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Integrated Education and Mathematics Outcomes: A Synthesis of Social Science Research

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INTEGRATED EDUCATION AND MATHEMATICS OUTCOMES: A SYNTHESIS OF SOCIAL SCIENCE RESEARCH*

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Mastery of mathematics and science by this nation's youth is essential for the nation's future development as well as students' personal growth and economic well-being. Yet the performance of U.S. students in mathematics and science is unimpressive compared to other advanced industrialized nations. In addition, stark racial and socioeconomic status ("SES") disparities in mathematics knowledge, skills, and achievement compound the predicament presented by the overall mediocre performance of U.S. students. A growing corpus of social science research indicates school racial and socioeconomic segregation are institutional sources of the disparate outcomes. Ironically, while the empirical evidence regarding the positive effects of racially and socioeconomically integrated learning environments has grown clearer and more definitive, the 2007 Supreme Court decision in Parents Involved in Community Schools v. Seattle School District No. 1 *has made it more difficult to create diverse schools.*

This Article clarifies the social science record about school composition effects on mathematics outcomes in K–12 schools by presenting a comprehensive synthesis of the educational, behavioral, and social science literatures on the topic. It combines narrative and vote-counting approaches to synthesize fifty-nine

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articles that met inclusion criteria that included: research disseminated in 1990 or later; reported effects of school racial and/or socioeconomic composition on mathematics outcomes; utilized a quantitative measure of any type of mathematics outcomes as a dependent variable; and employed appropriate statistical techniques given the structure of the data. Together, the fifty-nine articles demonstrate the relevance of school racial and socioeconomic diversity for enhancing mathematics outcomes for elementary, middle, and high school students. Mathematics outcomes are likely to be higher for students from all grade levels, racial, and SES backgrounds who attend racially and socioeconomically integrated schools. Given these findings, parents, educators, policy makers, and jurists should address the role of school racial segregation and concentrated poverty in the persistence of achievement gaps in mathematics outcomes.

INTRODUCTION

Overall mathematics and science performance by U.S. students is relatively unimpressive compared to the performance of students from other industrialized nations.[1] Mastery of mathematics and science by this nation's youth is essential for societal advancement. Innovations in the fields of science, technology, engineering, transportation, medicine, public health and safety, and commerce require citizens with mathematical knowledge and skills. The nation's ability to prepare the next generation to enter the increasingly technical workplace requires the public school system, where the vast majority of children receive their formal educations,[2] to successfully teach mathematics to all children.

Striking racial and socioeconomic status ("SES") disparities in mathematics knowledge, skills, and achievement compound the urgent predicament presented by the overall mediocre performance of U.S. students.[3] White, Asian, and middle-class students score higher on achievement tests, are more likely to enroll in more rigorous courses during high school, to attend college, and to choose scientific, mathematical, engineering, and technical majors than their

1. Maria Glod, *Scores on Science Test Causing Concerns in U.S.*, WASH. POST, Dec. 10, 2008, at A10; *see* NAT'L MATHEMATICS ADVISORY PANEL, U.S. DEP'T OF EDUC., FINAL REPORT OF THE NATIONAL MATHEMATICS ADVISORY PANEL, at xii (2008), *available at* http://www.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf.

2. NAT'L CTR. FOR EDUC. STATISTICS, U.S. DEP'T OF EDUC., NCES 2009-081, *Indicator 5—Private School Enrollment*, *in* THE CONDITION OF EDUCATION 2009, at 12, 12–13 (2009), *available at* http://nces.ed.gov/pubs2009/2009081.pdf.

3. NAT'L CTR. FOR EDUC. STATISTICS, U.S. DEP'T OF EDUC., NCES 2006-453, THE NATION'S REPORT CARD: MATHEMATICS 2005, at 6–8 (2005), *available at* http://nces.ed.gov/nationsreportcard/pdf/main2005/2006453.pdf; NAT'L CTR. FOR EDUC. STATISTICS, U.S. DEP'T OF EDUC., NCES 2006-466, THE NATION'S REPORT CARD: SCIENCE 2005, at 8–9 (2006), *available at* http://nces.ed.gov/nationsreportcard/pdf/main2005/2006466.pdf; NAT'L MATHEMATICS ADVISORY PANEL, *supra* note 1, at xii.

less advantaged working-class, Black, Latino/a, and Native American counterparts.[4] Weak mathematics knowledge and skills are not only detrimental for disadvantaged youths' futures and their communities' well-being, but collectively their poor mathematics outcomes are problematic for the nation's future workforce given the relative youthfulness and high growth rates of Black, Latino/a, Native American, and low-income populations.[5]

The importance of numeracy to students' long-term educational and occupational success is increasing. Workers across almost every occupational strata employ mathematical concepts in their everyday lives.[6] Math educator and MacArthur Foundation Genius Award winner Robert Moses characterizes numeracy, particularly in algebra, as a civil right.[7] Mastery of algebra is a gateway to higher level mathematics, science, and technology courses during secondary school.[8] Moses argues that economic access and full citizenship depend crucially upon math and science literacy.[9] He compares disadvantaged youths' struggles for opportunities to learn mathematics and science to their parents' struggles to secure political access in the form of voting rights during the 1950s and 1960s.[10] Economic access—in particular, professional and entrepreneurial opportunities in the information economy—is largely restricted to those with knowledge, skills, and understandings of mathematics,

4. COLLEGE BD., COLLEGE-BOUND SENIORS 2008: TOTAL GROUP PROFILE REPORT 3–4 (2008), http://professionals.collegeboard.com/profdownload/Total_Group_Report.pdf; NAT'L CTR. FOR EDUC. STATISTICS, U.S. DEP'T OF EDUC., NCES 2007-467, AMERICA'S HIGH SCHOOL GRADUATES: RESULTS FROM THE 2005 NAEP HIGH SCHOOL TRANSCRIPT STUDY 26–33 (2007), *available at* http://nces.ed.gov/nationsreportcard/pdf/studies/2007467.pdf.

5. NAT'L MATHEMATICS ADVISORY PANEL, *supra* note 1, at xii.

6. *Id.*; *see* COMM'N ON MATHEMATICS & SCI. EDUC., THE CARNEGIE CORP. OF N.Y., THE OPPORTUNITY EQUATION: TRANSFORMING MATHEMATICS AND SCIENCE EDUCATION FOR CITIZENSHIP AND THE GLOBAL ECONOMY, at vii (2008), *available at* http://www.opportunityequation.org/TheOpportunityEquation.pdf; Gail Burrill, *Mathematics Education: The Future and the Past Create a Context for Today's Issues*, *in* THE GREAT CURRICULUM DEBATE 25, 25–26 (Tom Loveless ed., 2001).

7. ROBERT P. MOSES & CHARLES E. COBB, JR., RADICAL EQUATIONS: MATH LITERACY AND CIVIL RIGHTS 12–22 (2001) (describing the case for why mathematics literacy is a contemporary civil rights issue for low-income minority students and how the Algebra Project in rural Mississippi approaches the challenge of meeting the numeracy challenge).

8. *Id.*

9. *Id.*

10. *Id.*

science, and technology.[11] Reconceptualizing the nature of the gaps as between children of color and low-income youths' current underachievement and their potential to meet criterion levels of performance,[12] rather than as among the races or the classes, as is typically done, positions educators and policy makers to identify the social structural sources of the gaps.

Social structural, or institutional, sources constitute only one aspect of a complex dynamic that underlies the gaps. This dynamic involves individual motivation and abilities; family financial, cultural, and social capital resources; community forces such as norms and values; as well as the social structure of opportunities to learn.[13] These structural and historical processes organize access and give meaning to an individual's mathematics participation and achievement.[14] Importantly, institutional contributions to racial and SES gaps in mathematics outcomes are more amenable to change through policy actions than factors like motivation, cultural norms, or family income.

School racial segregation is a notorious institutional source of the disparities. From the era of *Brown v. Board of Education*[15] through the early 1990s, Supreme Court opinions[16] and many public policies

11. William F. Tate, *School Mathematics and African American Students: Thinking Seriously About Opportunity-to-Learn Standards*, 31 EDUC. ADMIN. Q. 424, 424–34 (1995).

12. Asa G. Hilliard III, *No Mystery: Closing the Achievement Gap Between African Americans and Excellence*, *in* YOUNG GIFTED AND BLACK 131, 138 (Theresa Perry, Claude Steele & Asa G. Hilliard III eds., 2003).

13. DANIEL CHAZAN, BEYOND FORMULAS IN MATHEMATICS AND TEACHING: DYNAMICS OF THE HIGH SCHOOL ALGEBRA CLASSROOM 55–57 (2000); DANNY BERNARD MARTIN, MATHEMATICS SUCCESS AND FAILURE AMONG AFRICAN-AMERICAN YOUTH: THE ROLES OF SOCIOHISTORICAL CONTEXT, COMMUNITY FORCES, SCHOOL INFLUENCE, AND INDIVIDUAL AGENCY, at vii (2000).

14. CHAZAN, *supra* note 13, at 55–57; Rogers Hall, Book Review, EDUC. RESEARCHER, Oct. 2002, at 39, 39 (reviewing ROBERT P. MOSES & CHARLES E. COBB, JR., RADICAL EQUATIONS: MATH LITERACY AND CIVIL RIGHTS (1999), DANNY BERNARD MARTIN, MATHEMATICS SUCCESS AND FAILURE AMONG AFRICAN-AMERICAN YOUTH: THE ROLES OF SOCIOHISTORICAL CONTEXT, COMMUNITY FORCES, SCHOOL INFLUENCE, AND INDIVIDUAL AGENCY (2000)).

15. 347 U.S. 483 (1954). In *Mendez v. Westminster School District*, 161 F.2d 774, 780 (9th Cir. 1947) (en banc), the Ninth Circuit held that the segregation of Mexican American students violated state law and, only by extension, their constitutional rights. Although the ruling applied to segregation in California public schools, it foreshadowed *Brown*. *See* Vicki L. Ruiz, *We Always Tell Our Children They Are Americans:* Mendez v. Westminster *and the California Road to* Brown v. Board of Education, 2003 C. BD. REV. 1, 3.

16. Jack Boger, A Quick Look at the Remedial Responsibilities Under the Federal Constitution for School Districts Found to Have Practiced De Jure, or Intentional Segregation of Their Public Schools—And a Judicial Consideration of the Relation Between Continuing School Segregation and Private Housing Choices in Formerly

had been directed—with varying degrees of clarity and success—at creating schools that are not organized along racial lines. The nation made substantial progress toward this goal through the 1980s, especially in the South, after federal court orders to desegregate were eventually implemented.[17] Since the mid-1980s, however, progress toward integrated education has faltered as the federal government stepped back from pursuing desegregation, and once-desegregated schools in many areas began to resegregate.[18] School socioeconomic segregation, which is closely correlated with racial segregation, intensified as well.[19]

One aspect of the debate about the effects of school race and school SES composition concerns whether race effects are, in fact, actually SES effects. Racial gaps in achievement and other educational outcomes persist even after researchers control for parental income, education, and other measures of socioeconomic status.[20] Importantly, racial gaps in mathematics achievement remain after statistically controlling for mechanisms widely believed to be the underlying explanations for SES gaps in achievement.[21]

Segregated School Districts 1–3 (May 2, 2002) (unpublished manuscript, on file with the North Carolina Law Review) (summarizing Supreme Court jurisprudence). *See generally* ANGELO N. ANCHETA, SCIENTIFIC EVIDENCE AND EQUAL PROTECTION OF THE LAW (2006) (analyzing the role of scientific evidence in judicial processes in key equal protection cases); RICHARD KLUGER, SIMPLE JUSTICE: THE HISTORY OF *BROWN V. BOARD OF EDUCATION* AND BLACK AMERICA'S STRUGGLE FOR EQUALITY (1975) (chronicling the twentieth-century history of school segregation and desegregation efforts that culminated in the 1954 *Brown* decision).

17. Erwin Chermerinsky, *The Segregation and Resegregation of American Public Education: The Courts' Role*, *in* SCHOOL RESEGREGATION: MUST THE SOUTH TURN BACK? 29, 29 (John Charles Boger & Gary Orfield eds., 2005).

18. *See* GARY ORFIELD & ERICA FRANKENBERG, THE CIVIL RIGHTS PROJECT/*PROYECTO DERECHOS CIVILES* (UCLA), THE LAST HAVE BECOME FIRST: RURAL AND SMALL TOWN AMERICA LEAD THE WAY ON DESEGREGATION 6 (2008), *available at* http://www.civilrightsproject.ucla.edu/research/deseg/lasthavebecomefirst.pdf (reporting on trends in racial and economic segregation by type and size of community).

19. *Id.* at 8; GARY ORFIELD, THE CIVIL RIGHTS PROJECT/*PROYECTO DERECHOS CIVILES* (UCLA), REVIVING THE GOAL OF AN INTEGRATED SOCIETY: A 21ST CENTURY CHALLENGE 9 (2009), *available at* http://www.civilrightsproject.ucla.edu/research/deseg/reviving_the_goal_mlk_2009.pdf.

20. Eric Grodsky, John Robert Warren & Erika Felts, *Testing and Social Stratification in American Education*, 34 ANN. REV. SOC. 385, 387 (2008); Stephanie Moller et al., *Smooth and Rough Roads to Academic Achievement: Retention and Race/Class Disparities in High School*, 35 SOC. SCI. RES. 157, 159, 167 (2006).

21. Katerina Bodovski & George Farkas, *"Concerted Cultivation" and Unequal Achievement in Elementary School*, 37 SOC. SCI. RES. 903, 917 (2008); Jacob E. Cheadle,

Unpacking the unique contributions of racial composition and SES composition to achievement outcomes is a methodological challenge with striking implications for educational policy and practice. For example, if SES and race are not interchangeable constructs, using SES as a criterion for pupil assignment will not achieve racially diverse schools.[22] Statistically decomposing race effects from SES effects is premised on a belief that they are distinct social forces. Even though the analytic strategies used in many of the studies synthesized in this Article isolate the effects of a school's racial composition from the effects of its socioeconomic composition, in practice the two social constructs are interwoven—sometimes seamlessly—in the lived realities of students and schools. The actual experience of attending a racially diverse low-poverty school is very different from attending a racially diverse high-poverty school. Similarly, students experience their lives at the intersections of their own race, class, and gender as White working-class females or Black middle-class males, or as wealthy Asian immigrants, or as low-income Latinas, and so on. But being able to statistically identify the unique contribution of race and SES to school effects should not allow us to disregard how the two constructs interact, and how the resulting experience is different than merely the sum of their distinct parts.

This Article focuses on the relationships between persistent gaps in mathematics achievement and the racial and socioeconomic composition of the K–12 schools students attend.[23] Contemporary efforts to improve mathematics outcomes generally focus on improving curricula, enhancing teacher quality, and the three linked reform strategies of standards, assessment, and accountability.[24] Compared to much of the second half of the twentieth century when desegregation efforts were front-and-center to reform efforts, today

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Educational Investment, Family Context, and Children's Math and Reading Growth from Kindergarten Through the Third Grade, 81 SOC. EDUC. 1, 13–15 (2008).

22. *See* Brief of Amicus Curiae Walt Sherlin in Support of Respondents at 2–4, Parents Involved in Cmty. Sch. v. Seattle Sch. Dist. No. 1, 551 U.S. 701 (2007) (Nos. 05-908 & 05-915); Sean F. Reardon, John T. Yun & Michal Kurlaender, *Implications of Income-Based School Assignment Policies for Racial School Segregation*, 28 EDUC. EVALUATION & POL'Y ANALYSIS 49, 55–57, 67 (2006).

23. This Article is the first in a series of manuscripts the authors plan to write. Subsequent articles will synthesize the social and behavioral science literatures on science outcomes, reading and verbal achievement, and nonacademic outcomes that unfold over the life course (e.g., interracial friendship patterns, occupational attainment, characteristics of adult neighborhoods and workplaces, and criminal justice outcomes).

24. *See* NAT'L MATHEMATICS ADVISORY PANEL, *supra* note 1, at xvi–xxv.

policy makers and researchers pay much less attention to the role that school racial composition has on educational outcomes.[25]

Recent empirical research demonstrates that compositional characteristics of schools and classrooms are important contributing factors to persistent race, ethnic, and social class differences in achievement.[26] A sizable body of high quality social science research reports that students attending schools with concentrations of low-income and disadvantaged minority populations achieve much less academic progress than their counterparts in integrated schools.[27]

Ironically, while the empirical evidence regarding the positive effects of racially and socioeconomically integrated learning environments has grown clearer and more definitive, the 2007 Supreme Court decision in *Parents Involved in Community Schools v. Seattle School District No. 1*[28] has made it more difficult to create diverse schools. In *Parents Involved*, the Court concluded that the ways the Seattle and Louisville school districts used an individual student's race as a component of their voluntary desegregation assignment plans were unconstitutional because the plans were insufficiently narrowly tailored to meet the Court's standards for strict scrutiny.[29] The decision limits the ways in which school districts are able to use individual students' race for school assignments.[30] Significantly, five Justices recognized the state's compelling interest in creating diverse public schools and in overcoming the growing racial isolation within them.[31]

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25. *See* Janice Petrovich, *The Shifting Terrain of Educational Policy*, *in* BRINGING EQUITY BACK: RESEARCH FOR A NEW ERA IN AMERICAN EDUCATIONAL POLICY 3, 6–7 (Janice Petrovich & Amy Stuart Wells eds., 2005).

26. *See generally* Roslyn Arlin Mickelson, *Twenty-First Century Social Science on School Racial Diversity and Educational Outcomes*, 69 OHIO ST. L.J. 1173 (2008) (discussing new research on racial diversity in schools); Jacob L. Vigdor & Jens Ludwig, *Segregation and the Test Score Gap*, *in* STEADY GAINS AND STALLED PROGRESS: INEQUALITY AND THE BLACK-WHITE TEST SCORE GAP 181 (Katherine Magnuson & Jane Waldfogel eds., 2008) (reviewing test gap literature).

27. *See infra* Part V; Appendix.

28. 551 U.S. 701 (2007).

29. *Id.* at 720, 747–48.

30. Posting of Jim Ryan to Supreme Court—School Integration, http://scintegration.blogspot.com/2007/06/guest-blogger-seattle-schools-and-bakke.html (June 28, 2007, 14:19 EST).

31. *Parents Involved*, 551 U.S. at 782 (Kennedy, J., concurring); *id.* at 840 (Breyer, J., dissenting).

The Article proceeds as follows. After discussing its relevance in light of *Parents Involved*, the Article describes the nature of race and SES disparities in mathematics outcomes. The Article then explains the methodology used to conduct the integrative synthesis of the literature, presents findings, and concludes with a discussion of their implications for further research and school reform policies aimed at both improving mathematics outcomes for all students and narrowing the race and SES gaps in performance.

I. BACKGROUND

Scholars of the Court have raised serious questions about social science's influence in Supreme Court decision making, especially in desegregation cases.[32] The extent to which social science research influenced the Justices' decision making in *Parents Involved* is unclear.[33] Nonetheless, several Justices referred to social science

32. Scholars from many disciplines have commented extensively on the use of social science amicus briefs in educational rights cases. This lively debate is, however, beyond the scope of this paper. *See, e.g.*, ANCHETA, *supra* note 16, *passim*; MARK A. CHESLER, JOSEPH SANDERS & DEBRA S. KALMUSS, SOCIAL SCIENCE IN COURT: MOBILIZING EXPERTS IN THE SCHOOL DESEGREGATION CASES *passim* (1988); Angelo Ancheta, *Civil Rights, Education Research, and the Courts*, 35 EDUC. RESEARCHER Jan.–Feb. 2006, at 26, 26–27; Lee Epstein & Jack Knight, *Mapping Out the Strategic Terrain: The Informational Role of Amici Curiae, in* SUPREME COURT DECISION-MAKING: NEW INSTITUTIONALIST APPROACHES 215 *passim* (Cornell W. Clayton & Howard Gillman eds., 1999); Herbert Garfinkel, *Social Science Evidence and the School Segregation Cases*, 21 J. POL. 37, 38 (1959); Murray Levine & Barbara Howe, *The Penetration of Social Science into Legal Culture*, 7 LAW & POL'Y 173 *passim* (1985); Samuel R. Lucas & Marcel Paret, *Law, Race, and Education in the United States*, 1 ANN. REV. L. & SOC. SCI. 203, 203–04 (2005); Kelly J. Lynch, *Best Friends?: Supreme Court Law Clerks on Effective Amicus Curiae Briefs*, 20 J.L. & POL. 33, 34–36 (2004); Beverly I. Moran, *Constructing Reality: Social Science and Race Cases*, 25 N. ILL. U. L. REV. 243 *passim* (2005); Ronald Roesch et al., *Social Science and the Courts: The Role of Amicus Curiae Briefs*, 15 LAW & HUM. BEHAV. 1, 2–3 (1991); Michael Rustad & Thomas Koenig, *The Supreme Court and Junk Social Science: Selective Distortions in Amicus Briefs*, 72 N.C. L. REV. 91, 119–39 (1993); James E. Ryan, *The Limited Influence of Social Science Evidence in Modern Desegregation Cases*, 81 N.C. L. REV. 1659, 1659–61 (2003); Janet Ward Schofield & Linda R. M. Hausmann, *School Desegregation and Social Science Research*, 59 AM. PSYCHOLOGIST 538, 543–45 (2004); William L. Taylor, *Introduction and Overview: The Role of Social Science in School Desegregation Efforts*, 66 J. NEGRO EDUC. 196 *passim* (1997).

33. An opinion may not cite an amicus brief although its arguments may have influenced a Justice's opinion. *See* Lynch, *supra* note 32, at 36. Conversely, as with the case of the famous social science citations in *Brown*'s footnote 11, Brown v. Board of Education (*Brown I*), 347 U.S. 483, 494 n.11 (1959), which was not crucial to the *Brown* decision, 2 KLUGER, *supra* note 16, at 706, a citation of an amicus brief's social science argument does not necessarily mean it was vital to the Justice's opinion.

research in their opinions. The majority, concurring, and dissenting opinions expressed diametrically different interpretations of the social science research record on whether or not student body racial composition affects achievement. The opinions of Justice Breyer and Justice Thomas are emblematic of this tension: Justice Breyer referred repeatedly to the voluminous social science research record that shows positive effects of racial desegregation on educational outcomes to support his opinion that there are broad compelling interests in diversity and in avoiding racial isolation.[34] In contrast, Justice Thomas wrote that the scientific record is too ambiguous and contradictory to support a compelling interest in diversity.[35] His opinion quoted directly from the text of two social science amicus briefs filed on behalf of the petitioners to support his view: " '[i]n study after study, racial composition of a student body, when isolated, proves to be an insignificant determinant of student achievement,' "[36] and again with respect to the inferences about compelling interests from the school diversity literature: " 'the research shows that there is no clear and consistent evidence of [educational] benefits' " of diverse schools.[37]

The references to social science research in the other *Parents Involved* opinions were more oblique. Chief Justice Roberts's plurality opinion did not cite any social science research or any of the social science briefs.[38] But he noted that "[t]he parties and their *amici* dispute whether racial diversity in schools in fact has a marked impact

34. *Parents Involved*, 551 U.S. at 839–45 (Breyer, J., dissenting).

35. *Id.* at 761 (Thomas, J., concurring). Justice Thomas's opinion selectively cited from the corpus of social science and from portions of specific works of social science. For instance, Justice Thomas correctly noted that even in desegregated schools, Blacks are often resegregated by academic tracking. His opinion ignored the other findings in the same articles that demonstrated the benefits for Black and White students of attending a racially diverse school despite the deleterious effects of tracking. *See* Roslyn Arlin Mickelson, *Subverting Swann: First- and Second-Generation Segregation in the Charlotte-Mecklenburg Schools*, 38 AM. EDUC. RES. J. 215, 233–34 (2001) (describing this practice in the Charlotte-Mecklenburg Schools system); Susan Yonezawa et al., *Choosing Tracks: "Freedom of Choice" in Detracting Schools*, 39 AM. EDUC. RES. J. 37, 38 (2002) (discussing voluntary detracking programs and their effectiveness).

