat{\delta}$) over a given period can then be expressed as a function of the parameter estimates from model 1, the mean Black-White difference on each of the predictor variables ($\bar{C}_l^b - \bar{C}_l^w$), and the mean Black-White difference on the school-level means of the predictors ($\bar{C}_s^B - \bar{C}_s^W$):

$$(2) \quad \Delta \delta = \hat{\beta}_1 \left(1 - (\bar{B}_s^B - \bar{B}_s^W) \right) + \beta_1 (\bar{B}_s^B - \bar{B}_s^W) + \hat{\beta}_2 (\bar{B}_s^B - \bar{B}_s^W) \\ + \hat{\beta}_3 (\overline{SES}_i^B - \overline{SES}_i^W) (1 - (\overline{SES}_s^B - \overline{SES}_s^W)) + \hat{\beta}_3 (\overline{SES}_i^B - \overline{SES}_i^W) (\overline{SES}_s^B - \overline{SES}_s^W) \\ + \hat{\beta}_4 (\overline{SES}_s^B - \overline{SES}_s^W) \\ + \sum \hat{\beta}_k (\bar{C}_l^b - \bar{C}_l^w) (1 - (\bar{C}_s^B - \bar{C}_s^W)) + \sum \hat{\beta}_k (\bar{C}_l^b - \bar{C}_l^w) (\bar{C}_s^B - \bar{C}_s^W) + \sum \hat{\beta}_l (\bar{C}_s^B - \bar{C}_s^W) \\ + \sum \beta^{race} (\overline{race}_s^B - \overline{race}_s^W)$$

In (2), the first term on the first line of the RHS is the change in the adjusted unambiguously within-school gap, the second term is the adjusted ambiguous portion, and the third is the adjusted unambiguously between-school gap.

Results

Table 1 presents the decomposition results for changes in the Black-White reading gap by season. I show the total (unadjusted) gap change each season and the adjusted within, ambiguous, between, and total between-school portions (adjusting for within- and between-school effects of SES and other controls). I include the within, ambiguous, between, and total between-school contributions of SES each period. Table 2 presents analogous results for math.

As expected, the first three seasons show Black-White reading gap widening over the school year and narrowing over summer. Net of control, the school-year widening and summer narrowing primarily occurs between-schools. In fact, the adjusted reading gap widens more between schools than does the unadjusted gap, indicating that the between-school effect of SES counteracts some of this between-school Black-White gap-widening. The opposite holds over the post-K summer: The Black-White reading gap narrows primarily between-schools while the between-school effects of SES work against this narrowing.

A similar pattern emerges for math, whereby the gap widens over K, remains stagnant over summer, then widens over first (with little change subsequently). This widening happens primarily within schools over K, but primarily between-schools over first.

Conclusion

These decompositions show that in the early years of schooling, changes in Black-White test score gaps more often occur between- rather than within-school. The pattern of between-school reading gap widening over the school year and between-school narrowing over the summer is strong evidence that differential school quality by race plays an important role in gap-widening. The mechanisms behind this pattern, as well as the explanation as to why the Black-White math gap widens primarily within-schools over K but widens primarily between-schools over first, should be subjects of future study. These analyses suggest that the best strategy for preventing gap-widening may involve heavier investments in schools with higher percentages of Black students (as opposed to redistributing resources within schools).

References

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Table 1.

Decompositions of Changes in the Black-White Reading Gap by Season into Within-school, Between-school, and Ambiguous Portions.