36. *Parents Involved*, 551 U.S. at 762 (Thomas, J., concurring) (alteration in original) (quoting Brief of Amici Curiae Drs. Murphy et al. in Support of Petitioners at 8, *Parents Involved*, 551 U.S. 701 (Nos. 05-908 & 05-915)).

37. *Id.* at 763 (alteration in original) (quoting Brief for David J. Armor et al. as Amici Curiae Supporting Petitioners at 29, *Parents Involved*, 551 U.S. 701 (Nos. 05-908 & 05-915)).

38. *Id.* at 708–48 (plurality opinion).

on test scores and other objective yardsticks or achieves intangible socialization benefits."[39] Neither Justice Kennedy's opinion nor Justice Stevens's dissent directly referred to a social science study or to a specific social science amicus brief.[40]

Putting aside the question of how much the social science record did or did not contribute to the Justices' opinions, their conflicting interpretations of the social science record suggest a need to clarify precisely what is known about the effects of school racial and SES composition on mathematics outcomes.

The primary aim of this Article is to clarify the social science record about school composition effects on mathematics outcomes in K–12 schools by presenting a comprehensive synthesis of the educational, behavioral, and social science literatures on the topic. The need to clarify the scientific record arises not only from the conflicting interpretations displayed in the *Parents Involved* opinions but also because of the serious and persistent race and SES gaps in mathematics performance among the nation's youth.

Many eminent social scientists have summarized this literature within the last two decades. Almost half of the amicus briefs filed in *Parents Involved* included summaries of some of the relevant social science.[41] It is, thus, reasonable to ask what benefits to scientific knowledge or public policy a new synthesis will offer. There are several reasons this Article's synthesis is timely and useful.

This Article is a more comprehensive and current review of the scientific literature on school compositional effects on mathematics outcomes than any of the recent syntheses that appeared either as published research or amicus briefs. In recent years, the corpus of high quality research on the topic of compositional effects has increased dramatically, but many of the high quality newer empirical works were not included in the previous social science syntheses.[42]

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39. *Id.* at 726.

40. *See id.* at 782–98 (Kennedy, J. concurring); *id.* at 798–803 (Stevens, J., dissenting).

41. COMM. ON SOC. SCI. RESEARCH EVIDENCE ON RACIAL DIVERSITY IN SCH., NAT'L ACAD. OF EDUC., RACE CONSCIOUS POLICIES FOR ASSIGNING STUDENTS TO SCHOOLS: SOCIAL SCIENCE RESEARCH AND SUPREME COURT CASES 1 (Robert L. Linn & Kevin G. Welner eds., 2007) [hereinafter NAEd REPORT], *available at* http://www.naeducation.org/Meredith_Report.pdf (summarizing the social science research found in the sixty-four amicus briefs submitted in *Parents Involved*).

42. *See generally* David J. Armor, *Desegregation and Academic Achievement*, *in* SCHOOL DESEGREGATION IN THE 21ST CENTURY 147 (Christine H. Rossell, David J. Armor & Herbert J. Walberg eds., 2002) (arguing that desegregation offers too few

Even the most conscientious efforts to include the current research in a comprehensive synthesis unavoidably exclude key studies because of the constant appearance of new studies on any given topic.

More recent research on the topic is superior in quality to older studies of compositional effects on educational outcomes. Many early studies were experiments or quasi-experiments of desegregation plans implemented in a single school district, where researchers employed small samples to evaluate a specific desegregation plan's outcomes within one or two years of the plan's implementation.[43] A number of the early experimental studies on school desegregation were affected by sample attrition, nonrandom assignment to experimental and control conditions, weak measures of key constructs, or incomplete or inappropriate implementation of the desegregation treatment—all threats to the studies' internal validity.[44] Much of the research about the effects of desegregation on Black students' achievement conducted between 1959 and the mid-1970s was inconsistent in its findings largely because it was methodologically inadequate.[45]

Even when the earlier research designs were experimental studies that randomly assigned subjects to the desegregation treatment, their subjects were not randomly selected to participate in the study.[46] Therefore, at best, the early studies tell us about desegregation effects in a particular community, but they cannot be

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benefits and too many costs to be a viable school reform strategy); Jomills Henry Braddock III & Tamela McNulty Eitle, *The Effects of School Desegregation*, *in* HANDBOOK OF RESEARCH ON MULTICULTURAL EDUCATION 828 (James A. Banks ed., 2d ed. 2003) (indicating how school desegregation stimulates positive cognitive and social psychological outcomes for majority and minority youth); Maureen T. Hallinan, *Diversity Effects on Student Outcomes: Social Science*, 59 OHIO. ST. L.J. 733 (1998) (summarizing social science evidence on school diversity effects); Linda R. Tropp & Mary A. Prenovost, *The Role of Intergroup Contact in Predicting Children's Interethnic Attitudes: Evidence from Meta-Analytic and Field Studies*, *in* INTERGROUP ATTITUDES AND RELATIONS IN CHILDHOOD THROUGH ADULTHOOD 236 (Sheri R. Levy & Melanie Killen eds., 2008) (synthesizing research that demonstrates why diverse schooling fosters positive intergroup attitudes); Amy S. Wells & Robert L. Crain, *Perpetuation Theory and the Long-Term Effects of School Desegregation*, 64 REV. EDUC. RES. 531 (1994) (synthesizing social science research that distinguishes the short- and long-term outcomes of school desegregation); Kevin G. Welner, *K–12 Race-Conscious Student Assignment Policies: Law, Social Science, and Diversity*, 76 REV. EDUC. RES. 349 (2006) (summarizing social science evidence on school diversity effects and placing research in a legal context).

43. Mickelson, *supra* note 26, at 1194.

44. *Id.* at 1186, 1195.

45. Lawrence A. Bradley & Gifford W. Bradley, *The Academic Achievement of Black Students in Desegregated Schools: A Critical Review*, 47 REV. EDUC. RES. 299, 444 (1977).

46. *See id.*; Mickelson, *supra* note 26, at 1195.

generalized to the larger population. At worst, the early studies tell us even less because of the multiple threats to their internal validity discussed above.[47]

Later studies used survey research with representative national samples. Compared to earlier studies, the later ones were more likely to employ sophisticated measures of achievement and to control for possible mediating factors like family background, school quality, and other important predictors of achievement.[48] The advanced statistical methods available in recent decades, in conjunction with better quality data, enhanced social scientists' capacities to isolate the role of school racial composition on outcomes apart from other influential factors like school socioeconomic composition, student and teacher characteristics, and family socioeconomic status.[49]

The important differences between early and later studies of school compositional effects are noteworthy because so many of the *Parents Involved* amicus briefs summarized the social science literature on the topic,[50] making aspects of the briefs resemble a

47. Mickelson, *supra* note 26, at 1195–96. Two examples illustrate the limitations of early studies. The first was an evaluation of the Riverside, California, elementary school desegregation plan. The plan was initiated in 1965 shortly after the Watts riots in nearby Los Angeles and implemented one year later. The plan consisted of one-way transfers of Black and Latino/a students to White schools. When the plan began, a minority child was, on average, one of two children of color in a classroom. It was not until the sixth and final year of the study that the percent of minority children in the classrooms (twenty percent) approximated the distribution of the minority children in the district. These (and other) implementation and design flaws undermined the integrity of the desegregation "treatment" and, hence, compromised the study's internal validity. *See* HAROLD B. GERARD & NORMAN MILLER, SCHOOL DESEGREGATION: A LONG TERM STUDY 58 (1975). Another study was an experiment of a city-to-suburban voluntary transfer program of Black children. Stanley M. Zdep, *Educating Disadvantaged Children in Suburban Schools: An Evaluation*, 1 J. APPLIED SOC. PSYCHOL. 173, 181 (1971). Thirteen Black, inner-city first-grade volunteers were distributed among six suburban first-grade classrooms, and twelve second-grade volunteers were distributed among six second-grade classrooms. After one year, the results showed significant positive effects for outcomes among first graders but no significant effects for second graders. The study's small sample, weak research design, and short implementation limited its internal validity and restricted the external validity of its conclusions. *See* Bradley & Bradley, *supra* note 45, at 438.

48. Mickelson, *supra* note 26, at 1195–96.

49. *Id.* at 1196.

50. *See generally* NAEd REPORT, *supra* note 41 (summarizing research on race-conscious student assignment policies utilizing amicus curiae briefs filed before the Supreme Court); Linda R. Tropp, Amy E. Smith & Faye J. Crosby, *The Use of Research in the Seattle and Jefferson County Desegregation Cases: Connecting Social Science and the Law*, 7 ANALYSES SOC. ISSUES & PUB. POL'Y 93 (2007) (analyzing the use of social science in the *Parents Involved* decision). Although there were many more than five

literature synthesis. But it is unwise for amicus briefs to be mistaken for literature syntheses because they are rarely as comprehensive or objective as a scholarly synthesis of a scientific literature.[51] This is understandable given that briefs and scholarly syntheses, such as this Article, have different purposes. Amicus briefs are designed to bring to the attention of the Justices information relevant to parties' legal theory.[52] But in the final analysis, all amicus briefs are to varying degrees an advocacy tool designed to convince the Court on one or more issues.

Several influential social science amicus briefs in *Parents Involved* are illustrative of this larger point. The majority of the citations to social science research in the briefs filed on behalf of the petitioners[53] relied on older studies (pre-1990) and ignored many available newer ones (post-1990) not consistent with their legal theory.[54] Without a current and complete survey of the social science literature, these amicus briefs were dated and incomplete translations of the scientific literature. By comparison, the vast majority of the studies cited in the key social science amicus briefs filed on behalf of the respondents by the American Psychological Association,[55] the

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amicus briefs filed in *Parents Involved*, sections of five key briefs authored by social scientists or organizations representing social scientists illustrate elements of a literature synthesis. *See* Brief of Amici Curiae Drs. Murphy et al. in Support of Petitioners at 8, Parents Involved in Cmty. Sch. v. Seattle Sch. Dist. No. 1, 551 U.S. 701 (2007) (Nos. 05-908 & 05-915); Brief for David J. Armor et al. as Amici Curiae Supporting Petitioners at 5, *Parents Involved*, 551 U.S. 701 (Nos. 05-908 & 05-915); Brief for 553 Social Scientists as Amici Curiae Supporting Respondents at 2, *Parents Involved*, 551 U.S. 701 (Nos. 05-908 & 05-915); Brief for the American Educational Research Ass'n as Amicus Curiae Supporting Respondents at 3, *Parents Involved*, 551 U.S. 701 (Nos. 05-908 & 05-915); Brief for Amici Curiae the American Psychological Ass'n and the Washington State Psychological Ass'n in Support of Respondents at 2, *Parents Involved*, 551 U.S. 701 (Nos. 05-908 & 05-915).

51. *See* Ronald Roesch et al., *supra* note 32 at 2–3. *See generally* Rustad & Koenig, *supra* note 32 (examining the tension between objective social science research and the social science research included in amicus briefs); Ryan, *supra* note 32 (analyzing the impact of social science research on modern desegregation cases).

52. *See* ANCHETA, *supra* note 16, at 135; Ancheta, *supra* note 32, at 28.

53. *See* Brief of Amici Curiae Drs. Murphy et al. in Support of Petitioners, *supra* note 50, *passim*; Brief for David J. Armor et al. as Amici Curiae Supporting Petitioners, *supra* note 50, *passim*. The briefs filed by Armor et al., and Murphy et al., were quoted in Justice Thomas's opinion. *Parents Involved*, 551 U.S. at 762 (Thomas, J., concurring).

54. *See* NAEd REPORT, *supra* note 41, at 17–18; Mickelson, *supra* note 26, at 1197.

55. *See* Mickelson, *supra* note 26, at 1197 (observing that eighty percent of the social science citations in the Brief for Amici Curiae the American Psychological Ass'n and the Washington State Psychological Ass'n in Support of Respondents, *supra* note 50, were from 1990 or later).

American Educational Research Association,[56] and 553 Social Scientists[57] were disseminated or published after 1990,[58] making them more reflective of the cumulative knowledge available on the topic.

Unlike the social science amicus briefs filed on behalf of the parties in *Parents Involved*, this Article's survey of the scholarly literature offers a comprehensive and current synthesis of the effects of school racial and SES composition on mathematics outcomes in K–12 schools. Additionally, unlike amicus briefs, but consistent with established conventions that require scholars to describe the methods they employed in conducting a synthesis of a body of literature, this Article specifies the methods used to search the literature, the criteria employed to select articles for inclusion, and the evaluation standards used to draw conclusions from the studies included in the synthesis.

This synthesis's focus on mathematics outcomes is unique among recent reviews of the scientific record on school compositional effects. None of the prior scholarly synthesis or the *Parents Involved* amicus briefs specifically addressed mathematics. Given the national imperative to raise overall mathematics knowledge and skills and to close race and SES gaps, a comprehensive and objective examination of the contributions of school racial and SES composition to mathematics outcomes is appropriate.

II. THE SCOPE OF THE PROBLEM

Students' mathematics performance correlates with their race and SES. Table 1 presents mean 2009 National Assessment of Educational Progress ("NAEP")[59] mathematics scale scores for

56. *See id.* (observing that seventy-nine percent of the social science citations in the Brief for the American Educational Research Ass'n as Amicus Curiae Supporting Respondents, *supra* note 50, were from 1990 or later).

57. *See id.* (observing that seventy-seven percent of the social science citations in the Brief for 553 Social Scientists as Amici Curiae Supporting Respondents, *supra* note 50, were from 1990 or later).

58. *See id.* By way of comparison, forty-eight percent of the social science citations in the Brief for David J. Armor et al. as Amici Curiae Supporting Petitioners, *supra* note 50, and forty-five percent of the social science citations in the Brief of Amici Curiae Drs. Murphy et al. in Support of Petitioners, *supra* note 50, were from 1990 or later. *See* NAEd REPORT, *supra* note 41, at 17; Mickelson, *supra* note 26, at 1197.

59. Nat'l Ctr. for Educ. Statistics, U.S. Dep't of Educ., The Nation's Report Card, Frequently Asked Questions, http://nces.ed.gov/nationsreportcard/faq.asp (last visited Feb. 13, 2010). The National Assessment of Educational Progress ("NAEP") has been conducted for more than thirty years and is sponsored by the U.S. Department of Education. NAEP is administered in grades four and eight at the state level, and in grade

students in grades four and eight and Table 2 presents the mean 2005 scores for those in grade twelve.[60]

Tables 1 and 2 indicate that Asian and White students score higher than Black, Latino/a, and Native American youth in all grades.[61] Socioeconomic differences in scores exist as well; students from higher SES families outperform youths from lower SES families.[62]

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twelve at the national level. It assesses a variety of academic subjects including science, reading, mathematics, civics, economics, geography, U.S. history, and the arts through both multiple-choice and constructed-response questions. Subject-matter achievement is reported as scale scores and as achievement levels. NAEP scale scores give a numeric summary of students' knowledge about a particular subject and are presented for different demographic groups. The NAEP Web site describes NAEP scores as the only student achievement measure of performance of students in the US that is comparable across states. *See* Nat'l Ctr. for Educ. Statistics, U.S. Dep't of Educ., NAEP—Overview, http://nces.ed.gov/nationsreportcard/about/ (last visited Feb. 23, 2010). The national NAEP sample includes all the state samples of public school students, a national sample of nonpublic school students, as well as a determinate number of students and schools in nonparticipating states. Although the majority of the participation in NAEP is voluntary for every state, school district, school, and student, all states that receive federal education funds are required by federal law to participate in NAEP mathematics and reading fourth and eighth grades' assessments. *Id.*

60. Nat'l Ctr. for Educ. Statistics, U.S. Dep't of Educ., The Nation's Report Card, Mathematics, Interpreting NAEP Mathematics Results, http://www.nces.ed.gov/nationsreportcard/mathematics/interpret-results.asp (last visited Feb. 23, 2010). The performance of students on the Mathematics NAEP tests is reported on a scale of zero to five hundred for fourth and eighth grades, and a scale from zero to three hundred for twelfth grade. The range in the twelfth grade math scale score changed in 2005. In the past, the range was zero to five hundred, similar to the other two grades. *Id.*

61. NAT'L CTR. FOR EDUC. STATISTICS, U.S. DEP'T EDUC., NCES 2010-451, THE NATION'S REPORT CARD: MATHEMATICS 2009, at 4 (2009), *available at* http://nces.ed.gov/nationsreportcard/pdf/main2009/2010451.pdf (providing data for fourth and eighth graders). The most recent published report for NAEP scores of twelfth graders dates from 2007, reporting results from 2005. *See* NAT'L CTR. FOR EDUC. STATISTICS, U.S. DEP'T OF EDUC., NCES 2007-468, THE NATION'S REPORT CARD: 12TH GRADE READING AND MATHEMATICS 2005, at 17 (2007), *available at* http://nces.ed.gov/nationsreportcard/pdf/main2005/2007468.pdf. NAEP reports results by fourth and eighth grade students' socioeconomic status ("SES") in terms of whether their family qualifies for free and/or reduced price lunches ("FRL"). Because high school student data on FRL status is not always reliable, NAEP reports results for twelfth grade students by their parents' educational attainment.

62. NAT'L CTR. FOR EDUC. STATISTICS, THE NATION'S REPORT CARD: MATHEMATICS 2009, *supra* note 61, at 4; NAT'L CTR. FOR EDUC. STATISTICS, THE NATION'S REPORT CARD: 12TH GRADE READING AND MATHEMATICS 2005, *supra* note 61, at 17.

Table 1. Grade 4 and 8 NAEP Mathematics Scale Scores by Race and Free and/or Reduced Price Lunch ("FRL") Eligibility, 2009

	Asian	Black	Latino/a	Native American	White	Free Lunch Eligible	Reduced Lunch Eligible	Not FRL Eligible
Grade 4	251	220	226	226	246	225	236	249
Grade 8	295	255	262	264	289	263	274	291

Table 2. Grade 12 NAEP Mathematics Scale Scores by Race and Parental Educational Attainment, 2005

	Asian	Black	Latino/a	Native American	White	College Grad	Some College	High School	< High School
Grade 12	163	127	133	134	157	161	148	138	130

Mathematics scale scores have improved during the past two decades for all racial and SES groups.[63] Between 1975 and the late 1980s, the Black-White NAEP mathematics gap narrowed at all assessed grades.[64] According to National Assessment of Educational Progress Long-Term Trend data ("NAEP-LTT"),[65] mathematics gaps continued to converge through the mid-1980s, largely because of the relative improvements by Black students. Between 1978 and 1986, the gap declined from thirty-two to twenty-five points for nine-year-olds and from forty-two to twenty-four points for thirteen-year-olds.[66] After the late 1980s, progress in closing the gap stalled and held relatively steady.[67]

63. NAT'L CTR. FOR EDUC. STATISTICS, THE NATION'S REPORT CARD: MATHEMATICS 2009, *supra* note 61, at 24. The gap between Black and White eighth graders narrowed slightly between 2005 and 2009. *Id.*

64. Katherine Magnuson & Jane Waldfogel, *Introduction*, *in* STEADY GAINS AND STALLED PROGRESS: INEQUALITY AND THE BLACK-WHITE TEST SCORE GAP, *supra* note 26, at 7–8 .

65. NAT'L CTR. FOR EDUC. STATISTICS, U.S. DEP'T OF EDUC., NCES 2009-479, NAEP 2008 TRENDS IN ACADEMIC PROGRESS 34 (2007), *available at* http://nces.ed.gov/nationsreportcard/pdf/main2008/2009479.pdf.

66. Magnuson & Waldfogel, *supra* note 64, at 8.

67. *Id.* The overall gap between White and Latino/a students has not changed in significant ways. Trend data regarding other ethnic and racial groups are not available for the same time period. *Id.* at 7–10.

The time period during which race gaps in test scores narrowed coincided with greater school integration. Recent cross-sectional and time series data point to a strong association between levels of segregation and achievement gaps.[68] The period of stagnation in the narrowing of the gap corresponds with the period when desegregation stalled and income inequality grew.[69]

The trends in test score gaps should be considered in conjunction with striking changes in the demographic profile of U.S. public school students who today are more ethnically and racially diverse than their counterparts four decades ago. In 1968, eighty percent of public school students were White, fourteen percent were Black, five percent were Latinos/as, and one percent was Asian and Native American.[70] In 2006, the student population was fifty-seven percent White, twenty percent Latinos/as, seventeen percent Black, five percent Asian, and one percent Native American.[71] At present, a majority of public school students in California, Florida, and Texas are children of color.[72] Census Bureau projections suggest that by 2025, fifty-two percent of youth aged fifteen to nineteen will be from minority groups.[73] Student populations have increasing numbers of

68. Mark Berends & Roberto V. Peñaloza, *Increasing Racial Isolation and Test Score Gaps in Mathematics: A 30-Year Perspective*, 112 TCHRS. C. REC. (forthcoming 2010); Vigdor & Ludwig, *supra* note 26, at 181, 204–05.

69. Magnuson & Waldfogel, *supra* note 64, at 7–8, 15.

70. *See* ERICA FRANKENBERG, CHUNGMEI LEE & GARY ORFIELD, THE CIVIL RIGHTS PROJECT/*PROYECTO DERECHOS CIVILES* (HARVARD), A MULTIRACIAL SOCIETY WITH SEGREGATED SCHOOLS: ARE WE LOSING THE DREAM? 23 (2003), *available at* http://www.civilrightsproject.ucla.edu/research/reseg03/AreWeLosingtheDream.pdf (reporting demographic shifts in American student populations and levels of school segregation by race and socioeconomic status).

71. GARY ORFIELD & CHUNGMEI LEE, THE CIVIL RIGHTS PROJECT/*PROYECTO DERECHOS CIVILES* (UCLA), HISTORIC REVERSALS, ACCELERATING RESEGREGATION, AND THE NEED FOR NEW INTEGRATION STRATEGIES 16 (2007), *available at* http://www.civilrightsproject.ucla.edu/research/deseg/reversals_reseg_need.pdf (updating demographic shifts in American student populations and levels of school segregation by race and socioeconomic status through 2006).

72. NAT'L CTR. FOR EDUC. STATISTICS, U.S. DEP'T OF EDUC., NCES 2007-039, STATUS AND TRENDS IN THE EDUCATION OF RACIAL AND ETHNIC MINORITIES 29 (2007), *available at* http://nces.ed.gov/pubs2007/2007039.pdf; EDUC. INFO. & ACCOUNTABILITY SERVICES, FLA. DEP'T OF EDUC., 2009-07D, MEMBERSHIP IN FLORIDA'S PUBLIC SCHOOLS, FALL 2009 (2010), http://www.fldoe.org/eias/eiaspubs/word/pk12mbrshp.doc.

73. *See* U.S. Census Bureau, National Population Projections Released 2008 (Based on Census 2000), Summary Tables, http://www.census.gov/population/www/projections/summarytables.html (last visited Feb. 23, 2010).

immigrants, too. In the last decade of the twentieth century, approximately fifty percent of school-aged children in New York came from an immigrant family.[74] Nationwide, approximately ninety percent of Asian American students and fifty-nine percent of Latino/a youth were immigrants or children of immigrants.[75] The proportion of immigrant children tends to be higher in urban school districts.

In response to the recent dramatic shifts in the ethnic and racial backgrounds of student populations, the demographic compositions of American public schools in urban, suburban, and rural communities are changing as well. All types of communities today have higher percentages of Black and Latino/a students in their public schools compared to the past.[76] Additionally, levels of racial and socioeconomic segregation are increasing in public schools located in cities and suburbs.[77] Although there is some disagreement among scholars over the extent to which U.S. schools are resegregating,[78] even those who raise questions about levels of resegregation acknowledge that progress toward desegregation "has faltered since the early 1990's."[79]

Segregation among school districts now surpasses segregation within school districts.[80] Almost half of Black and Latino/a students attend schools in inner-ring suburban communities of large

74. CAROLA SUAREZ-OROZCO & MARCELO M. SUAREZ-OROZCO, CHILDREN OF IMMIGRATION 2, 53 (2001). *See generally* ALEJANDO PORTES & RUBEN G. RUMBAUT, IMMIGRANT AMERICA: A PORTRAIT (3d ed. 2006) (reporting experiences of twentieth-century immigrants to the United States with a focus on generational changes in adaptation and assimilation).

75. Min Zhou, *Growing Up American: The Challenge Confronting Immigrant Children and Children of Immigrants*, 23 ANN. REV. SOC. 63, 64 (1997).

76. *See* ORFIELD & FRANKENBERG, *supra* note 18, at 4–8 (discussing changes in school composition).

77. *Id.*

78. *Compare id.* at 2 (arguing that their data show "steadily growing [rates of] segregation for both black and Latinos on both a national and regional level since 1990"), *with* JOHN LOGAN, LEWIS MUMFORD CTR. FOR COMPARATIVE URBAN & REG'L RES., RESEGREGATION IN AMERICAN PUBLIC SCHOOLS? NOT IN THE 1990S, at 15–16 (2004), http://www.s4.brown.edu/cen2000/noresegregation/noresegregation_report.pdf (arguing that the evidence of purported resegregation after 1990 is primarily due to the shifting racial composition of the school-age population, not the greater racial polarization of students across schools).

79. LOGAN, *supra* note 78, at 15.

80. CHARLES T. CLOTFELTER, AFTER *BROWN*: THE RISE AND RETREAT OF SCHOOL DESEGREGATION 73 (2004) (indicating that among all metropolitan areas with a total segregation of 0.326, the between-district component of segregation was 0.225).

metropolitan areas.[81] Two-thirds of the schools that Blacks and Latinos/as attend are intensely racially segregated with high concentrations of poor students.[82] Asians are more likely to attend integrated schools than any other ethnic group.[83] Whites are the least likely of any student group to attend segregated minority schools, especially if their families live outside of central cities.[84]

Demographic shifts in student populations mean that, increasingly, the proportion of the U.S. student population from advantaged backgrounds, who tend to score well in mathematics, is shrinking relative to the proportion of students from less advantaged backgrounds, who are less likely to perform well. The resegregation of public schools also means that students from disadvantaged families are increasingly likely to attend schools with children from similar backgrounds. Together, these trends make the instrumental reasons and moral imperatives to address the racial and SES disparities in mathematics outcomes even more urgent.

III. TERMINOLOGY

Although all the social science studies discussed in this Article examined related outcomes, their foci, research designs, measurement of key constructs, and terminology differ across the disciplines and the decade in which a particular study was conducted. The following section describes variations in terminology for key constructs that were employed by the authors of the fifty-nine articles synthesized in this Article.

School Composition—A particular study included in this Article may have examined desegregation, integration, segregation, school racial composition, minority composition, or diversity. Studies that appeared prior to 1990 tended to be experiments or quasi-experiments on the effects of court-ordered desegregation in a single school district.[85] Since the late 1980s, desegregation researchers have

81. ORFIELD & FRANKENBERG *supra* note 18, at 4.
82. *Id.*
83. *Id.*
84. *Id.*
85. Mickelson, *supra* note 26, at 1195; *see also* Thomas Cook, *What Have Black Children Gained Academically from School Integration? Examination of the Meta-Analytic Evidence*, *in* SCHOOL DESEGREGATION AND BLACK ACHIEVEMENT 6, 40–41 (Thomas Cook ed., 1984) (presenting results of several meta-analyses of nineteen selected desegregation experiments conducted in the 1970s and 1980s).

shifted to using social surveys with representative samples or statewide populations because of the declining number of school systems under court orders[86] and the increasing difficulty in conducting experimental research with school children.[87] Differences in the terminology across studies reflect important distinctions in underlying conceptual frameworks, research designs, the nature of the relationships under investigation, and the social and political realities of the time frames in which the studies were conducted. Nevertheless, the core issue of interest in all the studies is essentially the same: the relationship between a school's racial and/or SES composition and mathematics outcomes of students who attend them.

Segregated—Most studies synthesized in this Article examine the relationship between varying levels of racial segregation and mathematics outcomes. This literature uses a variety of terms to convey the notion that a school's population was disproportionately composed of students from one race relative to a standard for racial balance that was tied to a community's racial and ethnic mix. The terms used include "segregated," "racially imbalanced" (or "isolated") "White," "racially imbalanced Black," "racially imbalanced Latino/a," "racially imbalanced minority," "segregated White," "segregated Black," "segregated Latino/a," and "segregated minority." Some recent research uses the term "concentrated minority" as a synonym for "segregated." Unless a particular type of segregation is specified (such as racially isolated White schools), the phrases "minority," "concentrated minority," "racially imbalanced," "racially isolated," and "segregated" describe schools that have disproportionate numbers of racial or ethnic minority students relative to the community's composition.

Integrated—A smaller group of studies focuses on the relationship between varying levels of racial integration and mathematics outcomes. Integrated schools are the goal of the process of desegregation. In the context of U.S. history, school desegregation is a legal, social, and policy process designed to transform segregated schools into schools that do not separate students by race. An integrated school has achieved the desegregation of its students, staff, curricula, extra- and co-curricular activities, and the school culture in ways that reflect the demographic balance of the community. In

86. Mickelson, *supra* note 26, at 1182.
87. NAEd REPORT, *supra* note 41, at 15; Mickelson, *supra* note 26, at 1185–86.

practice, many desegregated schools are not truly integrated because of racially correlated curricular tracking.[88] This important distinction aside, the terms "desegregated," "integrated," "racially balanced," and "diverse" are used interchangeably in the literature synthesized in this Article.

Race—"Race" and "ethnicity" are used interchangeably across the fifty-nine studies discussed in this Article. Typically, the studies categorized students as Asian (or Asian American, Pacific Islander), Black (or African American), Latinos/as (Hispanic), Native American (also Alaskan Native, Aleut, American Indian), Other (typically reserved for international or mixed-race students), or White (European American). In cases where very few Asian, Native Americans, or mixed race students remained in the sample, authors collapsed all students of color into the category of minority, which was then contrasted with Whites. Many recent studies examine the effects of race at the *student* level and at the *school* level, thereby permitting the researcher to report findings about how school racial composition affects mathematics outcomes for students from different racial or ethnic backgrounds.

This Article uses the terms "Blacks," "Whites," "Latinos/as," "Asians," "Native Americans," and "Other" to refer to members of the racial groups discussed above because they correspond to the categories used in the research. Admittedly, these commonly used racial labels blur meaningful within-race ethnic differences relevant to educational outcomes. For instance, among Asians, Hmong and Chinese students have distinct outcomes; among Latinos/as,

88. CLOTFELTER, *supra* note 80, at 126; SAMUEL R. LUCAS, TRACKING INEQUALITY: STRATIFICATION AND MOBILITY IN AMERICAN HIGH SCHOOLS 1 (1999) (describing the ways that curricular tracking with instructional differentiation has evolved into a less rigid practice during the recent past but how its effects, nonetheless, still create educational inequality for those who learn in the lower tracks); JEANNIE OAKES, KEEPING TRACK: HOW SCHOOLS STRUCTURE INEQUALITY, at xi (2d ed. 2005) (demonstrating how the practice of tracking and ability grouping results in fewer opportunities to learn for those in lower tracks, who tend to be children of color and from lower income families); KEVIN G. WELNER, LEGAL RIGHTS, LOCAL WRONGS: WHEN COMMUNITY CONTROL COLLIDES WITH EDUCATIONAL EQUITY 163–68 (2001) (presenting case studies of communities that used tracking to circumvent desegregation, and how efforts to detrack public schools challenged the educational privileges of middle-class families); Samuel R. Lucas, *Effectively Maintained Inequality: Education Transitions, Track Mobility, and Social Background Effects*, 106 AM. J. SOC. 1642, 1642 (2001) (modeling how tracking reproduces educational inequalities by race and SES).

Colombian and Mexican youths are likely to perform differently.[89] The number of generations a student's family has been in the United States further complicates racial and ethnic categorization.[90]

The vast majority of early school composition studies focused solely on Blacks and Whites. Historically, with exceptions of Latinos/as in California and the Southwest and Asians on the West Coast, there have been too few Latino/a, Asian, or Native American students in local school districts to allow for comprehensive analyses of diversity effects on their outcomes. The shift by researchers to using large-scale national surveys improved the chances that samples would have sufficiently large numbers of Latino/a, Asian, or Native American participants to permit subgroup analyses. Although more recent studies utilizing nationally representative survey data sets include larger numbers of these groups in the samples, there are still relatively few contemporary studies that report findings for all racial and ethnic groups in the U.S. student population.

Socioeconomic Status—Socioeconomic status ("SES") is often used in the literature interchangeably with the term social class or family background.[91] SES is a complex construct that reflects the relative rank of an individual's or a family's location in a social hierarchy based on combined rankings of income, occupational prestige, and educational attainment. SES is both strongly correlated with race and highly predictive of school outcomes.[92] Recent research examines the effects of SES at the *student* level and at the *school* level.

Studies operationalize SES in a variety of ways. A frequently used but crude measure of SES is free and/or reduced price lunch ("FRL") eligibility. This measure distinguishes only poor children

89. Roslyn A. Mickelson, *Race, Ethnicity, and Education*, *in* HANDBOOK OF EDUCATION POLICY RESEARCH 240, 241–44 (Gary Sykes, Barbara Schneider & David N. Plank eds., 2009).

90. *See* PORTES & RUMBAUT, *supra* note 74, at 75.

91. The concepts of SES and social class are based on different sets of theoretical assumptions about the nature of social stratification in society. Class location cannot be measured by educational or occupational attainment, the typical indicators of SES. Scholars who conduct quantitative analyses of social class are likely to use indicators of ownership, authority, and expertise. *See* ERIK O. WRIGHT, CLASSES 283 (1985). However, SES measures generally do not include a family's wealth, a critical dimension of economic well-being and social location. *See* MELVIN L. OLIVER & THOMAS M. SHAPIRO, BLACK WEALTH/WHITE WEALTH 55 (2006).

92. *See infra* Part V.B.

whose parents sign them up for FRL from those who are either not poor or who are poor but whose parents do not sign them up. A better SES indicator is parental education, typically denoted by mother's educational attainment. Superior SES indicators combine parental income, educational, and occupational attainment. Some studies use well-known indices such as the Duncan Socioeconomic Index ("SEI")[93] to measure SES. This Article uses the term SES to refer to all the operationalizations of socioeconomic status, social class, and family background described above.

Early Studies—For purposes of this Article, "early studies" refers to studies of school composition effects that were disseminated or published before 1990.[94]

Later Studies—For purposes of this Article, "later studies" refers to research about school composition effects that was disseminated or published in 1990 or after.

Mathematics Outcomes—Over half of the fifty-nine relevant studies' mathematics outcomes are standardized test scores.[95] The remaining studies either report composite achievement scores that included mathematics (such as grade point averages), state high school exit exams, proficiency levels on state standardized tests, or the number and rigor of mathematics courses completed during high school. Unless a specific outcome is described (e.g., test score), the broad term "mathematics outcomes" refers to any one of these various measures.

IV. METHODS

This Article is a synthetic review of the educational, social, and behavioral science literatures on the effects of school composition on

93. *See, e.g.*, Keiko Nakao & Judith Treas, *Updating Occupational Prestige and Socioeconomic Scores: How the Measures Measure Up*, 24 SOC. METHODOLOGY 1, 3 (1993) (evaluating the quality and design of the 1989 General Social Survey study on occupational prestige). For an overview of the Duncan Socioeconomic Index scale, see generally Otis Dudley Duncan, *A Socioeconomic Index for All Occupations*, *in* OCCUPATIONS AND SOCIAL STATUS 109 (Albert J. Reiss, Jr. ed., 1961); Otis Dudley Duncan, *Properties and Characteristics of the Socioeconomic Index*, *in* OCCUPATIONS AND SOCIAL STATUS 139 (Albert J. Reiss, Jr. ed., 1961).

94. Mickelson, *supra* note 26, at 1185–87, 1194–2000 (contrasting the methodologies, samples, data, and statistical analyses of the pre-1990s studies with the post-1990 studies).

95. *See* Appendix.

mathematics outcomes.[96] It becomes increasingly difficult to generate a comprehensive, coherent summary of a scientific literature as the size and complexity of the entire corpus of research on a topic grows over time. This challenge transcends disciplinary boundaries.[97] The validity and reliability of any synthesis depends on (a) how completely and unambiguously a researcher formulates the topic of interest; (b) how thoroughly the extant literature is searched and relevant studies are identified; (c) how reliably the researcher uses an explicit protocol of inclusion and exclusion criteria to evaluate all possible studies identified in the search; (d) whether the researcher deals with the quality of a study when incorporating its results into the synthesis; and (e) the consistency, clarity, and rigor with which the researcher combines information across studies and interprets findings.[98]

There is no one right way to survey and synthesize the literature field.[99] Three common strategies for synthesizing and integrating research on a topic are: (1) narrative literature reviews that combine previous findings and interpret them in a qualitative or descriptive fashion; (2) vote-counting approaches that tally the number of empirical studies reporting statistically significant positive effects, negative effects, or no effects across the defined set of studies; and (3) meta-analyses that statistically aggregate the respective size or

96. The late scholar of higher education, Ernest Boyer, distinguished among the scholarship of discovery (basic research), the scholarship of integration of knowledge through synthesis, the scholarship of application of knowledge to social issues of the time, the scholarship of teaching, and the scholarship of engagement that connects the above dimensions to civic and ethical problems. ERNEST BOYER, SCHOLARSHIP RECONSIDERED: PRIORITIES OF THE PROFESSORIATE 15–25, 75–81 (1990).

97. Rob Greenwald, Larry V. Hedges & Richard D. Laine, *When Reinventing the Wheel Is Not Necessary: A Case Study in the Use of Meta-Analysis in Educational Finance*, 20 J. EDUC. FIN. 1, 1 (1994).

98. *See* WILLIAM D. CRANO & MARILYN B. BREWER, PRINCIPLES AND METHODS OF SOCIAL RESEARCH 331 & n.1 (2d ed. 2002) (recognizing inherent problems with literature reviews in narrative studies); LARRY V. HEDGES & INGRAM OLKIN, STATISTICAL METHODS FOR META-ANALYSIS, at xv (1985) (acknowledging that the validity of meta-analytic studies is affected by the studies included in them and the assumption that the selected studies are narrowly tailored to address the same question); NAEd REPORT, *supra* note 41, at 14 n.11; Greenwald et al., *supra* note 97, at 6–7.

99. *See* Sandra Graham, *Narrative Versus Meta-Analytic Reviews of Race Differences in Motivation: A Comment on Cooper and Dorr*, 65 REV. EDUC. RES. 509, 513 (1995).

magnitude of effects across all empirical studies that meet inclusion criteria.[100]

Both qualitative and quantitative approaches to synthesizing research literatures have strengths and weaknesses.[101] Narrative reviews present a qualitative, holistic interpretation of the findings in the summarized relevant literature. Arguably, they offer a more nuanced and textured view of the theoretical and substantive findings than the quantitative vote-counting or meta-analysis approaches provide. Narrative reviews also tend to be more subjective than quantitative syntheses, and they do not report the magnitude of the effects they describe.[102]

Quantitative syntheses that rely on vote-counting approaches are objective and their results are readily accessible to readers. Typically, they do not provide a measure of the magnitude of effect size. And because they are conservative estimates of overall effects, they are subject to underestimating outcomes of interest.[103] Conservative estimates of overall effects can be results of a Type II error, which occurs when results falsely indicate there are no effects when, in fact, there are significant, substantive outcomes of interest.[104]

Meta-analyses are another widely used technique to statistically summarize the findings from a body of research. A meta-analysis estimates the size and consistency of the effects of certain factors on a given phenomenon across multiple empirical studies on the same topic.[105] Meta-analyses allow researchers to examine overall patterns of effects across many studies, to explore whether additional variables moderate those effects,[106] and to statistically test the possibility that

100. Phillip D. Rumrill, Jr. & Shawn M. Fitzgerald, *Using Narrative Literature Reviews to Build a Scientific Knowledge Base*, 16 WORK 165, 165 (2001).

101. *See* Graham, *supra* note 99, at 513 (comparing narrative and meta-analytic reviews); Rumrill & Fitzgerald, *supra* note 100, at 168.

102. *See* Graham, *supra* note 99, at 513; Rumrill & Fitzgerald, *supra* note 100, at 168.

103. GENE V. GLASS, BARRY MCGAW & MARY LEE SMITH, META-ANALYSIS IN SOCIAL RESEARCH 94 (1981); HEDGES & OLKIN, *supra* note 98, at 48–52.

104. Results of scientific studies are subject to two types of statistical errors. A Type I error conveys a false positive (e.g., indicating school composition has effects on mathematics outcomes when, in fact, it has none), while a Type II error indicates a false negative (e.g., indicating composition has no effects on mathematics outcomes when, in fact, it has an influence). *See* THOMAS D. COOK & DONALD T. CAMPBELL, QUASI-EXPERIMENTATION: DESIGN & ANALYSIS ISSUES FOR FIELD SETTINGS 41–43 (1979).

105. Tropp et al., *supra* note 50, at 106 n.4; NAEd REPORT, *supra* note 41, at 14 n.11.

106. Tropp et al., *supra* note 50, at 106 n.4; NAEd REPORT, *supra* note 41, at 14 n.11.

studies' outcomes were affected by their methodological quality[107] or the time period during which they were conducted. Meta-analyses have been criticized because typically they do not establish a priori quality criteria for inclusion, and they treat all studies as equal data points.[108] They tend not to be readily accessible to readers unfamiliar with inferential statistics.

The authors' selection of an approach to synthesize the school composition effects research for this Article took into consideration their goal of providing accessible information to the wide audience of this law journal, and the strengths and weaknesses of the various approaches to research integration. They chose to combine narrative and vote-counting approaches. Doing so permits them to present a nuanced and holistic integration of the research literature based on an objective and detailed analysis of the fifty-nine studies that met specific inclusion criteria. The following paragraphs describe the techniques the authors employed in collecting and summarizing the findings presented in this Article. This methodological information will enable readers to judge the validity and reliability of the conclusions the authors have drawn from their synthesis.

A. Database Searches

From 2006 through 2009, the two authors searched the educational, social, and behavioral science literatures for scholarship reporting the effects of school and classroom composition on a broad array of educational outcomes.[109] The authors identified approximately four hundred articles that address some aspect of the relationship of school composition and various outcomes broadly

107. Tropp et al., *supra* note 50, at 106 n.4; NAEd REPORT, *supra* note 41, at 14 n.11.

108. GLASS ET AL., *supra* note 103, at 22.

109. The American Sociological Association's Sydney Spivack Program in Applied Social Research and Social Policy awarded Professor Kathryn Borman and the first author initial support for a survey and synthesis of the social science research about school compositional effects. In 2006, the first author received additional support for the project from the Poverty and Race Research Action Council ("PRRAC") and from the National Science Foundation ("NSF"). Her research team developed a searchable database, the Spivack Archive, into which detailed two-page abstracts of the four hundred studies have been entered. The Spivack Archive includes quantitative and qualitative social scientific studies about the relationship of school and classroom diversity to various educational outcomes that have been conducted during the past four decades. The Spivack Archive will be posted on the American Sociological Association's Web site at the conclusion of the project in early 2010. A Preliminary Spivack Archive is on file with the North Carolina Law Review.

conceived as achievement, attainment, intergroup relations, racial attitudes, and adult life course outcomes. The findings in this Article focus on the subset of the fifty-nine relevant studies that address school race and/or SES compositional effects on mathematics outcomes.

The search of the literature was conducted in three phases. First, during 2006 and 2007, the authors conducted intensive searches of education, social, and behavioral science electronic databases for studies on effects of school and classroom composition on mathematics and science outcomes.[110] The keywords used included: "mathematics," "mathematics achievement," "science," "science achievement," "verbal achievement," "reading," "ability grouping," "tracking," "desegregation," "integration," "segregation," "diversity," "race," "ethnicity," "SES," "family background," and "school racial composition." Based on information provided in abstracts of the studies that emerged from the electronic searches, full articles, chapters, books, and reports were obtained for further consideration. The authors also examined a number of review articles and amicus briefs on the topic for relevant studies that were possibly overlooked in the database searches. Second, once relevant studies were identified in the manner described above, their own reference sections were examined for potential literature. Third, during 2008 and 2009, the authors conducted follow-up searches of the databases to identify the newest literature on the topic.[111]

110. Search databases included: JSTOR, Psychology Abstracts, Sociology Abstracts, Google Scholar, ERIC, Educational Research Complete, Academic Search Premier, Project Muse, and Dissertation Abstracts.

111. In 2010, *Teachers College Record* will publish a collection of twenty-two articles on school and classroom composition effects on educational outcomes in a three-issue set of Special Issues edited by Kathryn Borman and Roslyn Mickelson. 112 TCHRS. C. REC. (forthcoming 2010). In addition to maintaining rigorous scientific standards for the manuscripts accepted for publication, see Am. Educ. Res. Ass'n, *Standards for Reporting on Empirical Social Science Research in AERA Publications*, 35 EDUC. RES. 33, 33–40 (2006), the editors also sought to ensure the integrity of the editorial process. They therefore instituted a process that insulated their decisions as much as possible from subjectivities arising from their own scholarship and values about school composition and educational outcomes. On several occasions, Professor Gary Natriello, Executive Editor of *Teachers College Record*, participated in editorial decisions about specific manuscripts that posed conflicts of interest for one or the other of the editors. For greater details see Roslyn A. Mickelson, *Goals, Grades, Fears, and Peers: Introductory Essay for Special Issues on the Effects of School and Classroom Racial and SES Composition on Educational Outcomes*, 112 TCHRS. C. REC. (forthcoming 2010).

B. Inclusion Criteria

This Article's focus on mathematics outcomes required the Project Team to identify the subset of the four hundred Spivack Archive's entries with mathematics outcomes. Fifty-nine studies met the following inclusion criteria:

- Studies employed quantitative research methods.[112]
- Studies reported effects of school racial and/or socioeconomic composition on mathematics outcomes.
- Dependent variables were a quantitative measure of either mathematics outcomes (typically test scores), proficiency levels in mathematics, a composite measure that included math achievement (e.g., grade point average or high school proficiency), and the number and rigor of mathematics courses completed, among others.
- Appropriate statistical techniques were employed given the structure of the data.
- Reported findings were valid given the study's research design, data, sample, and analytic methods.
- Results appeared in a peer-reviewed journal, a book chapter, a book, a report issued by a professional or scientific organization (e.g., National Bureau of Economic Research, U.S. Commission on Civil Rights, established think tanks), papers presented at professional meetings, and dissertations. Unpublished manuscripts that otherwise met the other criteria were included as well.
- Publication or dissemination date of 1990 or later.[113] The higher quality data and more sophisticated statistics employed

112. The authors' choice to focus on quantitative studies rests, in part, on a decision to engage those who claim that, based on their review of selective portions of the quantitative literature, the social science evidence is too ambiguous or contradictory to support a compelling state interest in fostering diverse schooling and avoiding racial isolation. *See* Brief of Amici Curiae Drs. Murphy et al. in Support of Petitioners, *supra* note 50, at 8; Brief for David J. Armor et al. as Amici Curiae Supporting Petitioners, *supra* note 50, at 35.