	Total Change	Black-White Gap (Controlling for SES)				SES Contribution (Controlling for Race)			
		Within	Ambig.	Btwn	Total Btwn (Ambig+Btwn)	Within	Ambig.	Btwn	Total Btwn (Ambig+Btwn)
K	-.149 (.093)	-.019 (.042)	-.015 (.033)	-.173* (.078)	-.188* (.073)	.047* (.019)	-.013* (.006)	.053* (.021)	.039~ (.021)
%		13%	10%	116%	126%	-32%	9%	-36%	-26%
Sum. 1	.153* (.063)	.029 (.023)	.023 (.018)	.109* (.043)	.132** (.041)	-.008 (.007)	.002 (.002)	-.034* (.017)	-.032~ (.018)
%		19%	15%	71%	86%	-5%	1%	-22%	-21%
Grade 1	-.179*** (.051)	-.031 (.021)	-.024~ (.013)	-.087 (.058)	-.111* (.053)	-.008 (.012)	.002 (.004)	.004 (.023)	.007 (.026)
%		17%	13%	49%	62%	4%	-1%	-2%	-4%
Sum. 2	.04 (.044)	.019 (.026)	.015 (.02)	.003 (.045)	.018 (.041)	.009 (.01)	-.003 (.003)	-.017 (.019)	-.02 (.02)
%		48%	38%	8%	45%	22%	-7%	-43%	-50%
Grade 2	.002 (.043)	.016 (.025)	.013 (.02)	-.009 (.041)	.004 (.035)	-.006 (.009)	.002 (.003)	-.013 (.015)	-.011 (.016)
%		800%	650%	-450%	200%	-300%	100%	-650%	-550%

Note. Standard errors that adjust for sampling design are in parentheses. Decompositions also control for the within-school and between-school effects of student age, whether child is a first-time kindergartener, and school racial composition (not shown); gap components shown here therefore do not sum to total. Gap changes are differences in gaps standardized by wave-specific standard deviation units. Estimated from models that include all students who participated in fall sub-sample. Change score differences are standardized by the sd of the first time period included in the difference. Sampling weight=WIC0.

Table 2.

Decompositions of Changes in the Black-White Math Gap by Season into Within-school, Between-school, and Ambiguous Portions

	Total Change	Black-White Gap (Controlling for SES)				SES Contribution (Controlling for Race)			
		Within	Ambig.	Btwn	Total Btwn (Ambig+Btwn)	Within	Ambig.	Btwn	Total Btwn (Ambig+Btwn)
K	-.174*** (.046)	-.114** (.035)	-.091*** (.025)	.01 (.059)	-.081 (.049)	0 (.014)	0 (.004)	.023 (.021)	.023 (.022)
%		66%	52%	-6%	47%	0%	0%	-13%	-13%
Sum. 1	.016 (.068)	-.047 (.03)	-.038 (.027)	.077 (.049)	.039 (.045)	-.001 (.014)	0 (.004)	-.009 (.024)	-.009 (.026)
%		-294%	-237%	481%	244%	-6%	0%	-56%	-56%
Grade 1	-.123** (.043)	-.009 (.018)	-.007 (.014)	-.085~ (.046)	-.093* (.042)	-.006 (.013)	.002 (.004)	.016 (.019)	.017 (.021)
%		7%	6%	69%	76%	5%	-2%	-13%	-14%
Sum. 2	.006 (.038)	-.005 (.02)	-.004 (.016)	-.041 (.042)	-.045 (.037)	.013 (.01)	-.004 (.003)	.029* (.012)	.026~ (.013)
%		-83%	-67%	-683%	-750%	217%	-67%	483%	433%
Grade 2	-.08~ (.041)	-.036 (.023)	-.029 (.018)	-.01 (.04)	-.039 (.035)	.015 (.012)	-.004 (.004)	-.006 (.015)	-.01 (.017)
%		45%	36%	13%	49%	-19%	5%	8%	13%

Note. Standard errors that adjust for sampling design are in parentheses. Decompositions also control for the within-school and between-school effects of student age, whether child is a first-time kindergartener, and school racial composition (not shown); gap components shown here therefore do not sum to total. Gap changes are differences in gaps standardized by wave-specific standard deviation units. Estimated from models that include all students who participated in fall sub-sample. Change score differences are standardized by the sd of the first time period included in the difference. Sampling weight=WIC0.