113. Social science methods, data, and statistical tools improved in the years following the design, implementation, and evaluation of the initial wave of post-*Brown* desegregation programs. The year 1990 was selected to distinguish earlier from later studies because it marks the decade when the use of advanced statistical tools (like multilevel modeling) with nationally representative data sets became widespread among social scientists.

in the later studies warranted limiting the scope of the relevant literature to work that appeared after 1990.[114]

- No more than one study per author using the same sample, outcomes, and data set.[115]

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114. Mickelson, *supra* note 26, discusses in great detail the differences between early (pre-1990) and later (post-1990) social science on race and SES composition. Two well-known syntheses of pre-1990 research about the effects of desegregation on black achievement illustrate some of the weakness of early studies. The first synthesis was conducted in 1975 by psychologist Nancy St. John. NANCY H. ST. JOHN, SCHOOL DESEGREGATION: OUTCOMES FOR CHILDREN *passim* (1975). The second was conducted in 1984 by a panel convened by the National Institute of Education. *See* THOMAS COOK, NAT'L INST. OF EDUC., SCHOOL DESEGREGATION AND BLACK ACHIEVEMENT 2–5 (1984) [hereinafter NIE Study]. St. John's narrative review was cited by Justice Thomas, the Armor Amici Curiae Brief, and the brief of the 553 Social Scientists. *See* Parents Involved in Cmty. Sch. v. Seattle Sch. Dist. No. 1, 551 U.S. 701, 770 (Thomas, J., concurring); Brief for David J. Armor et al. as Amici Curiae Supporting Petitioners, *supra* note 50, at 13; Brief for 553 Social Scientists as Amici Curiae Supporting Respondents, *supra* note 50, at app.3 n.4. A content analysis of research cited by St. John revealed that the majority of the studies of black achievement she included in her synthesis were conducted before 1970. Almost all of them were case studies of a single school system's desegregation efforts. Roughly half of the studies had fewer than one hundred subjects, and some had as few as fifteen in the experimental group. Of the studies that provided information about the implementation of the desegregation plan being evaluated, almost sixty percent reported the plans were evaluated after one year or less of implementation. The NIE panel's meta-analysis focused on the nineteen studies it considered the best among the 157 that existed at that time. Fifteen of the nineteen studies were conducted before 1974. All nineteen studies were evaluations of specific desegregation plans that had been implemented in particular communities many years earlier. Only a few of the studies provided detailed information about the implementation of the desegregation plan. Many of the characteristics of the report's nineteen studies were problematic, even though the studies were designed as experiments or quasi-experiments. Only two of the nineteen studies had been published. The first published study was an experiment of a city-to-suburban voluntary transfer program that involved twenty-five black children who were placed in twelve different first or second grade classrooms. *See* Zdep, *supra* note 47, at 173. The author of the second published study cautioned that his findings were limited by the fact that his subjects were not randomly assigned to the treatment and control groups and therefore his results were confounded by selection bias. *See* Daniel S. Sheehan, *Black Achievement in a Desegregating School District*, 107 J. SOC. PSYCHOL. 185, 188 (1979). Nine of the nineteen studies were unpublished doctoral dissertations or master's theses. The other eight studies were reports produced by school districts' research units or papers presented at scholarly meetings. The characteristics of the fifty-nine studies included in this Article—all post-1990 research—appear in the Appendix. The high quality of their designs, samples, data, and analytic strategies sharply contrasts with the weaker qualities of the studies included in the St. John and Cook syntheses of early research just discussed.

115. In three cases, this Article cites an earlier version and a later version of the same manuscript. In one case, information regarding optimal diversity ranges for mathematics achievement (and other subjects) appeared in the unpublished version, *see* Shelly Brown, High School Racial Composition: Balancing Excellence and Equity (Aug. 1999) (unpublished manuscript, on file with the North Carolina Law Review) (presented at the

C. *Coding the Studies*

Each article was read, coded, and entered into the Spivack Archive electronic database. Graduate student research assistant members of the Project Team coded the articles under the supervision of the first author. The second author conducted the majority of the coding. All articles were coded for key words, research questions or hypotheses; research design; data; sampling frame, sample type, and sample characteristics; unit of analysis; analytic strategies; dependent, independent, and control variables; and findings related to school and classroom compositional effects. The reliability of the coding for the four hundred entries was assessed by an independent coding of a random subsample of articles by a

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annual meeting of the American Sociological Association), but not in the later published article, which focused on mathematics achievement. Shelly Brown-Jeffy, *School Effects: Examining the Race Gap in Mathematics Achievement*, 13 J. AFR. AM. STUD. 388, 402 (2009). In another instance, the authors reported results by student SES that were not included in the later version. *Compare* Douglas Ready & Megan Silander, Estimating the Influence of School Racial and Socioeconomic Composition on Student Learning: Methodological Challenges and Alternative Solutions (Apr. 2, 2009) (unpublished manuscript, on file with the North Carolina Law Review) (presented at *Looking to the Future: Legal and Policy Options for Racially Integrated Education in the South and the Nation*, Chapel Hill, North Carolina) (later version), *with* Douglas Ready & Megan Silander, Estimating the Influence of School Racial and Socio-Economic Composition on Student Learning: Methodological Challenges and Alternative Solutions (2008) (unpublished manuscript, on file with the North Carolina Law Review) (presented at the annual meeting of the American Educational Research Association, N.Y., N.Y.) (earlier version). In the third instance, the authors cite a revised version of an unpublished manuscript because the later version reported a significant finding that previously had not been reported as significant. *Compare* Elizabeth Covay, Composition Matters: Racial Differences in Access to and Returns from Advanced Math Course Taking 29 (Sept. 2009) (unpublished manuscript, on file with the North Carolina Law Review), *with* Elizabeth Covay, Composition Matters: The Relationship Between Race and School Composition in Explaining the Black-White Gap 25–28 (Sept. 2008) (unpublished manuscript, on file with the North Carolina Law Review) (presented at the American Sociological Association Annual Meeting, Boston, Mass.). In a personal communication to the first author, professors Brown-Jeffy and Ready explain that their original results hold but were not included in the later version of their respective manuscripts for simplicity of presentation of the primary focus of their research. E-mail from Shelly Brown-Jeffy to Roslyn Arlin Mickelson (July 29, 2009, 17:37 EST) (on file with the North Carolina Law Review); E-mail from Douglas Ready to Roslyn Arlin Mickelson (July 9, 2009, 10:00 EST) (on file with the North Carolina Law Review). In a third personal communication, Ms. Covay indicates that subsequent analyses changed one finding that is now reported in the later version of her manuscript. E-mail from Elizabeth Covay to Roslyn Arlin Mickelson (Feb. 9, 2010, 14:02 EST) (on file with the North Carolina Law Review). For purposes of counting the total number of studies in this synthesis, the authors treat the earlier and later versions of each paper as one study.

graduate student whose ratings were then compared to the original ones. The first author resolved any discrepancies between the first and second codings by returning to the document and analyzing the original text to determine which of the two codes was appropriate. The authors performed a final reliability check by jointly reviewing the codings for each of the fifty-nine studies that are included in this Article.

D. Standards for Drawing Conclusions from the Evidence

Interpreting results and drawing conclusions from the synthesis required the authors to evaluate the quality of the studies and quantity and strength of evidence pertinent to each finding. The criteria for assessing the quality of the research reported in each article and for drawing conclusions from sets of articles follow those found in the *Report of the Subcommittee on Standards of Evidence of the Final Report of the National Mathematics Advisory Panel.*[116]

1. Quality

The standards for assessing the scientific quality of the evidence presented in a social science article are based on an assessment of the study's research design, the quality of variables used to operationalize the core concepts under investigation, the size and representativeness

116. NAT'L MATHEMATICS ADVISORY PANEL *supra* note 1, at 82–85. The report of the panel generated a great deal of critical response from methodologists and mathematics education experts. The December 2008 issue of *Educational Researcher* (Volume 37, Issue 9) was devoted to critics' analysis of the report. *See* Anthony E. Kelly, *Reflections on the National Mathematics Advisory Panel Final Report*, 37 EDUC. RESEARCHER 561, 561 (2008). Criticisms included the development and the content of the report. Much of the debate concerned the panel's reliance on "scientifically-based" research (that is, randomized trials and other quantitative studies) and the exclusion of any qualitative research from consideration as scientifically based evidence. *See, e.g.*, Jo Boaler, *When Politics Took the Place of Inquiry: A Response to the National Mathematics Advisory Panel's Review of Instructional Practices*, 37 EDUC. RESEARCHER 588, 592 (2008). Critics charged that doing so was political, unjustifiable on a scientific basis, and resulted in ignoring the crucial social context of learning and teaching mathematics. *See, e.g.*, James G. Greeno & Allan Collins, *Commentary on the Final Report of the National Mathematics Advisory Panel*, 37 EDUC. RESEARCHER 618, 620–21 (2008). While the authors agree with many of these criticisms, they nonetheless rely on only quantitative studies for the synthesis. The authors adapted the panel's criteria for judging the quality of research in each of the fifty-nine studies, and the number (quantity) of studies required to draw conclusions about a particular issue.

of the samples, the appropriateness of the statistical analysis, and the generalizability of the findings beyond the study itself.[117]

Following the National Mathematics Advisory Panel's Subcommittee Report, the authors utilized three broad categories into which research falls and the corresponding claims that can be made based on that research.[118] The first category is the highest quality scientific evidence. A study is judged to be of the highest scientific quality based on the strength of the "design, the validity and reliability of measures, the size and diversity of student samples, and similar considerations of internal and external validity."[119] Eighty percent of the fifty-nine studies met the criteria for being of the highest quality.

Twenty percent of the fifty-nine articles fell into the moderate quality category. According to the National Mathematics Advisory Panel, moderate quality studies are promising or suggestive studies that do not meet the highest standards of scientific evidence, but they represent sound scientific research that needs to be further investigated or extended.[120] The third category of studies includes those that are based on weak evidence or the values of the researcher.[121] Weak studies present "essentially unfounded claims," with "scientifically [un]justified conclusions,"[122] and none are included in this Article's synthesis.

2. Quantity and Strength of the Evidence

The National Mathematics Advisory Panel acknowledged that the number of studies necessary for evaluating the strength of a conclusion is a debatable issue.[123] Following the panel's practice, the authors define the evidence of a finding as *strong* if a preponderance of the applicable high quality studies in the synthesis reported similar findings and there were at least "three independent studies with different relevant samples and settings or one large high quality multisite study."[124]

117. NAT'L MATHEMATICS ADVISORY PANEL *supra* note 1, at 82.
118. *Id.* at 83–85.
119. *Id.* at 82.
120. *See id.* at 82–83.
121. *Id.* at 82.
122. *Id.*
123. *See id.* at 83.
124. *Id.*

The panel defines the evidence of a finding as *moderately strong* when "there are fewer than three high quality studies (but at least one), or the effects have not been independently replicated by different researchers, or they do not involve different samples (i.e., diversity of characteristics) and settings."[125] They consider the evidence of a finding as *suggestive* when there are either (a) "some high quality studies that support the conclusion (statistically significant effects, significant mean effects) but others that do not (non-significant), but those that do not are null, not negative (non-significant effects or mean effects but not significant negative effects). Any moderate quality studies show a comparable pattern or better," or (b) "[t]here are no high quality studies, but all the applicable moderate quality studies support the conclusion . . . and there are at least three such studies."[126]

The authors consider the evidence of a finding as *inconsistent* when evidence depends on relevant studies with conflicting outcomes, when they found the quality of the studies' designs to be weak, or when the methods employed in the studies were outmoded.[127] The results of high-quality designs trumped the results of lower quality designs. Following the panel's criteria, "[m]ixed results of high and/or moderate quality studies that are not consistent enough to fall into any of the above categories, and cannot be adjudicated by methodological criteria," were deemed inconsistent.[128] Finally, the authors evaluated evidence for a conclusion as *weak* when there were only low quality studies and no applicable high or moderate quality studies.[129] No evaluation is possible if there are insufficient data.

V. FINDINGS—OVERVIEW OF EFFECTS OF SCHOOL-LEVEL INTEGRATION ON MATHEMATICS OUTCOMES

The preponderance of the fifty-nine studies synthesized in this Article employed diverse samples, used valid and reliable data, and conducted sophisticated analyses that replicated results of other studies.[130] Of the fifty-nine studies, forty-four reported statistically

125. *Id.*
126. *Id.*
127. *See id.*
128. *Id.*
129. *See id.* at 84.
130. The Appendix provides detailed information about each of the fifty-nine articles, chapters, books, or papers synthesized herein including author, source of data utilized,

significant effects of racial composition on outcomes.[131] The strength of the association between composition and outcomes varied across the studies (this Article does not address the magnitude of the effects). Six reported that while racial composition was important to outcomes, the effects were not statistically significant or were inconsistent because racial effects were expressed through SES compositional effects;[132] seven focused on SES composition of schools and reported that it was important to outcomes;[133] two suggested that while they found no significant race effect, racial composition likely

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samples, analytic methods, variables and measures, and categories of findings obtained. The authors provide full pinpoint citations when they report substantive findings. They direct readers to the Appendix when the citation refers to a characteristic of a research study, such as its sample characteristics, as providing full pinpoint citations about study characteristics for every report would require extensive repetition.

131. *See* Appendix.

132. *See* Appendix: James Benson & Geoffrey Borman, *Family, Neighborhood, and School Settings Across Seasons: When Do Socioeconomic Context and Racial Composition Matter for the Reading Achievement Growth of Young Children?*, 112 TCHRS. C. REC. (forthcoming 2010); JOHN E. CHUBB & TERRY M. MOE, POLITICS, MARKETS & AMERICA'S SCHOOLS 126–27 (1990); Valerie E. Lee, Julia B. Smith & Robert G. Croninger, *Course-Taking, Equity, and Mathematics Learning: Testing the Constrained Curriculum Hypothesis in U.S. Secondary Schools*, 19 EDUC. EVALUATION & POL'Y ANALYSIS 99, 112 (1997) [hereinafter Lee et al., *Course-Taking*]; Daniel Addison McCathern, Jr., The Relationship Between PreK–5 and K–5 Elementary School Size and Student Achievement of Grade 5 Students on the MAT7 in South Carolina for the School Years 1996–97 and 1997–98, at 201 (2004) (unpublished Ph.D. dissertation, University of South Carolina) (on file with the North Carolina Law Review); Richard J. Murnane et al., *Understanding Trends in the Black-White Achievement Gaps During the First Years of School*, *in* BROOKINGS-WHARTON PAPERS ON URBAN AFFAIRS 2006, at 97, 125–27 (2006); Russell W. Rumberger & Gregory J. Palardy, *Does Segregation Still Matter? The Impact of Student Composition on Academic Achievement in High School*, 107 TCHRS. C. REC. 1999, 2020 (2005).

133. *See* Appendix: Stephen J. Caldas & Carl Bankston III, *Effect of School Population Socioeconomic Status on Individual Academic Achievement*, 90 J. EDUC. RES. 269, 274–75 (1997); Thomas B. Hoffer, *Middle School Ability Grouping and Student Achievement in Science and Mathematics*, 14 EDUC. EVALUATION & POL'Y ANALYSIS 205, 223–26 (1992); KIRK A. JOHNSON, THE HERITAGE CTR. FOR DATA ANALYSIS, COMPARING MATH SCORES OF BLACK STUDENTS IN D.C.'S PUBLIC AND CATHOLIC SCHOOLS 11 (1999), *available at* http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/16/2a/7c.pdf; Valerie E. Lee & Julie B. Smith, *Effects of School Restructuring on the Achievement and Engagement of Middle-Grade Students*, 66 SOC. EDUC. 164, 179 (1993); Gregory J. Palardy, *Differential School Effects Among Low, Middle, and High Social Class Composition Schools: A Multiple Group, Multilevel Latent Growth Curve Analysis*, 19 SCH. EFFECTIVENESS & SCH. IMPROVEMENT 21, 21 (2008); Kevin J. Payne & Bruce J. Biddle, *Poor School Funding, Child Poverty, and Mathematics Achievement*, EDUC. RESEARCHER, Aug.–Sept. 1999, at 4, 11; Linda Ruth Williams Sorhaindo, The Relationship Between Degrees of Poverty and Student Achievement 34 (May 2003) (unpublished Ph.D. dissertation, University of Miami).

still mattered for outcomes but either their sample size or the nature of their data could not capture the effects of school composition;[134] and one author found no significant race effects.[135]

Findings show either that integrated education is associated with higher achievement in math or that as concentrations of minority students increase, math outcomes decrease.[136] The quantity and quality of the studies that discuss the effects of racial composition collectively offer strong evidence that racially isolated minority schools hinder mathematics outcomes and diverse schools foster higher performance. Several studies report that racially diverse schools offer more students the chance to excel in math than either racially isolated White schools or isolated minority schools.[137] These findings offer suggestive evidence that racially diverse schools are, in fact, superior to racially isolated White schools for the mathematics outcomes of some students.[138]

Overall, the studies that describe the effects of SES composition collectively offer strong evidence that schools with concentrated poverty hinder mathematics outcomes and socioeconomically diverse schools foster higher performance. Forty-two of the fifty-nine studies reported the effects of school SES on mathematics outcomes.[139] Irrespective of the type of school, age, or ethnicity of the sample, or

134. *See* Appendix: Mary A. Burke & Tim R. Sass, *Classroom Peer Effects and Student Achievement* 11 (Fed. Reserve Bank of Boston, Working Paper No. 08-5, 2008), *available at* http://www.bos.frb.org/economic/wp/wp2008/wp0805.pdf; Payne & Biddle, at 11.

135. *See* Appendix: David J. Armor & Shanea H. Watkins, School Composition and Hispanic Achievement 1 (Feb. 10, 2007) (unpublished manuscript, on file with the North Carolina Law Review) (presented at the Sociology of Education Association Conference in Asilomar, Cal.).

136. *See* Appendix.

137. *See* Appendix: Pat António Goldsmith, *All Segregation Is Not Equal: The Impact of Latino and Black School Composition*, 46 SOC. PERSP. 83, 100–01 (2003) (finding no effects of percent Black on Black students' mathematics scores but a significant positive effect of percent Latinos/as in the school on the performance of Whites, Latinos/as, and Blacks); Stephanie Southworth, The Effects of Institutional Characteristics of Schools on North Carolina Elementary and Middle School Student Achievement 197 (2008) (unpublished Ph.D. dissertation, University of North Carolina at Charlotte) (on file with the North Carolina Law Review).

138. *See* Appendix: Shelly Brown-Jeffy, *School Effects: Examining the Race Gap in Mathematics Achievement*, 13 J. AFR. AM. STUD 388, 388, 402 (2009); Jorden Schiff, William Firestone & John Young, Organizational Context for Student Achievement: The Case of Student Racial Compositions 13 (Apr. 1999) (unpublished manuscript, on file with the North Carolina Law Review) (presented at the annual conference of the American Educational Research Association in Montreal, Quebec, Canada); Southworth, at 94.

139. *See* Appendix.

research design, without exception, the forty-two studies show that as concentrations of low-income students increase, math outcomes decrease.

The preceding paragraphs discussed general patterns of race and SES findings based on the preponderance of evidence reported in the fifty-nine studies that met the inclusion criteria. In the next sections, the Article presents a more granular picture of school race and SES composition influences on mathematics outcomes for specific race, SES, or grade-level samples. These results draw upon the subsets of studies that provided detailed findings for students from specific race, SES, or grade levels.

A. Findings by Student Race

Fifty-seven of the fifty-nine studies analyzed include Black students in their samples,[140] fifty-four include Whites,[141] thirty-two include Latinos/as,[142] sixteen include Asians,[143] and seven studies

140. *See* Appendix. Only the Robert Crosnoe, *The Diverse Experiences of Hispanic Students in the American Educational System*, 20 SOC. F. 561 (2005), and Igor Ryabov & Jennifer Van Hook, *School Segregation and Academic Achievement Among Hispanic Children*, 36 SOC. SCI. RES. 767 (2007), studies did not analyze Black students in their samples.

141. *See* Appendix.

142. *See* Appendix. Two studies restricted their sample to only Latinos/as. *See* Appendix: Crosnoe, at 567; Ryabov & Van Hook, at 772.

143. *See* Appendix: Benson & Borman; Brown-Jeffy, at 392; Rebecca Callahan et al., *ESL Placement and Schools: Effects on Immigrant Achievement*, 23 EDUC. POL'Y 355, 364 (2009); Roger D. Goddard, Serena J. Salloum & Dan Berbitsky, *Trust as a Mediator of the Relationships Between Poverty, Racial Composition, and Academic Achievement: Evidence from Michigan's Public Elementary Schools*, 45 EDUC. ADMIN. Q. 292, 302 (2009); DOUGLAS N. HARRIS, CTR. FOR AM. PROGRESS, LOST LEARNING, FORGOTTEN PROMISES—A NATIONAL ANALYSIS OF SCHOOL RACIAL SEGREGATION, STUDENT ACHIEVEMENT, AND "CONTROLLED CHOICE" PLANS 28 (2006), http://www.americanprogress.org/issues/2006/11/pdf/lostlearning.pdf; Melissa R. Herman, *The Black-White-Other Test Score Gap: Academic Achievement Among Mixed Race Adolescents*, 81 SOC. EDUC. 20, 22 (2009); Chandra Muller et al., *Race and Academic Achievement in Racially Diverse High Schools: Opportunity and Stratification*, 112 TCHRS. C. REC. (forthcoming 2010); Xioxia Newton, *End of High School Mathematics Attainment: How Did Students Get There?*, 112 TCHRS. C. REC. (forthcoming 2010); Lindsay C. Page, Richard J. Murnane & John B. Willett, *Trends in the Black-White Achievement Gap: Clarifying the Meaning of Within and Between School Achievement Gaps* 26 (Nat'l Bureau of Econ. Research, Working Paper No. 14213, 2008); Gregory J. Palardy, *Differential School Effects Among Low, Middle, and High Social Class Composition Schools: A Multiple Group, Multilevel Latent Growth Curve Analysis*, 19 SCH. EFFECTIVENESS & SCH. IMPROVEMENT 21, 33 (2008); Payne & Biddle, at 9–10; Suet-ling Pong, *The School Compositional Effect of Single Parenthood on 10th-Grade Achievement*, 71 SOC. EDUC. 23,

include Native Americans.[144] More than half of the fifty-seven studies (N=35) discussed in detail the effects of school composition on the math outcomes for Blacks, but only twelve of the fifty-four studies with Whites in their samples thoroughly discussed results for Whites.[145] Detailed results for other racial groups are discussed only in some of the studies: sixteen of the thirty-two studies with Latinos/as discussed results directly related to them,[146] three of the

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30 (1998); Alejandro Portes & Lingxin Hao, *The Schooling of Children and Immigrants: Contextual Effects on the Educational Attainment of the Second Generation*, 101 PROC. NAT'L ACAD. SCI. U.S.A. 11,920, 11,922 (2004); Russell W. Rumberger & J. Douglas Willms, *The Impact of Racial and Ethnic Segregation on the Achievement Gap in California High Schools*, 14 EDUC. EVALUATION & POL'Y ANALYSIS 377, 380 (1992); Southworth, at 63; Tenisha L. Tevis, African-American Students' College Transition Trajectory: An Examination of the Effect of High School Composition and Expectations on Degree Attainment 53, 54 (Dec. 2007) (unpublished Ph.D. dissertation, Pennsylvania State University) (on file with Penn State Electronic Thesis and Dissertation Collection).

144. *See* Appendix: Benson & Borman; Harris, at 28; Newton; Page, at 26; Payne, at 33; Southworth, at 79; Tevis, at 54.

145. *See* Appendix: Brown-Jeffy, at 398–402; Caldas & Bankston III, at 550–52; Elizabeth Covay, Racial Differences in Access to and Returns from Advanced Math Course Taking 25–28 (Sept. 2008) (unpublished manuscript, on file with the North Carolina Law Review); Doris R. Entwisle & Karl L. Alexander, *Summer Setback: Race, Poverty, School Composition, and Mathematics Achievement in the First Two Years of School* 57 AM. SOC. REV. 72, 75–81 (1992); Christy Lleras, *Race, Racial Concentration, and the Dynamics of Educational Inequality Across Urban and Suburban Schools* 45 AM. EDUC. RES. J. 886, 899–900 (2008); Julianne Kirgis McNalley, "We Value Diversity, but . . ." Academic Achievement of White, Middle Class Elementary Students in Segregated and Integrated Schools 53 (May 2005) (unpublished Ph.D. dissertation, University of Iowa) (on file with the North Carolina Law Review); Roslyn Arlin Mickelson, How Middle School Segregation Contributes to the Race Gap in Academic Achievement 11–13 (Sept. 2008) (unpublished manuscript, on file with the North Carolina Law Review); Roslyn Arlin Mickelson, *Subverting Swann: First- and Second-Generation Segregation in the Charlotte-Mecklenburg Schools* 38 AM. EDUC. RES. J. 215, 231–36 (2001); Vincent J. Roscigno, *Race and the Reproduction of Educational Disadvantage*, 76 SOC. FORCES 1033, 1050 (1998); Rumberger & Palardy, at 2032–36; Schiff et al., at 12–13; Southworth, at 91.

146. *See* Appendix: Armor & Watkins (2007), at 10–11; Valentina A. Bali & R. Michael Alvarez, *The Race Gap in Student Achievement Scores: Longitudinal Evidence from a Racially Diverse School District*, 32 POL'Y STUD. J. 393, 398–405 (2004); Benson & Borman; MARK BERENDS ET AL., RAND CORP., EXAMINING GAPS IN MATHEMATICS ACHIEVEMENT AMONG RACIAL-ETHNIC GROUPS, 1972–1992, at 71–75 (2005); Brown-Jeffy, at 397–401; Crosnoe, at 582–83; Goldsmith, at 101–02; Harris, at 17–18; Herman, at 38–39; Hoffer, at 214; Ge Liu & William Carbonaro, Friendship Networks and Racial/Ethnic Differences in Academic Outcomes 14–16 (Aug. 4, 2008) (unpublished manuscript, on file with the North Carolina Law Review) (presented at the American Sociological Association Annual Meeting, Boston, Mass.); Chandra Muller et al., Race, Social Class and Academic Achievement in U.S. High Schools 9 (2004) (unpublished manuscript, on file with the North Carolina Law Review) (presented at the American

sixteen with Asians in the samples actually discussed Asians,[147] and none of the seven studies with Native Americans in the sample reported specific findings about them. Six studies presented findings for minorities in general,[148] and four reported findings on immigrants.[149] Table 3 summarizes the quality of the findings by type of school composition for specific racial, ethnic, and SES groups.

Table 3. Strength of Findings About School Racial and SES Composition by Student Race and SES

Race and SES of Students	**School Racial Composition and Evidence of Segregation's Harm/Diversity's Benefits**	**School SES Composition and Evidence of Segregation's Harm/Diversity's Benefits**
Student Race		
Black	Strong	Strong
White	Strong	Moderately strong
Latino/a	Strong	Suggestive
Asian	Strong	Insufficient Data
Native American	Insufficient Data	Insufficient Data
Immigrant	Suggestive	Insufficient Data
Minority	Strong	Insufficient Data
Student SES		
Low Income	Insufficient Data	Moderately Strong
Not Low Income	Insufficient Data	Moderately strong

Sociological Association Annual Meeting, S.F., Cal.); Muller et al. (forthcoming 2010); Portes & Hao, at 11,926; Ryabov & Van Hook, at 782–83.

147. *See* Appendix: Brown-Jeffy, at 398–99; Palardy, at 26, 32; Portes & Hao, at 11,923–26.

148. *See* Appendix: Liu & Carbonaro, at 16; Muller et al. (forthcoming 2010); Newton; Vincent J. Roscigno, Donald Tomaskovic-Devey & Martha Crowley, *Education and the Inequalities of Place*, 84 SOC. FORCES 2122, 2139 (2006); Rumberger & Willms, at 393; Schiff et al., at 14–15.

149. *See* Appendix: Rebecca Callahan et al., at 355; Goldsmith, at 102; Portes & Hao, at 11920; Ryabov & Van Hook, at 767.

1. Blacks

The preponderance of the studies that discussed the effect of racial composition on Black achievement concluded that racial diversity in schools positively affects Black students' math achievement,[150] or that racial segregation negatively affects their mathematics performance.[151] Among studies that reported significant effects for Blacks and Whites, several sources specified that segregation had a larger impact for Blacks than for Whites.[152] Of the thirty-five that specifically discussed Blacks, only one study found no significant relationship between Black concentration and math

150. *See* Appendix: Brown-Jeffy, at 399–400; Harris, at 21; Liu & Carbonaro, at 16; Schiff et al., at 12–13; Southworth, at 147; *see also* Bali & Alvarez, at 410 (suggesting this finding).

151. *See* Appendix: David J. Armor & Stephanie Duck, The Effect of Black Peers on Black Test Scores 14 (May 28, 2007) (unpublished manuscript, on file with The North Carolina Law Review); David J. Armor & Shanea J. Watkins, *School Segregation and Black Achievement: New Evidence from the 2003 NAEP*, *in* THE BENEFITS OF RACIAL AND ETHNIC DIVERSITY IN ELEMENTARY AND SECONDARY EDUCATION 28, 34–37 (U.S. Comm'n on Civil Rights ed., 2006); Carl Bankston III & Stephen J. Caldas, *Majority African American Schools and Social Injustice: The Influence of De Facto Segregation on Academic Achievement*, 75 SOC. FORCES 535, 543–49 (1996); Berends et al. (2005), at 74–75; Mark Berends, Samuel R. Lucas & Roberto V. Peñaloza, *How Changes in Families and Schools Are Related to Trends in Black-White Test Scores*, 81 SOC'Y. EDUC. 313, 329 (2008); Kathryn M. Borman et al., *Accountability in a Postdesegregation Era: The Continuing Significance of Racial Segregation in Florida's Schools*, 41 AM. EDUC. RES. J. 605, 624 (2004); Dennis J. Condron, *Social Class, School and Non-School Environments, and Black/White Inequalities in Children's Learning*, 74 AM. SOC. REV. 683, 699 (2009); Entwisle & Alexander, at 82; Covay, at 17; William J. Glenn, *Separate but Not Yet Equal: The Relation Between School Finance Adequacy Litigation and African American Student Achievement*, 81 PEABODY J. EDUC. 69, 85, 91 (2006); Eric A. Hanushek & Steven G. Rivkin, *School Quality and the Black-White Achievement Gap* 23 (Nat'l Bureau of Econ. Research, Working Paper No. 12651, 2006); Eric A. Hanushek & Steven G. Rivkin, *Harming the Best: How Schools Affect the Black-White Achievement Gap* 21 (Nat'l Bureau of Econ. Research, Working Paper No. 14211, 2008); Eric A. Hanushek, John F. Kain & Steven G. Rivkin, *New Evidence About* Brown v. Board of Education*: The Complex Effects of School Racial Composition on Achievement*, 27 J. LAB. ECON. 349, 375 (2009); Lleras, at 901–02; Mickelson (2001), at 229–31; Mickelson (2008), at 19–20; Muller et al. (2004), at 12–14; Muller et al. (forthcoming 2010); Douglas Ready & Megan Silander, Estimating the Influence of School Racial and Socioeconomic Composition on Student Learning: Methodological Challenges and Alternative Solutions (Apr. 2, 2009) (unpublished manuscript at 24, on file with the North Carolina Law Review) (presented at *Looking to the Future: Legal and Policy Options for Racially Integrated Education in the South and the Nation*, Chapel Hill, N.C.); Roscigno, at 1045; Rumberger & Willms, at 390–91; Schiff et al., at 12–13.

152. *See* Appendix: Armor & Watkins (2006), at 31; Bankston & Caldas, at 552; Covay, at 18; Liu & Carbonaro, at 1; Muller et al. (2004), at 10.

achievement.[153] Four studies found that Black school composition was not as important as SES.[154] Research on the effects of SES composition on Black students' achievement reported that low concentrations of poor children are positively related to math achievement.[155] Together, these findings offer strong evidence that attending diverse schools is associated with positive mathematics outcomes for Blacks and that racial and/or SES segregation has negative effects on their achievement.

2. Whites

Almost all of the studies summarized in this Article include Whites in their sample, yet only twelve of them discuss the effects of racial or SES composition for White students in detail.[156] Of these, seven reported that as minority segregation increases, Whites' math outcomes decrease.[157] One study noted that the relationship between racially isolated minority schools and diminished achievement for Whites is weaker than it is for Blacks.[158] Three of the twelve studies found that while attending a diverse school had no positive effect on the math achievement of Whites, neither did it have a negative

153. *See* Appendix: Goldsmith, at 83.

154. *See* Appendix: Benson & Borman; Chubb & Moe, at 127–28; McCathern, at 201; Rumberger & Palardy, at 1999.

155. *See* Appendix: Johnson, at 11; Palardy, at 33.

156. *See* Appendix: Brown-Jeffy, at 398–402; Caldas & Bankston III, at 550–52; Covay, at 25–28; Entwisle & Alexander, at 75–81; Lleras, at 899–900; McNalley, at 16–17; Mickelson (2001), at 231–36; Mickelson (2008), at 11–13; Roscigno, at 1050; Rumberger & Palardy, at 33; Schiff et al., at 12–13; Southworth, at 91. The absence of a discussion of compositional effects on Whites, even though data are available to do so, may reflect underlying assumptions that Whites are a criterion category or that only students of color, not all students in a school, are the beneficiaries of diversity. This limitation is glaringly repeated throughout the school racial composition literature and, in the authors' opinion, reflects a major shortcoming. By focusing interpretations and discussions of compositional effects only on children of color, researchers miss the opportunity to report the implications of integration for White students' mathematics outcomes. Robert Garda makes a similar argument with respect to Whites' broader interests in integrated education. *See generally* Robert A. Garda, Jr., The White Interest in School Integration (2009) (unpublished manuscript), *available at* http://ssrn.com/abstract=1463598 (arguing that Whites have broad interests in integrated education).

157. *See* Appendix: Bankston & Caldas, at 535; Entwisle & Alexander, at 80; Lleras, at 1; Mickelson (2001), at 230; Mickelson (2008), at 21; Roscigno, at 1047. Elizabeth Covay also reported this in an updated version of an earlier manuscript. *See* Elizabeth Covay, Racial Differences in Access to and Returns from Advanced Math Course Taking 29 (Sept. 2009) (unpublished manuscript, on file with the North Carolina Law Review).

158. *See* Appendix: Bankston & Caldas, at 552.

effect.[159] Two studies reported that, for Whites, schools with racially diverse student bodies (within specific thresholds) foster higher math achievement than do racially isolated White schools.[160] Several studies report the positive correlation of low-poverty school composition with the achievement of White students.[161] Together, these studies present strong evidence that minority segregation negatively affects the achievement of Whites and that attending diverse schools does not harm the mathematics achievement of White students. Additionally, there is moderately strong evidence that a school's SES composition is important for its students' math achievement.

3. Latinos/as

Eleven out of the sixteen studies that discussed outcomes specifically for Latinos/as reported that as racial diversity increases in schools, mathematics outcomes do as well,[162] or that racial segregation negatively affects Latino/a achievement in mathematics.[163] Two articles found a positive effect for Latino/a segregation on the mathematics achievement of students.[164] The positive segregation effect is likely rooted in the benefits of immigrant concentration rather than in Latino/a concentration per se.[165] Only one study reports no significant effect of segregation on Latino/a achievement.[166] Socioeconomic composition also influences Latino/a math achievement. Two articles reported that socioeconomic composition was closely related to math achievement of Latino/a students.[167] Overall, the research record presents strong evidence that segregation undermines Latinos/as' mathematics achievement and moderately strong evidence that attending diverse schools fosters it. In addition, there is suggestive evidence that concentrated poverty is also

159. *See* Appendix: Brown-Jeffy, at 398; McNalley, at 40; Schiff et al., at 13.

160. *See* Appendix: Brown-Jeffy, at 398; Southworth, at 147.

161. *See* Appendix: Entwisle & Alexander, at 82; Rumberger & Palardy, at 1999; Southworth, at 147.

162. *See* Appendix: Brown-Jeffy, at 400; Liu & Carbonara, at 16; *see also* Bali & Alvarez, at 410 (suggesting this finding).

163. *See* Appendix: Berends & Peñaloza, at 21; Berends et al. (2005), at 73; Crosnoe, at 579; Muller et al. (forthcoming 2010); Muller et al. (2004), at 2; Harris, at 17; Herman, at 36–39; *see also* Ryabov & Van Hook, at 767 (reporting that the relationship holds only in the case of foreign-born Latinos/as).

164. *See* Appendix: Goldsmith, at 96; Portes & Hao, at 11,926.

165. *See* Appendix: Goldsmith, at 97.

166. *See* Appendix: Armor & Watkins (2007), at 1.

167. *See* Appendix: Benson & Borman; Hoffer, at 225.

negatively related to Latino/a math achievement. The exception to these trends is ethnic segregation's possible positive effects for math outcomes of Latino/a immigrants.

4. Asians

Sixteen studies included Asians in their samples,[168] but only three of these studies reported outcomes specifically for Asians' mathematics achievement.[169] Twelve of the studies that included Asians in their samples reported positive effects of diversity, although not all studies reported effects of diversity specifically for Asians. Findings from the other three showed that attending a school with more privileged students benefits Asians' math achievement.[170] One of the three studies concluded that Asian concentration acts as a positive leveling factor for other Asian students.[171] Another study reported that Asian students have better outcomes in schools that are overwhelmingly White and/or Asian,[172] and the third one indicated that attending school with concentrations of high income students benefits Asians more than it does Whites.[173]

5. Native Americans

The seven studies that included Native Americans in their samples reported that attending either a racially or socioeconomically diverse school has a positive effect on mathematics outcomes,[174] but none of the studies discussed the effect of racial and/or SES composition specifically with regard to Native American mathematics achievement. Without specific findings about Native American samples, there is insufficient evidence to draw conclusions about the effects of either racial or SES composition on their mathematics achievement.

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168. *See* Appendix: Benson & Borman; Brown-Jeffy, at 388; Callahan et al., at 364; Goddard et al., at 301; Harris, at 3; Herman, at 26; Muller et al. (forthcoming 2010); Newton; Page et al., at 23; Palardy, at 26; Payne & Biddle, at 4; Pong, at 23; Portes & Hao, at 11,921; Rumberger & Willms, at 380; Southworth, at 3; Tevis, at 54.

169. *See* Appendix: Brown-Jeffy, at 402; Palardy, at 32; Portes & Hao, at 11,926.

170. *See* Appendix: Brown-Jeffy, at 402; Palardy, at 32; Portes & Hao, at 11,926.

171. *See* Appendix: Portes & Hao, at 11,926.

172. *See* Appendix: Brown-Jeffy, at 402.

173. *See* Appendix: Palardy, at 32.

174. *See* Appendix: Benson & Borman; Harris, at 18; Newton, at 8; Page et al., at 33; Palardy, at 31; Southworth, at 100, 107; Tevis, at 57.

6. Immigrants

Two of the four studies that report school compositional effects on immigrant students' mathematics achievement find that Asian and Latino/a immigrants perform better in schools with greater numbers of their co-ethnics.[175] Another study reported that high concentrations of immigrants have an indirect effect on math outcomes through greater likelihood of ESL program placement, which itself positively affects mathematics achievement.[176] In contrast, a fourth article reported that an increase in school minority composition has a negative effect on grades in the case of Latino/a immigrants (but not Latinos/as in general).[177] Together, the four studies present suggestive evidence that for Asian and Latino/a immigrant students, there is a positive relationship between higher concentrations of their co-ethnics and their mathematics achievement.

7. Minorities

Five articles referred to effects of racial composition on mathematics outcomes for minorities in general. Four of these articles reported that increases in minority concentration correspond to decreases in minority students' mathematics achievements.[178] The remaining study found that diversity is particularly beneficial for the academic achievement of minorities because of the opportunities to gain social capital that diverse schooling offers.[179] Overall, studies that report findings about minority students offer strong evidence that school racial segregation is negatively related to minority math achievement.

B. Findings by Student SES

The social science literature is quite clear that school racial composition is not equivalent to school socioeconomic composition, although they are highly correlated.[180] The research record is also

175. *See* Appendix: Goldsmith, at 97; Portes & Hao, at 11,925.

176. *See* Appendix: Callahan et al., at 376.

177. *See* Appendix: Ryabov & Van Hook, at 776.

178. *See* Appendix: Newton, at 12; Rumberger & Willms, at 393; Roscigno, at 2136; Schiff et al., at 14.

179. *See* Appendix: Liu & Carbonaro, at 16.

180. *See generally* DAVID GRUSKY, SOCIAL STRATIFICATION IN SOCIOLOGICAL PERSPECTIVE: RACE, CLASS, AND GENDER (2d ed. 2001) (presenting social science

unambiguous about the overall effects of school socioeconomic composition on mathematics outcomes: concentrated school poverty has a negative effect on the mathematics outcomes of all students who attend such institutions.[181] The general literature indicates that children from less advantaged families benefit academically from SES integration while those from the middle class are not hurt, and may benefit from it.[182]

Empirical studies differentiating the influence of schools' racial and SES composition on mathematics outcomes for students from *different* socioeconomic backgrounds are relatively rare. Only five of the fifty-nine studies included in this synthesis discuss in detail the impact of variations in school SES composition[183] on the mathematics achievement of students categorized by their own socioeconomic backgrounds.[184] The five studies provide moderately strong evidence that students from various socioeconomic strata are differentially affected by a school's SES composition. Two studies reported that SES effects are comparable for students from any SES background.[185] Two others report low-SES youth are more strongly affected by school SES than children from more advantaged backgrounds.[186] The fifth study reports that the mathematics achievement of White, middle class students is not affected by the SES composition of a school.[187]

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research on the structure of social inequality organized around three distinct, but related, concepts of race, class, and gender).

181. *See generally* RICHARD KAHLENBERG, ALL TOGETHER NOW: CREATING MIDDLE-CLASS SCHOOLS THROUGH PUBLIC SCHOOL CHOICE (2001) (presenting a broad overview of twenty years of research that shows how and why concentrated school poverty negatively affects achievement).

182. *See id.* at 39; Appendix: Palardy, at 21.

183. None of the five addressed the impact of racial composition.

184. *See* Appendix: Valerie E. Lee, Julia B. Smith & Robert G. Croninger, *How High School Organization Influences the Equitable Distribution of Learning in Mathematics and Science*, 70 SOC. EDUC. 128, 137–38 (1997) [hereinafter Lee et al., *High School Organization*]; McNalley, at 32; Palardy, at 32–34; Rumberger & Palardy, at 2012–14; Ready & Silander, at 20–30. This Article focuses exclusively on research conducted with U.S. students, although international studies report similar findings.

185. *See* Appendix: Lee et al. *High School Organization*, at 138; Rumberger & Palardy, at 1999.

186. *See* Appendix: Palardy, at 21; Ready & Silander, at 14–19.

187. *See* Appendix: McNalley, at 32.

C. *Findings by Grade Level*

The fifty-nine studies synthesized in this Article utilized samples of students from elementary, middle, and high school. Of these, thirty-one included high school students in their sample,[188] twenty-seven studies reported on middle school students,[189] and twenty-two dealt with kindergarten and elementary school students.[190] Some studies combined elementary and middle school samples, middle and high school samples, and so on. The majority focused exclusively on only one grade level. Table 4 summarizes the quality of the evidence for school race and SES compositional effects by grade level structure of the samples.

Table 4. Strength of Findings About School Racial and SES Composition and Grade Structure of Sample

Grade Structure of Sample	*Racial Composition and Evidence of Segregation's Harm/ Diversity's Benefits*	*SES Composition and Evidence of Segregation's Harm/ Diversity's Benefits*
High School		
High School Only	Strong	Strong
High and Middle School	Strong	Suggestive
High, Middle, and Elementary School	Suggestive	Insufficient Data
Middle School		
Middle School Only	Strong	Strong
Middle and Elementary School	Strong	Moderately Strong
Elementary School		
Elementary Only	Suggestive	Strong

1. High School Samples

The results of the twenty-three studies with exclusively high school samples[191] show that both racial segregation[192] and

188. *See* Appendix.
189. *See* Appendix.
190. *See* Appendix.
191. *See* Appendix.

concentrated poverty[193] are detrimental for mathematics achievement. The one study that focused on diversity, rather than segregation, suggested that high school racial diversity within certain parameters fosters achievement.[194] Another study reported that SES composition has stronger effects on gains in mathematics achievement during grades eleven through twelve than on gains made during grades eight through ten.[195] Two of them found no significant relationships between racial composition and achievement.[196] Overall, with the possible exception of schools with large concentrations of immigrant youth,[197] the evidence is strong that both minority segregation and poverty concentration undermine the mathematics achievement of high school students.

2. High School and Middle School Samples

Almost all of the studies that use samples containing both high school and middle school students show that racial segregation has a negative impact on mathematics achievement.[198] The only exception to this finding was a single study that found that racial concentration had no effect on mathematics achievement of high school and middle school Black students, although the same study found a positive effect in the case of Latino/a immigrant concentration.[199] Studies that address the impact of school SES found that concentrated poverty has a negative effect on math achievement.[200] Like the findings from the

192. *See* Appendix: Bankston & Caldas, at 535; Berends & Peñaloza, at 21; Berends et al. (2005), at 73; Berends et al. (2008), at 329; Caldas & Bankston III, at 275; Covay, at abstract; Crosnoe, at 579; Herman, at 36–37; Liu & Carbonaro, at 16; Mickelson (2001), at 215; Muller et al. (forthcoming 2010); Pong, at 33; Roscigno, at 1047; Rumberger & Palardy, at 2020; Tevis, at 54.

193. *See* Appendix: Lee et al. *Course-Taking*, at 112; Roscigno et al., at 2136–38; Rumberger & Palardy, at 2014; Tevis, at 52–58; Adrian N. Welcher, Head of the Class: Black/White Inequality, Cultural and Social Capital, and High School Math Achievement 27 (Jan. 17, 2008) (unpublished manuscript, on file with the North Carolina Law Review) (presented at the annual meeting of the American Sociological Association Annual Meeting, Sheraton Boston and the Boston Marriott Copley Place, Boston, Mass., 2008).

194. *See* Appendix: Brown-Jeffy, at 399–400.

195. *See* Appendix: Lee et al., *High School Organization*, at 137.

196. *See* Appendix: Chubb & Moe, at 126, 127; Lee et al., *Course-Taking*, at 112.

197. *See* Appendix: Callahan, at 376.

198. *See* Appendix: Lleras, at 23; Muller et al. (2004), at 12; Newton, at 28; Ryabov & Van Hook, at 767 (reporting that this finding holds only in the case of foreign born Latinos/as).

199. *See* Appendix: Goldsmith, at 101.

200. *See* Appendix: Muller et al. (2004), at 5; Ryabov & Van Hook, at 782.

high school-only samples, results from these combined samples offer strong evidence that racial segregation is detrimental for the math achievement of middle and high school students.

3. Middle School Samples

Nine of the fifty-nine studies utilized a sample of exclusively middle school students.[201] The majority of these studies either found that racial segregation has negative effects on math outcomes,[202] or they concluded that concentrated school poverty has a negative effect on math achievement.[203] One study reported that school SES interacts with family SES, compounding the already considerable advantages of students from more privileged backgrounds.[204] In summary, the research that exclusively employs middle school student samples offers strong evidence that concentrated poverty and racial segregation hinder mathematics performance.

4. Elementary School Samples

Nine studies utilized samples with only elementary students.[205] Many of the studies found that SES composition was more influential than racial composition for mathematics outcomes.[206] Four studies found that as racial segregation increased, mathematics achievement of elementary students decreased.[207] Two articles reported that racially diverse schools may offer their students a better chance to excel in math.[208] Three studies showed no statistically significant effect of racial composition on mathematics achievement.[209] While

201. *See* Appendix: Armor & Watkins (2006), at 30; Hoffer, at 205; Lee & Smith, at 164; Mickelson (2008), at 1; Page et al., at 34; Palardy, at 22; Payne & Biddle; Portes & Hao, at 11,921; Schiff et al., at 8.

202. *See* Appendix: Armor & Watkins (2006), at 35–36; Schiff et al., at 14; Mickelson (2008), at 21; Page et al., at 34.

203. *See* Appendix: Hoffer, at 225; Lee & Smith, at 174; Palardy, at 21; Payne & Biddle, at 11.

204. *See* Appendix: Portes & Hao, at 11,924.

205. *See* Appendix: Bali & Alvarez, at 397; Benson & Borman; Condron, at 689; Entwisle & Alexander, at 73; Goddard et al., at 299; McCathern, at 1; McNalley, at 2; Murnane et al., at 99; Ready & Silander, at 7.

206. *See* Appendix: Benson & Borman; McCathern, at 147 tbl.29, 171 tbl.38; Murnane et al., at 175–76.

207. *See* Appendix: Condron, at 699; Entwisle & Alexander, at 82; Goddard et al., at 308; Ready & Silander, at 20.

208. *See* Appendix: Bali & Alvarez, at 410; McNalley, at 32.

209. *See* Appendix: Benson & Borman; McCathern, at 190; Murnane et al., at 124.

studies employing only elementary school samples offer strong evidence regarding the harmful effect of poverty concentration on mathematics achievement, they offer suggestive evidence regarding the effects of racial composition on mathematics achievement of elementary students.

5. Middle and Elementary School Samples

The preponderance of studies that used samples with both elementary and middle school students show that minority concentration has a negative effect on mathematics achievement.[210] Four studies found a negative relationship between poverty concentration and math achievement.[211] One study found no significant relationship between minority concentration and achievement.[212] The sole study that examined diversity effects reported that integrated elementary and middle schools foster the mathematics achievement of their students.[213] In summary, the evidence from combined middle and elementary school samples strongly indicates that attending racially segregated schools negatively affects the mathematics outcomes of these students. This set of research also offers moderately strong evidence that poverty concentration negatively influences outcomes.

6. Combined Elementary, Middle, and High School Samples

Three of the studies relevant to this synthesis examined the effects of school racial composition with samples that included students in elementary through high school.[214] Two of these studies showed that racial composition mattered for math achievement of students and that integrated schools benefitted minority students in all school grades.[215] The third study obtained very few significant

210. *See* Appendix: Armor & Duck, at 18; Glenn, at 91; Eric A. Hanushek & Margaret E. Raymond, *Does School Accountability Lead to Improved Student Performance?* 14 (Nat'l Bureau of Econ. Research, Working Paper No. 10591, 2004); Hanushek & Rivkin (2008), at 13–14; Hanushek & Rivkin (2006), at 25; Hanushek et al., at 349; Southworth, at 137, 146–147.

211. *See* Appendix: Hanushek & Raymond, at 13–14; Johnson, at 11; Sorhaindo, at 34; Southworth, at 146.

212. *See* Appendix; Armor & Watkins (2006), at 42.

213. *See* Appendix: Southworth, at 147.

214. *See* Appendix: Borman et al., at 615; Burke & Sass, at 16; Harris, at 14.

215. *See* Appendix: Borman et al., at 626; Harris, at 17.

effects for the racial composition variables.[216] Overall, studies using combined elementary, middle, and high school samples offer suggestive evidence that racial composition negatively affects mathematics outcomes.

In summary, the preponderance of findings from the fifty-nine studies indicates that mathematics outcomes are negatively affected by minority racial isolation and concentrated poverty and that mathematics outcomes are likely to be higher for students from all grade levels, racial, and SES backgrounds if they attend integrated schools. These generalities are more tentative with respect to Asians and Native Americans because there is insufficient research to draw reliable conclusions about them. There is also suggestive evidence that Latino/a and Asian immigrant students may benefit from attending school with co-ethnics. Finally, findings on elementary students' achievement are less definitive than the evidence about students in higher grade levels. Although six studies using elementary school samples show strong evidence of the negative effects of racial segregation or the benefits of integrated education,[217] three other studies showed no effects.[218] Some of the researchers who obtained these findings speculate that the weaker influence of school composition on very young students' (K–2) mathematics scores is likely due to their exposure to limited mathematics curriculum in the earliest grades.[219]

VI. DISCUSSION

From time to time, scholars, government actors, and policy analysts update the list of "what works" in education.[220] The findings

216. *See* Appendix: Burke & Sass, at 11.

217. *See* Appendix: Bali & Alvarez, at 410; Condron, at 699; Entwisle & Alexander, at 82; Goddard et al., at 20; McNalley, at 53; Ready & Silander, at 20.

218. *See* Appendix: Benson & Borman; McCathern, at 190; Murnane et al., at 124.

219. *See* Appendix: Benson & Borman.

220. For example, the Association for Supervision and Curriculum Development, in conjunction with Robert Marzano, has developed a tool for educational practitioners called "What Works in Schools." Association for Supervision and Curriculum Development, What Works in Schools: Online Survey, http://www.whatworksinschools.org (last visited Feb. 13, 2010). In 2002, the U.S. Department of Education's Institute of Educational Sciences established a "What Works Clearinghouse." U.S. Dep't of Educ., What Works Clearinghouse, http://ies.ed.gov/ncee/wwc/ (last visited Feb. 13, 2010). Over two decades ago, the Department of Education published a pamphlet entitled *What Works: Research About Teaching and Learning*. U.S. DEP'T OF EDUC., WHAT WORKS:

from this Article indicate that for the vast majority of mathematics learners, integrated schools could be added to the list of "what works." The findings demonstrate the relevance of school racial and socioeconomic diversity for enhancing mathematics outcomes for elementary, middle, and high school students from all racial and SES backgrounds. There is some evidence that the effects of composition are especially keen for youth from low-income Black and Latino/a families.

This Article's findings will contribute to clarifying confusions about the empirical record on this topic as reflected in the *Parents Involved* opinions' disparate interpretations of the social science literature. The current corpus of social science literature provides consistent and unambiguous evidence that attending a racially diverse school with low concentrations of poor children is positively related to mathematics outcomes for most students irrespective of their age, race, or family's SES. The inverse of this statement is also true—attending a school with high concentrations of minority or poor students is negatively related to mathematics outcomes for most students.

Because of the design flaws, sample problems, and underdeveloped analytic strategies found in many of the studies conducted during the first few decades after *Brown*, the early research record on compositional effects is inconsistent and inadequate for assessing the effects of integrated education on achievement outcomes.[221] But the flaws of the early studies do not mean that more recent ones suffer from the same methodological weaknesses, or that the entire corpus of social science on school compositional effects is inconsistent and ambiguous.[222] Newer, better studies have superseded the older ones. Science is cumulative. As this Article has documented,[223] the preponderance of post-1990 research consistently indicates that integrated education is positively correlated with mathematics achievement for almost every student

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RESEARCH ABOUT TEACHING AND LEARNING (1986), *available at* http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/2e/fc/ca.pdf.

221. Bradley & Bradley, *supra* note 45, at 443–44.

222. *But see* Parents Involved in Cmty. Sch. v. Seattle Sch. Dist. No. 1, 551 U.S. 701, 762–63 (2007) (Thomas, J., concurring) (alteration in original) (quoting Brief of Amici Curiae Drs. Murphy et al. in support of Petitioners, *supra* note 50, at 8) (asserting that the social science literature is "inconclusive").

223. *See* Appendix.

group throughout their elementary and secondary schooling. In the future, some policy makers, citizens, or jurists may wish to advance an argument that there is no consistent or unambiguous body of social science research about the effects of integrated education. But with respect to mathematics outcomes, it is difficult to fathom how anyone could draw upon the current and complete social scientific record as a warrant for such a claim.

The literature synthesized in this Article does not fully address several vital aspects of the topic because the research foundation to do so is weak or absent. The first gap in the research concerns *the people* school composition affects. Most research reports findings for Blacks and, to a lesser extent, for Whites. The most striking weakness in this informational mosaic concerns the relationships of racial integration to mathematics outcomes for Asians, Latinos/as, Native Americans, multiracial, and immigrant students. More research about students in these specific groups is essential, especially given the expected demographic transformation of the U.S. student population in the next few decades.[224] In a related vein, further investigations are needed to identify the most advantageous combinations of ethnic, racial, and socioeconomic backgrounds to optimize opportunities to learn for all students in a school.

Even though the majority of the studies synthesized in this Article included Whites in their sample, the overall social science research record provides inadequate information about outcomes specifically for White students. Forty-one of the fifty-four studies with White students in their samples fail to report the effects of school composition on Whites.[225] Researchers' silence neglects the point that school diversity has the potential to benefit or harm Whites as well as children of color. Failing to report outcomes for Whites when the data are available to do so is disappointing from the perspective of basic research and educational policy. As this Article's findings suggest, Whites can benefit from integrated schooling. Interest-convergence theory proposes that integrated schools are unlikely to

224. *See* U.S. Census Bureau, 2008 National Population Projections: Summary Table, http://www.census.gov/population/www/projections/summarytables.html (last visited Feb. 24, 2010).

225. *See* Appendix.

be created or to garner political support from White parents unless they believe integrated schools serve their children's best interests.[226]

Similarly, even though most data sets have family SES data for every student, only a few studies examine how a student's SES mediates the relationships among mathematics outcomes and school's racial composition. One can apply interest-convergence theory to the SES issue as well: until middle-class parents see a value in diverse schools, they are unlikely to support them.

The second gap in the research record concerns *how* racially diverse schools foster greater mathematics achievement. There are several fruitful lines of inquiry in this area that are already shedding light on the gaps in our knowledge base.

(1) Resources distinguish integrated from segregated minority schools, and teacher quality is emblematic of these resources disparities. Better qualified teachers are less likely to teach in racially segregated minority schools or those with concentrated poverty,[227] and teacher quality (operationalized as experience, licensure, test scores, and selectivity of undergraduate institution) correlates with higher student performance.[228]

(2) Peer effects are a second factor widely known to influence adolescents' school performance. Students who attend racially

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226. *See* Derrick A. Bell, Jr., Brown v. Board of Education *and the Interest Convergence Dilemma*, 93 HARV. L. REV. 518, 523 (1980) ("The interest of blacks achieving racial equality will be accommodated only when it converges with the interests of whites."); Garda, *supra* note 156, at 1.

227. Charles Clotfelter, Helen F. Ladd & Jacob L. Vigdor, *School Segregation Under Color-Blind Jurisprudence: The Case of North Carolina* 17 (Duke Univ. Terry Sanford Inst. of Pub. Pol'y Working Paper Series SAN08-02, 2008), *available at* http://sanford.duke.edu/research/papers/SAN08-02.pdf. *See generally* Hamilton Lankford, Susanna Loeb & James Wyckoff, *Teacher Sorting and the Plight of Urban Schools: Descriptive Analysis*, 24 EDUC. EVALUATION & POL'Y ANALYSIS 37 (2002) (demonstrating that teachers leave schools with high levels of minority or low income students). In fact, the resegregation of the Charlotte-Mecklenburg School system after unitary status spurred better qualified teachers to leave newly racially isolated schools. *See* Kirabo Jackson, *Student Demographics, Teacher Sorting, and Teacher Quality: Evidence from the End of Desegregation*, 27 J. LAB. ECON. 213, 216 (2009).

228. *See* Jackson, *supra* note 227, at 214; *see also* Charles Clotfelter, Helen F. Ladd, & Jacob L. Vigdor, *Teacher-Student Matching and the Assessment of Teacher Effectiveness*, 41 J. HUM. RESOURCES 778, 807 (2006) (showing evidence of the superiority of experienced over novice teachers); Sarah Theule Lubienski, Christopher Lubienski & Corinna Crawford Crane, *Achievement Differences and School Type: The Role of School Climate, Teacher Certification, and Instruction*, 115 AM. J. EDUC. 97, 97 (2008) (finding that the only teacher qualifications to predict improved student performance were experience and licensure scores).

and socioeconomically diverse schools benefit from social interactions with peers whose social networks, cultural capital, values, beliefs, goals, and school-oriented behaviors are conducive to academic achievement. According to peer effects theories, advantaged students (typically, but not exclusively, middle-class White and Asian youth) positively influence the pro-education beliefs, values, and behaviors of other students with whom they attend school through a variety of sociological, cultural, and psychological dynamics.[229]

(3) A third promising line of inquiry suggests that the social structure of a diverse school or classroom directly fosters achievement by exposing interacting peers to new ideas, cognitive skills, and problem-solving techniques.[230] Diverse groups of problem solvers—people with distinctive cognitive and technical tools sets—consistently outperform homogeneous groups of the best and the brightest because a larger pool of interacting individuals means a greater array of talents is available for problem solving.[231] Differences in how people think, in the cognitive tools they possess, and in their perspectives translate into a broad range of techniques, skills, dispositions, and abilities available to complete the group's tasks at hand.[232] When authorities (e.g., management, educators, administrators) structure interactions to maximize the potential of the identity diversity within a group, people tend to find better solutions and are more productive than if they are members of homogeneous groups.[233] The military and corporate worlds recognize the importance of diversity in their workforce for many of these reasons.[234] Social scientists have

229. Douglas N. Harris, *How Do School Peers Influence Student Educational Outcomes? Theory and Evidence from Economics and Other Social Sciences*, 112 TCHRS. C. REC. (forthcoming 2010); *see* Clotfelter et al., *supra* note 227, at 16.

230. Mark Granovetter, *The Micro-Structure of School Desegregation*, *in* SCHOOL DESEGREGATION RESEARCH: NEW DIRECTIONS IN SITUATIONAL ANALYSIS, 99–101 (Jeffrey Prager, Douglas Longshore & Melvin Seeman eds., 1986); *see* Clotfelter et al., *supra* note 227, at 14; Harris, *supra* note 229.

231. SCOTT E. PAGE, THE DIFFERENCE: HOW THE POWER OF DIVERSITY CREATES BETTER GROUPS, FIRMS, SCHOOLS, AND SOCIETIES 158–65 (2007).

232. *See id.* at xix–xx.

233. *See id.* at 13 (stating generally that diverse groups are better at solving problems and making predictions).

234. Brief for 65 Leading American Businesses as Amici Curiae Supporting Respondents, Gratz v. Bollinger, 539 U.S. 244 (2003) (No. 02-516) and Grutter v. Bollinger, 539 U.S. 306 (2003) (No. 02-241) ("The existence of racial and ethnic diversity in institutions of higher education is vital to *amici*'s efforts to hire and maintain a diverse

designed successful pedagogical approaches for heterogeneous classrooms based on these dynamics.[235]

(4) The fourth area that promises to account for the advantages of integrated learning environments is research on human cognition. Mathematics achievement involves higher order thinking processes. Compared with homogeneous environments, school settings composed of racially diverse students are likely to produce a learning environment that fosters the deeper, more conscious, more effortful thinking that is associated with higher order thinking processes.[236] Conscious, effortful thinking contrasts with automatic, mindless, or routine thinking. A socially diverse learning environment creates discrepancies, discontinuities, and disequilibria that can inhibit automaticity in cognitive processes and trigger the effortful, reflective thinking,[237] associated with better mathematics performance.

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workforce, and to employ individuals of all backgrounds who have been educated and trained in a diverse environment . . . [because] . . . such a workforce is important to *amici*'s continued success in the global marketplace."); Consolidated Brief of Lt. Gen. Julius W. Becton, Jr. et al. as Amici Curiae Supporting Respondents, Gratz v. Bollinger, 539 U.S. 244 (2003) (No. 02-516) and Grutter v. Bollinger, 539 U.S. 306 (2003) (No. 02-241) ("[A] highly qualified, racially diverse officer corps educated and trained to command our nation's racially diverse enlisted ranks is essential to the military's ability to fulfill its principal mission to provide national security.").

235. *See* ELIZABETH G. COHEN, DESIGNING GROUPWORK STRATEGIES FOR THE HETEROGENEOUS CLASSROOM, at xv–xvi (2d ed. 1994); Rachel A. Lotan, *Stepping into Groupwork*, *in* TEACHING COOPERATIVE LEARNING: THE CHALLENGE FOR TEACHER EDUCATION 167, 167 (Elizabeth G. Cohen, Celeste M. Brody & Mara Sapon-Shevin eds., 2004).

236. *See* Patricia Gurin et al., *Diversity in Higher Education: Theory and Impact on Educational Outcomes*, 72 HARV. EDUC. REV 330, 330 (2002); Sylvia Hurtado, Diversity Effects on Student Cognitive and Social Cognitive Outcomes (2006, white paper prepared for the Spivack workshop, on file with the North Carolina Law Review) (reviewing research that demonstrates how diversity plays a role in a student's academic development); Expert Report of Patricia Gurin § IV, Gratz v. Bollinger, No. 97-7521 (E.D. Mich. 2001) and Grutter v. Bollinger, No. 97-75928 (E.D. Mich. 2001), *available at* http://www.vpcomm.umich.edu/admissions/research/expert/summ.html. *See generally* SOCIAL PSYCHOLOGY AND THE UNCONSCIOUS: THE AUTOMATICITY OF HIGHER MENTAL PROCESSES (John A. Bargh ed., 2007) (describing unconscious or "automatic" forms of psychological and behavioral processes of which people tend to be unaware, that occur without intention or consent, yet influence individuals in striking ways).

237. Gurin et al., *supra* note 236, at 330.

CONCLUSION

Racially integrated schools are not *the* silver bullet that will address all sources of racial and SES gaps in mathematics outcomes. The gaps are products of complex interrelated dynamics arising from individual agency, family resources, and community forces that interact with the structures of opportunity to learn mathematics present in a given school.[238] Nevertheless, this Article's findings are useful in several ways for addressing the gaps.

First, the findings provide an empirical warrant for educators, policy makers, and parents voluntarily seeking to promote integrated schools and to create diverse mathematics classrooms in them.[239] Policy choices matter. An integrated educational system is not a phenomenon, like the weather, that is largely beyond the reach of conscious human efforts to create. School leaders make policy choices—highly conscious policy choices—when they draw district boundaries and school attendance zones. School district boundaries and school attendance zones have historically been mechanisms for translating residential demographic patterns into the racial and SES composition of schools.[240] Attendance boundaries can duplicate or challenge the homogeneous demographic composition of many residential neighborhoods. Justice Kennedy's concurrence in *Parents Involved*, suggesting various strategies to avoid racially isolated schools and to create diverse ones, recognizes that school district leaders can make various choices in pupil assignment with distinct consequences for the racial and socioeconomic composition of the schools they lead.[241]

Next, in light of Justice Kennedy's identification of several possible strategies that could be used to foster diversity and avoid

238. *See* MARTIN, *supra* note 13, at 187–89.

239. For literature indicating the value of diverse classrooms for mathematics, see OAKES, *supra* note 88, at 61–92; Jo Baler, *How a Detracked Mathematics Approach Promotes Respect, Responsibility, and High Achievement*, 45 THEORY INTO PRAC. 40, 40 (2006); Janet Ward Schofield, *International Evidence on Ability Grouping with Curriculum Differentiation and the Achievement Gap in Secondary School*, 112 TCHRS. C. REC. (forthcoming 2010).

240. John R. Logan, Deirdre Oakley & Jacob Stowell, *School Segregation in Metropolitan Regions, 1970–2000: The Impacts of Policy Choices on Public Education*, 113 AM. J. SOC. 1611, 1636 (2008).

241. *See* Parents Involved in Cmty. Sch. v. Seattle Sch. Dist. No. 1, 551 U.S. 701, 788–89 (2007) (Kennedy, J., concurring).

racial isolation,[242] a number of school districts may voluntarily take steps to promote racial diversity in their schools. Doing so is likely to trigger litigation that could revisit the question of whether racially integrated K–12 schools are a compelling state interest and if specific plans are narrowly tailored. To the extent that the corpus of social science research on mathematics outcomes and integrated schooling is brought to bear on the question of compelling interests through expert testimony or amicus briefs, the findings in this Article will contribute to the answer.

Social science evidence may be necessary but it is far from sufficient for influencing public policy, judicial decisions, or changing public opinion on controversial issues like school integration.[243] Legal scholars have repeatedly argued that social science evidence tends to have a limited impact on modern desegregation cases.[244] Nonetheless, scholars have identified several ways that social science may affect outcomes of litigation. Thus, the third manner in which this Article's findings may be useful is by contributing to the nation's evolving *weltanschauung* on the issue, which then indirectly shapes the Court's opinions by becoming part of the social context in which Justices render their decisions.[245] For example, Professor Kevin Welner argues that by changing public discourse and beliefs, social science research

242. *Id.* at 789–90.

243. The authors wish to thank Andrew Grant-Thomas for raising this point in his discussant remarks. Audio Recording: Looking to the Future: Legal and Policy Options for Racially Integrated Education in the South and the Nation Conference, Chapel Hill, North Carolina, Andrew Grant-Thomas, Discussant Remarks for Panel 1 (Track 2). (Apr. 2, 2009), https://deimos.apple.com/WebObjects/Core.woa/BrowsePrivately/unc-public.2060017869.

244. *See* Ancheta, *supra* note 32, at 26–27; Moran, *supra* note 32, at 244; Ryan, *supra* note 32, at 1661; *see also* Epstein & Knight, *supra* note 32, at 215 (discussing the informational role of amici curiae); Levine & Howe, *supra* note 32, *passim* (discussing the use of social science in recent Supreme Court decisions and its impact on legal culture); Lynch, *supra* note 32, at 65–69 (discussing results of interviews with Supreme Court clerks on the way they and their Justices perceive social science data); Roesch et al., *supra* note 32 at 2–3 (explaining the difficulty in measuring the impact of social science data on justices and proposing hypothetical reasons why judges may ignore such data); Rustad & Koenig, *supra* note 32, at 111–14 (discussing the ways in which the modern Supreme Court has expanded their use of social science data as well as ways in which the Justices are reluctant to rely upon it).

245. Moran, *supra* note 32 at 244; Kevin G. Welner, Scholars as Policy Actors: Social Science Research, Societal Beliefs, and the Shifting Zone of Judicial Constraints 10 (2009) (unpublished manuscript, on file with the North Carolina Law Review) (presented at *Looking to the Future: Legal and Policy Options for Racially Integrated Education in the South and the Nation*, Chapel Hill, N.C.).

can shift the zone of judicial constraints in which the Court's decision making takes place.[246]

Social science research, though, is only one part of the dynamic process of changing public opinion and a nation's *weltanschauung* concerning integrated education. Psychologist Howard Gardner describes other factors that foster changes in peoples' minds. They include the use of reason, the resonance of the issues for individuals' own lives (e.g., seeing integrated schools as beneficial for their children's academic futures, as laboratories for democracy and for positive intergroup relations), representative redescriptions that more clearly portray the issue (e.g., detailing how modern businesses, sports teams, and the military benefit from heterogeneous groups of actors),[247] resources (e.g., creating incentives for communities to develop diverse schools), and real-world events (e.g., pressures arising from demographic shifts among the nation's student population).[248] Just as there was resistance to desegregation after *Brown*, there is contemporary resistance to maintaining and expanding integrated schools.[249] However, if the empirical research synthesized in this Article is disseminated to citizens and public policy decision makers in a variety of ways that appeal to their logical, cognitive, and affective thinking,[250] the likelihood of changing their minds about the benefits of integrated education for all students may increase.

The centrality of public schools to a democratic society—and to the lives of the millions of students who attend them—requires that citizens, public policy decision makers, and jurists have the most

246. Welner, *supra* note 245, at 12–13.

247. HOWARD GARDNER, CHANGING MINDS: THE ART AND SCIENCE OF CHANGING OUR OWN AND OTHER PEOPLE'S MINDS 15–19 (2004). *Cf.* PAGE, *supra* note 231, at xix–xx (stating that diverse groups of problem solvers will consistently outperform homogenous groups of the "best and brightest").

248. GARDNER, *supra* note 247, at 16–17.

249. *See* JONATHAN KOZOL, THE SHAME OF THE NATION: THE RESTORATION OF APARTHEID SCHOOLING IN AMERICA 18–20 (2005); Erica Frankenberg & Chinh Q. Le, *The Post-*Parents Involved *Challenge: Confronting Extralegal Obstacles to Integration*, 69 OHIO ST. L.J. 1015, 1070 (2008); James E. Ryan & Michael Heise, *The Political Economy of School Choice*, 111 YALE L.J. 2043, 2051–52 (2002). *See generally* Roslyn A. Mickelson & Carol A. Ray, *Fear of Falling from Grace: The Middle Class, Downward Mobility, and School Desegregation*, 10 RES. SOC. EDUC. & SOCIALIZATION 207 (1994) (discussing the school system reforms in Charlotte in 1992 and arguing that parents' opposition to desegregation arises, in part, from their concerns about education's role in the status attainment process).

250. GARDNER, *supra* note 247, at 30.

current, comprehensive, and rigorous social science available to inform their deliberations and, ultimately, their decisions. This Article's review of the social scientific literature demonstrates that, with respect to mathematics achievement and related outcomes, it matters if schools are racially and socioeconomically integrated. Given the empirical evidence that integration has positive effects on outcomes, parents, educators, policy makers, and jurists should consider addressing the role that school racial segregation and concentrated poverty play in the persistence of achievement gaps in mathematics outcomes.

APPENDIX

Source	Table	Number
Armor & Duck	Table 1	1
Armor & Watkins (2007)	Table 1	2
Armor & Watkins (2006)	Table 2	45
Bali & Alvarez	Table 1	3
Bankston & Caldas	Table 1	4
Benson & Borman	Table 3	47
Berends & Peñaloza	Table 1	5
Berends et al. (2008)	Table 1	6
Berends et al. (2005)	Table 1	7
Borman et al.	Table 1	8
Brown-Jeffy	Table 1	9
Burke & Sass	Table 2	46
Callahan et al.	Table 1	10
Caldas & Bankston	Table 4	53
Chubb & Moe	Table 3	48
Condron	Table 1	11
Covay	Table 1	12
Crosnoe	Table 1	13
Entwisle & Alexander	Table 1	14
Glenn	Table 1	15
Goddard & Salloum	Table 1	16
Goldsmith	Table 1	17
Hanushek & Raymond	Table 1	18
Hanushek & Rivkin (2008)	Table 1	19
Hanushek & Rivkin (2006)	Table 1	20
Hanushek et al.	Table 1	21
Harris	Table 1	22
Herman	Table 1	23

Source	Table	Number
Hoffer	Table 4	54
Johnson	Table 4	55
Lee et al. *High School Achievement*	Table 1	24
Lee et al. *Course Taking*	Table 3	49
Lee & Smith	Table 4	56
Liu & Carbonaro	Table 1	25
Lleras	Table 1	26
Kirgis	Table 1	27
McCathern	Table 3	50
Mickelson (2001)	Table 1	28
Mickelson (2008)	Table 1	29
Muller et al. (forthcoming 2010)	Table 1	30
Muller et al. (2004)	Table 1	31
Murnane et al.	Table 3	51
Newton	Table 1	32
Page et al.	Table 1	33
Palardy	Table 4	57
Payne & Biddle	Table 4	58
Pong	Table 1	34
Portes & Hao	Table 1	35
Ready & Silander	Table 1	36
Roscigno	Table 1	37
Roscigno et al.	Table 1	38
Rumberger & Palardy	Table 3	52
Rumberger & Willms	Table 1	39
Ryabov & Van Hook	Table 1	40
Schiff et al.	Table 1	41
Sorhaindo	Table 4	59
Southworth	Table 1	42
Tevis	Table 1	43
Welcher	Table 1	44

Table 1. Articles with Statistically Significant Race Effects

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demo-graphics
1	David J. Armor & Stephanie Duck, The Effect of Black Peers on Black Test Scores (Sept. 12, 2007) (unpublished manuscript, on file with the North Carolina Law Review) (cited in Petitioners Reply Brief).	Longitu-dinal, at 11.	N.C. End-of-Grade tests ("EOG"), S.C. Palmetto Achievement Challenge tests ("PACT"), Early Childhood Longitudinal Survey ("ECLS") data. 1997–2005, at 10.	Population of students in N.C. and S.C. grades 3 to 8 - N.C. sample 500,000 students - S.C. sample 230,000 students, at 11.	Black and White, at 14.
2	David J. Armor & Shanea H. Watkins, School Composition and Hispanic Achievement (Feb. 10, 2007) (unpublished manuscript, on file with the North Carolina Law Review) (presented at the Sociology of Education Association conference in Asilomar, Cal.).	Longitu-dinal, at 28.	2003 NAEP, at 18.	8th grade Latino/a students in Arizona, California, Illinois, New Mexico, New York, and Texas. Approximately 30,000, at 30.	Black, White. and Latino/a, at 30.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
1	Ordinary least squares ("OLS"), fixed effects, two-stage least squares with twice-lagged test scores, at 24–25.	N.C. EOG and S.C. PACT, at 10.	% Black students, % free lunch, parent education, years in same school, % highly qualified teachers, % certified teachers, and pupils per teacher, at 29–30.	Race, elementary, and middle school.
2	Fixed effect models, at 30.	Math or reading achievement, at 32.	% free lunch, % Latino/a, student background characteristics, school characteristics, and peer characteristics, at 29–30.	Race, elementary, and middle school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demographics
3	Valentina A. Bali & R. Michael Alvarez, *The Race Gap in Student Achievement Scores: Longitudinal Evidence from a Racially Diverse School District*, 32 POL'Y STUD. J. 393 (2004).	Longitudinal, at 393.	Database containing reading and math test scores, background, and school information for students attending the Pasadena Unified School District ("PUSD"), 1999 through 2002, at 396.	Population of students who were in 4th grade in 2002 in the PUSD: 1,221 students in 22 elementary schools, at 397.	Black, White, and Latino/a, at 397.
4	Carl Bankston III & Stephen J. Caldas, *Majority African American Schools and Social Injustice: The Influence of De Facto Segregation on Academic Achievement*, 75 SOC. FORCES 535 (1996).	Cross sectional, at 541.	1990 test scores on the Louisiana Graduation Exit Examination ("GEE"), at 541.	42,041 Black and White Louisiana 10th graders, at 541.	Black and White, at 397.
5	Mark Berends & Roberto V. Peñaloza, *Increasing Racial Isolation and Test Score Gaps in Mathematics: A 30-Year Perspective*, 112 TCHRS. C. REC. (forthcoming 2010).	Longitudinal.	1) National Longitudinal Study of the High School Class of 1972 ("NLS:72"). 2) High School and Beyond senior cohort of 1982 ("HS&B:82"). 3) National Education Longitudinal Study senior cohort of 1992 ("NELS:92").	National random-stratified sample; 1972: 14,469 students; 1982: 26,000 students; 1992: 25,000 8th grade students.	Black, White, and Latino/a.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
3	Hierarchical linear modeling ("HLM"), at 400.	NCE reading and math test scores and levels of high school math courses completed, at 400.	Individual and family variables, school variables (including % Latinos/as in school, % Blacks in schools, and % minority teachers in school), at 400–03.	Race, elementary school.
4	Multilevel regression, at 543–44.	Three components of the GEE taken by 10th graders 1990: math, English language arts, and written composition, at 541–42.	School-level data (% Black, school means of individual level variables) and individual-level data (demographic information and measures of behavioral patterns and habits), at 542–43.	Race and SES, high school.
5	Oaxaca decomposition, multilevel regressions.	Student mathematics achievement between 1972 and 2004.	Individual, family, and school predictor variables (minority composition, race–ethnicity, and socioeconomic composition of school).	Race and SES, high school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demographics
6	Mark Berends, Samuel R. Lucas & Roberto V. Peñaloza, *How Changes in Families and Schools Are Related to Trends in Black-White Test Scores*, 81 SOC. EDUC. 313 (2008).	Longitudinal, at 318.	1) NLS:72 2) HS&B:82 3) NELS:92 4) Educational Longitudinal Study senior cohort of 2004 ("ELS:2004"), at 318.	National random-stratified sample of high school seniors 1972: 14,469 students in 875 schools; 1988: 20,888 students in 905 schools; 1992: 11,661 students in 1,245 schools; 2004: 12,267 students in 740 schools, at 333–35.	Black and White, at 318.
7	MARK BERENDS ET AL., RAND CORP., EXAMINING GAPS IN MATHEMATICS ACHIEVEMENT AMONG RACIAL-ETHNIC GROUPS, 1972–1992 (2005).	Longitudinal, at 33–35.	1) NLS:72 2) HS&B:82 3) NELS:92, at 33–35.	National random-stratified sample of high school seniors, 14,469 students in 875 schools, at 34.	Black, White, and Latino/a, at 33–35.
8	Kathryn M. Borman et al., *Accountability in a Postdesegregation Era: The Continuing Significance of Racial Segregation in Florida's Schools*, 41 AM. EDUC. RES. J. 605 (2004) (cited in Briefs of AERA and Petitioners Reply).	Cross sectional, at 617.	Florida Schools Indicators Report and the School Advisory Council Report for the academic year 1999–2000, at 615.	Florida population of 2.3 million students in 1,547 elementary schools, 513 middle schools, and 368 high schools, at 615.	Black and White, at 615.
9	Shelly Brown-Jeffy, *School Effects: Examining the Race Gap in Mathematics Achievement*, 13 J. AFR. AM. STUD. 388 (2009).	Cross sectional, at 392–93.	High school effectiveness study ("HSES"), at 392.	National random-stratified sample of 3,392 students in 177 schools, at 393.	Black, White, Latino/a, and Asian, at 393.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
6	Oaxaca decomposition, multilevel regressions, at 320–21.	Individual students' scores on mathematics tests, at 318.	Individual, family, and school measures (including socioeconomic and minority composition); a socio-psychological measure of track placement, at 319.	Race and SES, high school.
7	Literature review, multilevel regressions, decompositions, at 41.	Mathematics achievement, at 35.	Individual variables, family variables, and school variables (including school socioeconomic composition, and school minority composition), at 37–41.	Race and SES, high school.
8	Multivariate regression models, at 621–23.	Florida Comprehensive Assessment Test ("FCAT") scores, % of students in a school achieving level 3, 4, or 5 on the math and reading portions of the test, at 615.	Segregation measures (racial balance, racial composition), and other measures, at 615.	Race, elementary school, middle school, and high school
9	Multilevel modeling, at 396.	12th grade mathematics achievement, at 393.	Student level and school level composition, at 393–95.	Race, high school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demographics
10	Rebecca Callahan et al., *ESL Placement and Schools: Effects on Immigrant Achievement*, 23 EDUC. POL'Y 355 (2009).	Cross sectional, at 371.	AddHealth and the Adolescent Health and Academic Achievement Study ("AHAA") for the 1994–1995 school year, at 362.	1,683 first- and second-generation immigrant students in the 26 schools offering ESL courses, at 363–64.	Black, White, Latino/a, and Asian, at 365.
11	Dennis J. Condron, *Social Class, School and Non-School Environments, and Black/White Inequalities in Children's Learning*, 74 AM. SOC. REV. 683 (2009).	Longitudinal, at 689.	Early Childhood Longitudinal Study-Kindergarten Cohort ("ECLS-K") 1998 1st graders, at 689.	National random-stratified sample (n=3,442 students), at 690.	Black and White, at 690.
12	Elizabeth Covay, Composition Matters: The Relationship Between Race and School Composition in Explaining the Black-White Gap (Sept. 2008) (unpublished manuscript, on file with the North Carolina Law Review) (presented at the American Sociological Association Annual Meeting, Boston, Mass.).	Longitudinal, at 14.	Education Longitudinal Study ("ELS") 2002 10th graders and 2004 12th graders, at 14.	National random-stratified sample, approximately 11,330 students (2,190 Black and 9,140 White), at 32.	Black and White, at 32.
13	Robert Crosnoe, *The Diverse Experiences of Hispanic Students in the American Educational System*, 20 SOC. FORCES 561 (2005).	Longitudinal, at 567.	National Longitudinal Study of Adolescent Health ("AddHealth"), mid 1990s sample, at 567.	National random-stratified sample of 2,602 Latinos/as in 69 high schools, at 567.	Latino/a, at 567.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
10	Propensity score matching, at 369.	Math and science enrollment, overall college preparatory course enrollment, junior-year GPA, and cumulative course failures, at 373.	ESL course placement, AH-PVT (English Vocabulary Test), proportion Filipino in school, and proportion Cuban in school, among many others, at 368–69.	Race, high school.
11	HLM and OLS regression models, at 691.	Gains in skills in student's reading and math skills (IRT scale scores), at 692.	Student variables, various non-school factors, and various school factors (including level of integration of school), at 693.	Race and SES, elementary school
12	Logistic regression, OLS, at 17.	Highest math course as of his/her senior year of high school (trigonometry, pre-calculus, or calculus), and math gains from 10th to 12th grade (math IRT scores), at 32.	Race, school composition (racial composition, etc.), control variables (math skills, grade level, student's effort), and student background variables (gender, family structure, and family SES), at 32.	Race, high school.
13	Multiple regression, cluster analysis (k-means in STATA), at 571.	Membership in the four student profiles (four category cluster solution) based on their grades in math, science, English, and social studies for the past year, at 573.	Student level variables, school characteristics (mean parent education, % Latino/a students, and % Latino/a teachers), and academic press (mean academic achievement, mean educational aspirations, % students taking math and science, and % students going on to college), at 578.	Race and SES, high school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demographics
14	Doris R. Entwisle & Karl L. Alexander, *Summer Setback: Race, Poverty, School Composition, and Mathematics Achievement in the First Two Years of School*, 57 AM. SOC. REV. 72 (1992).	Longitudinal, at 72.	Beginning School Study ("BSS") 1982, at 73.	Random sample of 790 beginning first-graders in Baltimore, at 73.	Black and White, at 74.
15	William J. Glenn, *Separate but Not Yet Equal: The Relation Between School Finance Adequacy Litigation and African American Student Achievement*, 81 PEABODY J. EDUC. 63 (2006).	Mixed methods, cross sectional, at 69–70.	2003 NAEP, at 69.	National random-stratified sample of approximately 150,000 students, at 70.	Black, at 70.
16	Roger D. Goddard, Serena J. Salloum & Dan Berbitsky, *Trust as a Mediator of the Relationships Between Poverty, Racial Composition, and Academic Achievement: Evidence from Michigan's Public Elementary Schools*, 45 EDUC. ADMIN. Q. 292 (2009).	Cross sectional, at 300.	Michigan Department of Education 2003–2004 "head count" file, at 299.	Random-stratified sample of 80 eligible public schools with 4th and 5th grade classrooms, at 299.	Black, White, Latino/a, and Asian, at 302.
17	Pat António Goldsmith, *All Segregation Is Not Equal: The Impact of Latino and Black School Composition*, 46 SOC. PERSP. 83 (2003).	Longitudinal, at 87.	NELS and zip code level data from the 1990 U.S. Census, at 87.	National random sample of approximately 10,050 students in 944 schools, at 88.	Black, White, and Latino/a, at 88.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
14	Descriptive statistics, ANOVA, multivariate analysis of variance, at 77.	Score on the mathematics subtest of the California Achievement Test ("CAT") for grades 1, 2, and 3, at 79.	Student/school type (racial/mix), economic standing, parent configuration, and family educational level, at 79.	Race and SES, elementary school.
15	HLM, cross sectional analysis, at 69.	4th grade math and 8th grade math, at 69–70.	Student, family, teacher, school (% minority, % free reduced lunch, etc.), and legal variables, at 69–70.	Race and SES, elementary school, middle school.
16	Path analysis, at 293.	Proportion of students passing the 5th grade mathematics and readings assessments, at 302.	Faculty trust (114-item scale), school SES, school racial composition, geographic location, size, and school level achievement, among others, at 302.	Race and SES, elementary school.
17	Multilevel modeling, at 88.	Test performance (IRT-estimated number right covering four subject areas: reading, math, science, history), at 88–89.	Nativity and language background; % Latino/a, Black, and other non-White; race, ethnicity, gender; neighborhood variables; school-level peer effects; school quality; family background; prior achievement; and region, at 90–91.	Race, middle school, high school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demo-graphics
18	Eric A. Hanushek & Margaret E. Raymond, *Does School Accountability Lead to Improved Student Performance?* (Nat'l Bureau of Econ. Research, Working Paper No. 10591, 2004).	Panel data, at 10.	NAEP, at 10.	Random-stratified, at 10–11.	Black and White, at 10.
19	Eric A. Hanushek & Steven G. Rivkin, *Harming the Best: How Schools Affect the Black-White Achievement Gap* (Nat'l Bureau of Econ. Research, Working Paper No. 14211, 2008).	Panel data, at 7.	Texas-wide student and school indicators from 1994, 1995, and 1996, at 6–7.	Over 200,000 Texas public elementary and middle school students in over 3,000 public schools, at 6–7.	Black, White, and Latino/a, at 2–3.
20	Eric A. Hanushek & Steven G. Rivkin, *School Quality and the Black-White Achievement Gap* (Nat'l Bureau of Econ. Research, Working Paper No. 12651, 2006).	Longitu-dinal, at 3.	Early Childhood Longitudinal Survey ("ECLS") and the Texas Schools Project ("TSP"), at 3.	Random-stratified sample of approximately 640,000 Texas students, at 18.	Black and White, at 10.
21	Eric A. Hanushek, John F. Kain & Steven G. Rivkin, *New Evidence about* Brown v. Board of Education*: The Complex Effects of School Racial Composition on Achievement*, 27 J. LAB. ECON. 349 (2009) (cited in Briefs of AERA, 553 Social Scientists and Armor et al.).	Panel data, at 1.	Texas-wide student and school indicators from 1994, 1995, and 1996, at 16.	Texas public elementary and middle school students; 142,106 Blacks and 661,352 Whites, at 16.	Black and White, at 33–34.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
18	Panel model with fixed effects, at 12–19.	Achievement data, at 20.	School racial and ethnic composition, racial and ethnic composition across the schools in each state (state fixed effects), at 21–23.	Race and SES, elementary school, middle school.
19	Fixed effect models, at 13.	Math achievement, at 21.	Teacher experience, school % Black, class size, and % Latino/a students, at 20.	Race, elementary school, middle school.
20	Fixed effect multiple regress-ions, at 10.	Student scores in math on Texas Assessment of Academic Skills ("TAAS"), at 7.	Student, family, teacher and peer factors, and school factors (including racial composition, % eligible for a subsidized lunch), at 6.	Race, elementary school, middle school.
21	Panel data, at 1.	TAAS Mathematics, at 17.	Student, family, school and peer factors to explain achievement, at 28.	Race, elementary school, middle school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demographics
22	DOUGLAS N. HARRIS, CTR. FOR AM. PROGRESS, LOST LEARNING, FORGOTTEN PROMISES—A NATIONAL ANALYSIS OF SCHOOL RACIAL SEGREGATION, STUDENT ACHIEVEMENT, AND "CONTROLLED CHOICE" PLANS (2006).	Longitudinal, at 14.	No Child Left Behind ("NCLB") data for grades in elementary, middle, and high school in 2004, at 14.	18 million students in 22,000 schools in 45 states, at 14.	Black, White, Latino/a, Asian, and Native American, at 28.
23	Melissa R. Herman, *The Black-White-Other Test Score Gap: Testing Theories of Academic Performance Among Multiracial and Monoracial Race Adolescents*, 81 SOC. EDUC. 20 (2009).	Cross sectional, at 25–26.	Survey of students in 7 high schools in California and Wisconsin between 1987 and 1990, at 25–26.	Purposive sample of 7 high schools in California and Wisconsin of 10,275 respondents, at 25–26.	Black, White, Latino/a, and Asian, at 26–27.
24	Valerie E. Lee, Julia B. Smith & Robert G. Croninger, *How High School Organization Influences the Equitable Distribution of Learning in Mathematics and Science*, 70 SOC. EDUC. 128 (1997).	Longitudinal, at 128.	First three waves of NELS 1988 study of 8th graders; follow up with students in high school in 1990, at 131.	National random-stratified sample of 9,631 seniors in 789 high schools, most public, at 128.	Minority (Black and White) and Latino/a, at 128.
25	Ge Liu & William Carbonaro, Friendship Networks and Racial/Ethnic Differences in Academic Outcomes (Aug. 4, 2008) (unpublished manuscript, on file with the North Carolina Law Review) (presented at the American Sociological Association Annual Meeting, Boston, Mass.).	Longitudinal, at 11.	AddHealth 1994–1995, at 3.	National random-stratified sample of 10,496 high school students in 97 schools, at 12.	Black, White, and Latino/a, at 26.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
22	Simulations and multivariate regressions with fixed effects, at 20.	Math score gains from 7th–12th grade, at 22.	Previous test scores, school % migrant, school status, and multiple student-level factors, at 29–30.	Race and SES, elementary school, middle school, high school.
23	Auto-regressive change models, at 31.	Achievement (student-reported grades: average of 4 student-reported grades in social studies, English, math, and science), at 27–29.	Peer group, school context (% White students), family context, and neighborhood context (racial and SES composition), at 31–36.	Race, high school.
24	HLM, at 131–32.	Two parameters of growth in science and math performance: early (8th–10th grade) and late (10th–12th grade), at 132.	Student controls, school controls (including composition), structural practices, thirty practices, and social and academic organization, at 133–34.	Race and SES, high school.
25	HLM, at 13.	2002 Peabody Vocabulary Test score percentile rank; cumulative GPA of math courses; cumulative GPA of science courses; and college attendance in 2001–2002, at 25.	Racial heterogeneity and average GPA of students' friendship network, variables of friendship network attributes (size, age, race, grades), 1994–1995 score percentile rank, individual educational expectations, course-taking, and parental involvement, at 18–20.	Race, high school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demographics
26	Christy Lleras, *Race, Racial Concentration, and the Dynamics of Educational Inequality Across Urban and Suburban Schools* 45 AM. EDUC. RES. J. 886 (2008).	Longitudinal, at 895.	NELS (1988–1990), at 895.	National random-stratified sample of 6,063 White and 650 Black students in 660 public middle schools and 667 public high schools, at 894.	Black and White, at 894.
27	Julianne Kirgis McNalley, "We Value Diversity, but . . ." Academic Achievement of White, Middle Class Elementary Students in Segregated and Integrated Schools 53 (May 2005) (unpublished Ph.D. dissertation, University of Iowa) (on file with the North Carolina Law Review).	Longitudinal, at 18.	ECLS-K, at 18.	Random-stratified of 2,217 children, at 26–27.	Black and White, at 5.
28	Roslyn Arlin Mickelson, *Subverting* Swann*: First- and Second-Generation Segregation in the Charlotte-Mecklenburg Schools,* 38 AM. EDUC. RES. J. 215 (2001) (cited in Brief of 553 Social Scientists).	Cross-sectional, at 225.	1997 high school survey and Charlotte-Mecklenburg School District records 1999, at 224.	Random-stratified sample of 1,833 high school students, at 224.	Black and White, at 225.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
26	HLM, at 898.	Academic engagement, math test scores: 8th and 10th grade, at 897.	School level (including % receiving free or reduced price lunch, % Black), race, 8th grade math test score, and 10th grade student engagement and math course sequence in the first two years of high school, at 905.	Race and SES, middle school, high school.
27	OLS regression, at 5.	Two direct cognitive assessments in reading and in math (score obtained by administering routing tests), at 22–23.	% minority students in the school, % free and/or reduced lunch eligible students; students fall kindergarten achievement scores for math and reading (prior achievement), and gender, at 22–23.	Race and SES, elementary school.
28	Multilevel modeling, at 225.	Weighted GPA, end-of-course tests, sixth grade CAT score (composite measures), Scholastics Assessment Test, at 225.	Race, gender, cultural capital, effort, college-bound peer group, track placement, prior achievement, attitudes toward education, concrete attitudes toward education, exposure to segregated elementary education, magnet, and % gifted in high school, at 226–27.	Race, high school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demographics
29	Roslyn Arlin Mickelson, *How Middle School Segregation Contributes to the Race Gap in Academic Achievement*, (2008) (unpublished manuscript, on file with the North Carolina Law Review).	Cross-sectional, at 13.	1997 middle school survey & Charlotte-Mecklenburg School District records, records 1999, at 12–13.	Random-stratified sample of 2,730 middle school students, at 10.	Black and White, at 11–12.
30	Chandra Muller et al., *Race and Academic Achievement in Racially Diverse High Schools: Opportunity and Stratification*, 112 TCHRS. C. REC. (forthcoming 2010).	Longitudinal.	AddHealth 1994–1996.	National random-stratified sample of 3,149 students.	Black, White, Latino/a, and Asian.
31	Chandra Muller et al., Race, Social Class, and Academic Achievement in US High Schools (2004) (unpublished manuscript, on file with the North Carolina Law Review) (paper presented at the Annual Meetings of the American Sociological Association, S.F., Cal.).	Longitudinal, at 2.	AddHealth 1994–1995, 1996, 2001, 2002, at 2.	National random-stratified sample of 12,250 students in 78 schools, at 8.	Black, White, and Latino/a, at 9–10.
32	Xioxia A. Newton, *End of High School Mathematics Attainment: How Did Students Get There?* 112 TCHRS. C. REC. (forthcoming 2010).	Longitudinal.	Longitudinal Study of American Youth ("LSAY") 1987–1993.	National random-probability sample of approximately 3,116 students in 52 high schools.	Black, White, Latino/a, Asian, and Native American.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
29	Multilevel modeling, at 12.	8th grade end-of-grade tests in math and reading, at 13.	Race, gender, cultural capital, effort, track placement, prior achievement, attitudes toward education, exposure to segregated elementary education, and middle school % minority concentration, at 17.	Race and SES, middle school.
30	HLM.	GPA (for all 12th grade classes) and attending a four year college.	School level (10th grade math course, school location, minority under-representation in advanced math, % taking advanced math as 10th graders, and region), and individual level (gender, parental education, AddHealth vocabulary test score, and 9th grade GPA).	Race, high school.
31	HLM, at 9.	Three measures of academic achievement (highest math class, highest science class, and diploma attainment), at 9–10.	School level variables (% minority, SES measures (% college educated parents, and % free lunch), and % minority in advanced classes) and student level variables (race, gender, and parental education, and 9th grade academic performance), at 9–10.	Race and SES, middle school, high school.
32	HLM.	Growth in math from grades 7–12, end of high school math attainment, and number and levels of high school math courses completed.	Student level (including prior math, mother's education) and school level (including % minority).	Race, middle school, high school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demographics
33	Lindsay C. Page, Richard J. Murnane & John B. Willett, *Trends in the Black-White Achievement Gap: Clarifying the Meaning of Within and Between School Achievement Gaps* (Nat'l Bureau of Econ. Research, Working Paper No. 14213, 2008).	Longitudinal, at 24–25.	National Assessment of Educational Progress Long Term Trend ("NAEP-LTT"), 1978–2004 (for math), at 3.	Three-stage sampling of 13 year old students. 25,545 in 1971; 4,001 in 1988; 4,090 in 1999; and 4,720 in 2004, at 24–25.	Black, White, Latino/a, Asian, and Native American, at 26.
34	Suet-ling Pong, *The School Compositional Effect of Single Parenthood on 10th-Grade Achievement*, 71 SOC. EDUC. 23 (1998).	Cross sectional, at 32.	NELS, 1990, at 23.	National random-probability sample of 654 schools and 10,399 10th grade students, at 27–28.	Black, White, Latino/a, and Asian, at 28–29.
35	Alejandro Portes & Lingxin Hao, *The Schooling of Children and Immigrants: Contextual Effects on the Educational Attainment of the Second Generation*, 101 PROC. NAT'L ACAD. SCI. U.S.A. 11,920 (2004).	Longitudinal, at 11,920.	Children of Immigrants Longitudinal Study ("CILS") 1992–1993, at 11,920.	Purposive sample of 5,266 children of immigrants in the school system of Miami and Ft. Lauderdale in Florida and San Diego, California, at 11,923.	Black, White, Latino/a, and Asian, at 11,924.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
33	Oaxaca decomposition, at 27–28.	Reading assessments 1971–2004 and math assessments 1978–2004, at 45.	% minority in school, at 45.	Race, middle school.
34	HLM, at 32.	Scores on the 10th grade mathematics and reading tests (the IRT-estimated number right), at 28–29.	Individual-level and school-level (including school's SES, school's % of single parents and school-based indicators of social capital, and high concentration of minority students), at 29–36.	Race and SES, high school.
35	Multinomial logistic regression, ANOVA, HLM, at 11,924–25.	GPA in senior high school and indicators of dropping out and inactivity reported by the respective school systems, at 11,924.	Region, age, sex, length of U.S. residence, family SES, educational expectations, self-esteem, and national origin, at 11,924.	Race and SES, middle school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demo-graphics
36	Douglas Ready & Megan Silander, Estimating the Influence of School Racial and Socioeconomic Composition on Student Learning: Methodological Challenges and Alternative Solutions (Apr. 2, 2009) (unpublished manuscript, on file with the North Carolina Law Review) (presented at *Looking to the Future: Legal and Policy Options for Racially Integrated Education in the South and the Nation*, Chapel Hill, N.C.).	Longitu-dinal, at 7.	ECLS-K, at 9.	National random-stratified sample of 9,186 children, nested within 659 public and non-public schools, at 25.	Black, White, and minority, at 25.
37	Vincent J. Roscigno, *Race and the Reproduction of Educational Disadvantage*, 76 SOC. FORCES 1033 (1998).	Cross sectional, at 1042–43.	First follow-up of NELS (1990) and district data in the Common Core of Data ("CCD"), at 1036.	National random-stratified sample of 11,058 students in 971 schools, at 1037.	Black and White, at 1037.
38	Vincent J. Roscigno, Donald Tomaskovic-Devey & Martha Crowley, *Education and the Inequalities of Place*, 84 SOC. FORCES 2122 (2006).	Longitu-dinal, at 2125.	NELS 1988, 1990 and 1992 and the CCD 1986–87 through 1991–92, at 2125.	National random sample, at 2125.	Black and White, at 2136.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
36	HLM, at 9.	Math assessment, at 25.	Child's characteristics (SES status, gender, age, and language) and school characteristics (school average SES, racial composition, location, class sizes, etc.), at 25.	Race and SES, elementary school.
37	HLM, at 1043.	Reading and math test scores, at 1040.	Family income, parental education, a measure of cultural capital, family structure and number of siblings, teacher expectations, track placement, student/teacher ratio, per pupil spending, school racial composition and school SES composition, at 1040.	Race and SES, high school.
38	Multilevel modeling, at 2129–30.	Math, reading achievement, and dropout status, at 2126.	Family characteristics, investment, school characteristics (resources, % receiving free lunch, % non-White, per pupil expenditure), and controls by race and gender, at 2128.	Race and SES, high school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demo-graphics
39	Russell W. Rumberger & J. Douglas Willms, *The Impact of Racial and Ethnic Segregation on the Achievement Gap in California High Schools*, 14 EDUC. EVALUATION & POL'Y ANALYSIS 377 (1992).	Cross sectional, at 392.	California Basic Educational Data System ("CBEDS") 1988–1989 and California Assessment Program ("CAP") Achievement tests in grades 3, 6, 8, and 12, at 380.	Sample of 198,127 12th grade students in the six largest districts in California, at 380.	Black, White, Latino/a, and Asian, at 380.
40	Igor Ryabov & Jennifer Van Hook, *School Segregation and Academic Achievement Among Hispanic Children*, 36 SOC. SCI. RES. 767 (2007).	Cross sectional, at 772.	1995 AddHealth, at 772.	Sample of 4,066 Latinos/as from 132 schools, at 772.	Latino/a, at 772.
41	Jorden Schiff, William Firestone & John Young, Organizational Context for Student Achievement: The Case of Student Racial Compositions (April 1999) (unpublished manuscript, on file with the North Carolina Law Review) (presented at the annual conference of the American Educational Research Association in Montreal, Quebec, Canada).	Cross sectional, at 8.	NELS: 88, at 8.	National random-stratified sample of 17,598 students within 1,000 schools, at 9.	Black and White, at 9.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
39	Multilevel modeling, at 382.	Student achievement (standardized measures of the CAP scores on reading and CAP scores on mathematics), at 380.	Student level variables and school level variables (including segregation measures (dissimilarity index and isolation index)), at 380.	Race, high school.
40	HLM, at 772.	Academic achievement is measured by GPA and AddHealth picture vocabulary test ("AHPVT") score, at 772.	School composition (including % Latino/a and Black students, ethnic origin, immigration generation status, individual level controls, SES, and family structure) and family social capital, at 772–76.	Race and SES, middle school, high school.
41	ANOVA, at 13.	Student achievement in math (40-item test) and in reading (21-item test), self-concept (composite of the self-concept items that appeared on the student survey), at 13.	Student SES and school racial composition, at 11–13.	Race, middle school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demographics
42	Stephanie Southworth, The Effects of Institutional Characteristics of Schools on North Carolina Elementary and Middle School Student Achievement (2008) (unpublished Ph.D. dissertation, University of North Carolina at Charlotte) (on file with North Carolina Law Review).	Panel data, at 64–65.	North Carolina statewide data provided by North Carolina Educational Research Center, 1999–2005, at 62.	Population of 56,176 elementary and middle school students in North Carolina, at 63.	Black, White, Latino/a, Asian, and Native American, at 62–63.
43	Tenisha L. Tevis, African-American Students' College Transition Trajectory: An Examination of the Effect of High School Composition and Expectations on Degree Attainment (Dec. 2007) (unpublished Ph.D. dissertation, Pennsylvania State University) (on file with Penn State Electronic Thesis and Dissertation Collection).	Longitudinal, at 15.	National Education Longitudinal Study ("NELS: 88/2000"), at 36.	National random-stratified sample of 18,209 students, at 38.	Black, White, Latino/a, Asian, and Native American, at 49.
44	Adrian N. Welcher, Head of the Class: Black/White Inequality, Cultural and Social Capital, and High School Math Achievement (Jan. 17, 2008) (unpublished manuscript, on file with the North Carolina Law Review) (presented at the Annual Meeting of the American Sociological Association Annual Meeting, Boston, Mass., 2008).	Longitudinal, at 15.	Education Longitudinal Study ("ELS: 2002–2004"), Restricted Data, at 14.	National random-stratified sample of 4,592 students, at 15.	Black and White, at 14.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
42	HLM, at 64.	Students' yearly achievement in 4th, 6th, and 8th grade, (math and reading) measures by their End-of-Grade scores, at 55.	School race composition and SES composition, student/teacher ratios, teacher characteristics, per pupil expenditures, race/gender cohorts, and socioeconomic status, among others, at 55.	Race and SES, elementary school, middle school.
43	Regress-ion and structural equation modeling, at 44.	Degree attainment of students (math grade), at 44.	Race, gender, SES, school composition (race/ethnicity and free or reduced lunch), and student's grade in previous test score, at 45.	Race and SES, high school.
44	OLS, at 23.	Math achievement in 12th grade (IRT scores), at 23.	Cultural capital, social capital variables, quality of parent-child relationship, gender, family compositional variables, and school level variables (including % enrolled in free/reduced lunch, and % minority), at 25.	Race and SES, high school.

Table 2. Articles with No Statistically Significant Race Effects

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demographics
45	David J. Armor & Shanea J. Watkins, *School Segregation and Black Achievement: New Evidence from the 2003 NAEP, in* THE BENEFITS OF RACIAL AND ETHNIC DIVERSITY IN ELEMENTARY AND SECONDARY EDUCATION 28 (U.S. Comm'n on Civil Rights, ed. 2006).	Cross Sectional, at 30.	2003 NAEP, at 30.	National random-stratified sample of 150,000 students, at 30.	Black and White, at 28.
46	Mary A. Burke & Tim R. Sass, *Classroom Peer Effects and Student Achievement* (Fed. Reserve Bank of Boston, Working Paper No. 08-5, 2008).	Panel data, at 15.	School administrative records from Florida, 1999–2000 through 2003–2004, at 15.	Randomly selected samples of 100 elementary, 100 middle and 100 high schools in Florida, at 15–18.	Black, White, and Latino/a, at 39.

Table 3. Articles with No Statistically Significant Race Effects but with Statistically Significant SES Effects

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demographics
47	James Benson & Geoffrey Borman, *Family, Neighborhood, and School Settings Across Seasons: When Do Socioeconomic Context and Racial Composition Matter for the Reading Achievement Growth of Young Children?*, 112 TCHRS. C. REC. (forthcoming 2010).	Longitudinal.	National Center for Education Statistics ("NCES") ECLS-K, Census 2000.	National random-stratified sample of 4,178 students attending one of 292 schools, and living in one of 699 neighborhoods.	Black, White, Latino/a, Asian, and Native American.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
45	Descriptive analysis, regressions, at 31.	Reading and math achievement, SES adjusted achievement, at 32–33.	Racial composition, % of students eligible for free lunch, racial composition, SES, and classroom characteristic, at 37–41.	Race and SES, middle school.
46	Fixed effect models with instrumental variables, at 1.	Mean classroom peer math and reading achievement gains in Florida, 1999–2000 through 2003–2004, at 39.	Fraction of peers who are female, Black, who are special education students, who changed schools, mean age of peers, class size, at 36–43.	Race, elementary school, middle school, high school.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
47	Multilevel growth models.	Reading and math assessments.	Within-student measures, student-level covariates, and contextual-level variables (including minority composition or schools and neighborhoods), among others.	Race and SES, elementary school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demo-graphics
48	JOHN E. CHUBB & TERRY M. MOE, POLITICS, MARKETS & AMERICA'S SCHOOLS (1990).	Cross sectional, at 24.	1983–1984 Administrators and Teachers Survey ("ATS") and HS&B data, at 22.	National random sample of approximately 9,000 students, at 72.	Black and White, at 266.
49	Valerie E. Lee, Julia B. Smith & Robert G. Croninger, *Course-Taking, Equity, and Mathematics Learning: Testing the Constrained Curriculum Hypothesis in U.S. Secondary Schools*, 19 EDUC. EVALUATION & POL'Y ANALYSIS 99 (1997).	Cross sectional, at 103.	1990 High School Transcripts Study, conducted in connection with the 1990 National Assessment of Educational Progress ("NAEP"), at 103.	National random-stratified sample of 3,056 high school graduates in 123 schools, at 103.	Black, at 115.
50	Daniel Addison McCathern, Jr., The Relationship Between PreK–5 and K–5 Elementary School Size and Student Achievement of Grade 5 Students on the MAT7 in South Carolina for the School Years 1996–97 and 1997–98 (2004) (unpublished Ph.D. dissertation, University of South Carolina) (on file with the North Carolina Law Review).	Cross sectional, at 86.	Metropolitan Achievement Test ("MAT7") & Data from the S.C. Department of Education,1996–1997 and 1997–1998, at 1–2.	South Carolina population of PreK–5 and K–5 public school students in 334 schools in 1997 and 348 schools in 1998, at 1.	Black and White, at 15.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
48	Linear regression models, at 125.	Student achievement (total log gain scores in reading, writing, vocabulary, math and science), at 115.	Student ability, family background, background of student body-peer group influence (average family SES, % of students who are Black), school resources, and school organization, at 174, 266.	Race, high school.
49	HLM, at 99.	Student's score on the 1990 NAEP basic mathematics assessment, at 111.	Student demographics, academic ability, and school factors (including school average SES, minority concentration), among others, at 111.	Race and SES, high school.
50	Stepwise OLS, at 86, 111.	Mean scales scores of 5th grade students on the 1997 and 1998 spring administrations of the MAT7 (student achievement in reading, and math), at 97.	School size, grade structure, pupil-teacher ratio, % of students on the free and reduced lunch program, amount of teacher experience, level of teacher education, gender, racial composition of the school (% of Blacks students among the number of tested), school operating costs, and community setting, at 2.	Race and SES, elementary school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demographics
51	Richard J. Murnane et al., *Understanding Trends in the Black-White Achievement Gaps During the First Years of School*, *in* BROOKINGS-WHARTON PAPERS ON URBAN. AFFAIRS 2006, at 97 (2006).	Cross sectional, at 115–17.	Phases I, II, and III of the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development ("NICHD SEECYD"), at 100.	National random-conditional sample of 1,364 families, at 100.	Black, White, and Latino/a, at 101.
52	Russell W. Rumberger & Gregory J. Palardy, *Does Segregation Still Matter? The Impact of Student Composition on Academic Achievement in High School*, 107 TCHRS. C. REC. 1999 (2005).	Longitudinal, at 1999.	NELS 1988, at 2008.	National random-stratified sample of 14,217 students who attended 913 high schools, at 1999.	Black and White, at 2008–09.

Table 4. Articles Exclusively About SES and with Statistically Significant SES Effects

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demographics
53	Stephen J. Caldas & Carl Bankston III, *Effect of School Population Socioeconomic Status on Individual Academic Achievement*, 90 J. EDUC. RES. 269 (1997).	Cross sectional, at 272.	Louisiana GEE 1989, at 271.	42,041 Louisiana 10th grade public high school students in 1989, at 271.	Black and White, at 272.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
51	Fixed effect models, random effects models, at 115.	Math and English ELA scores (kindergarten/54 months, first grade, third grade), at 105–08.	Race, ethnicity, and gender indications, personal characteristics and family background, school quality (including student body composition (25% or more students are Black, Latino/a), % students eligible for free lunch), and instructional time, at 105–08.	Race and SES, elementary school.
52	HLM, at 2009.	1) 1988, 1990, and 1992 standardized achievement test in math, science, reading, and social science; 2) composite scores for the four tests in each year, at 2009.	Various aspects of individual, family, and school characteristics (including race composition, structure, resources, and processes), at 2009.	Race and SES, high school.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
53	OLS regression, at 272.	Student achievement on the GEE (principal component of the raw mathematics, language arts, and written composition scores), at 271.	Family poverty status, family social status, school-level measures of SES (peer poverty and peer family social status), and individual-level control variables (% student population Black), at 271.	SES, high school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demographics
54	Thomas B. Hoffer, *Middle School Ability Grouping and Student Achievement in Science and Mathematics*, 14 EDUC. EVALUATION & POL'Y ANALYSIS 205 (1992).	Panel data, at 211.	LSAY from fall 1987 to fall 1989, NAEP 1989, at 211.	National random-stratified sample of 1,900 students, at 211.	Black, White, and Latino/a, at 213.
55	KIRK A. JOHNSON, THE HERITAGE CTR. FOR DATA ANALYSIS, COMPARING MATH SCORES OF BLACK STUDENTS IN D.C.'S PUBLIC AND CATHOLIC SCHOOLS (1999).	Cross sectional, at 4.	NAEP 1996 math survey, at 4.	Random stratified Black 4th and 8th grade students in Washington, DC public and Catholic schools, at 7.	Black, at 8–9.
56	Valerie E. Lee & Julie B. Smith, *Effects of School Restructuring on the Achievement and Engagement of Middle-Grade Students*, 66 SOC. EDUC. 164 (1993).	Cross sectional, at 169.	NELS 1988, at 169.	National random sample of 8,845 students in 377 schools, at 164.	Black, White, and Latino/a, at 169–70.
57	Gregory J. Palardy, *Differential School Effects Among Low, Middle, and High Social Class Composition Schools: A Multiple Group, Multilevel Latent Growth Curve Analysis*, 19 SCH. EFFECTIVENESS & SCH. IMPROVEMENT 21 (2008).	Longitudinal, at 22.	NELS 1988, at 22.	National random-stratified sample of 5,326 public school student nested in 344 schools, at 25.	Black, White, Latino/a, Asian, and Native American, at 33.
58	Kevin J. Payne & Bruce J. Biddle, *Poor School Funding, Child Poverty, and Mathematics Achievement*, EDUC. RESEARCHER, Aug.–Sept. 1999, at 4.	Cross sectional, at 6–7.	School District Data Book ("SDDB") available from the National Center for Education Statistics (1995), at 6.	Sample of school districts, at 7.	Black, White, Latino/a, and Asian, at 9–10.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
54	Propensity scores, lagged regression, ordered probit equations, at 212.	Composite score or performance in different domains tapped by the NAEP-derived LSAY tests (in both science and math), at 212–13.	Ability grouping, number of ability levels in each subject that the school defined, background variables, and school-context measures (amount of course work in subject, social composition, and size of school), at 213–14.	SES, middle school.
55	Multi-variate models, at 14–15.	Math score, at 12.	Public or Catholic school, mother's education, family status, number of reading materials in home, school median income, and whether the child changed schools in the last two years, at 14–15.	SES, elementary school, middle school.
56	HLM, descriptive analysis, at 171.	Academic achievement (combining reading and math scores), at 172.	Students' demographic and structural characteristics of schools (average SES, minority concentration, etc.), school restructuring, at 172.	SES, middle school.
57	Multilevel latent growth curve, at 27.	Students' achievement growth or learning rate on a composite score: math, reading, science, and history, over a four-year period, at 35.	Students' backgrounds, school and classroom level variables (including compositional characteristics of the student body, the structural characteristics of the school, and the human and financial resources available), at 35.	SES, middle school.
58	Multi-variate regression, at 10–11.	Mathematics achievement, at 9–10.	School funding, child poverty in the district, % non-White, level of curriculum in the classroom (remedial to advanced), at 22.	SES, middle school.

#	Author & Title	Data Type	Data Source	Sample Size & Type	Sample Demographics
59	Linda Ruth Williams Sorhaindo, The Relationship Between Degrees of Poverty and Student Achievement (May 2003) (unpublished dissertation, University of Miami) (on file with the North Carolina Law Review).	Cross sectional, at 17.	Miami-Dade County Public Schools, 1997–1998, at 17.	4,500 4th graders and 4,500 8th grade students for the 1997–1998 school year in Miami-Dade County Public Schools, at 17.	Black, White, and Latino/a, at 18–19.

#	Analytic Strategy	Outcome Variable	Key Control Variables	Findings Categories
59	HLM, MANOVA, ANOVA, at 22.	Academic achievement (Stanford Achievement Test reading comprehension and mathematics applications), at 22.	Student level, measure of poverty, school level variable of school composition (three levels of levels of poverty: high, medium, and low), at 26–27.	SES, elementary school, middle school.