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High-Quality Preschool: The Socioeconomic Composition of Preschool Classrooms and Children's Learning

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Research Findings: As policymakers expand access to preschool, the sociodemographic composition of preschool classrooms will become increasingly important. These efforts may create programs that increase the concentration of children from low-income families or, alternatively, foster the creation of socioeconomically diverse preschool classrooms. What effect the creation of such contexts would have on very young children remains unclear. Using multilevel methods and data on 2,966 children in 704 prekindergarten classrooms, this study explores the relationship between socioeconomic classroom composition and children's social and cognitive development. The results indicate positive associations between the mean socioeconomic status (SES) of the class and children's receptive language, expressive language, and mathematics learning, regardless of children's own sociodemographic backgrounds and the characteristics of their classrooms. However, the analyses indicate no association between the development of social competence and class mean SES. *Practice or Policy:* The links between classroom SES and language and mathematics development were comparable in size to those associated with instructional quality and even children's own SES. Neither structural nor instructional characteristics of prekindergarten classrooms explained these relationships, suggesting the possibility of direct peer effects. The findings indicate that the composition of children's classrooms should be considered an important aspect of preschool quality.

Over the past decade, state governments have dramatically increased access to preschool. In 2011, 39 states enrolled more than 1.3 million children in prekindergarten (pre-K) programs at a cost of $5.5 billion, representing one third of all 4-year-olds in the country (Barnett, Carolan, Fitzgerald, & Squires, 2011). With multiple studies demonstrating the effectiveness of high-quality preschool in fostering children's cognitive and noncognitive growth (Barnett, 2011; Bowman, Donovan, & Burns, 2001; Bradley & Vandell, 2007; Dearing, McCartney, & Taylor, 2009; Frede, 1995; Peisner-Feinberg & Burchinal, 1997), federal and state policymakers are focused on defining publicly funded preschool quality in a systematic way.

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In this dynamic policy environment, early education researchers have specifically sought to identify the components of preschool programs that are associated with children's cognitive and noncognitive development (Bowman et al., 2001; Burchinal, Howes, et al., 2008; Camilli, Vargas, Ryan, & Barnett, 2010; Howes et al., 2008; Mashburn et al., 2008; Peisner-Feinberg et al., 2001; Pianta et al., 2005; Preschool Curriculum Evaluation Research Consortium, 2008). Many studies have found instructional quality to be a consistent and strong predictor of children's preschool development (Bowman et al., 2001; Burchinal & Cryer, 2003; Burchinal, Howes, et al., 2008; Camilli et al., 2010; Howes et al., 2008; Mashburn et al., 2008; Peisner-Feinberg et al., 2001).

By comparison, little attention has been paid to the relationship between classroom socioeconomic composition and children's preschool learning, although a growing number of studies have examined the effects of peers' cognitive skills on children's learning in preschool settings (Henry & Rickman, 2007; Justice, Petscher, Schatschneider, & Mashburn, 2011; Mashburn, Justice, Downer, & Pianta, 2009). For many policymakers, the model programs, such as the High Scope/Perry Preschool, remain the gold standard of quality, and much of the preschool research considers quality in the context of programs that serve mostly or entirely low-income children (Barnett & Belfield, 2006; Camilli et al., 2010). Yet pre-K policies are altering the preschool landscape, as some state programs give low-income families access to socioeconomically diverse classrooms (Dotterer, Burchinal, Bryant, Early, & Pianta, 2009).

The present study helps to fill the research gap on classroom composition and preschool quality by examining the relationship between the socioeconomic composition of children's classrooms and their learning during 5 months in pre-K. Using a sample of 2,966 children in 704 pre-K classrooms, we use multilevel modeling to estimate the relationship between socioeconomic composition and children's receptive language, expressive language, math, and social skills learning, controlling for children's own socioeconomic status (SES) and other background characteristics, the racial/ethnic composition of the class, and other aspects of the classroom (such as instructional quality).

THE EXPANSION OF PRE-K

In the first years of children's lives, substantial differences in skills and knowledge emerge that correlate strongly with children's SES (G. J. Duncan & Magnuson, 2005; Lee & Burkam, 2002). These disparities have expanded in recent generations, as income inequality in the United States has increased and parenting practices among social classes have diverged (Reardon, 2011). Amid these concerns, the success of model preschool programs in promoting children's early learning has fostered broad support for publicly funded preschool (Kirp, 2007). The most prominent result has been a dramatic increase in state pre-K programs, whose enrollment of 4-year-olds (1.1 million) now far exceeds that of Head Start (461,118; Barnett et al., 2011; Office of Head Start, 2010). Although most states target their programs to children from low-income families, many aspire to a universal framework that would offer preschool to middle-income families who cannot afford private programs (Barnett & Yarosz, 2007).

Unlike in the K–12 system, parents of preschool-age children choose whether and where to enroll their children among the supply of affordable programs. The choices for low-income parents are generally of lower quality than those for high-income parents (Burchinal, Nelson, Carlson, & Brooks-Gunn, 2008; Dowsett, Huston, Imes, & Gennetian, 2008; Fuller, Kagan,

Loeb, & Chang, 2004; Hynes & Habasevich-Brooks, 2008). This is a particular concern given that some research suggests that children from low-SES families benefit the most from high-quality settings (Dearing et al., 2009; Peisner-Feinberg & Burchinal, 1997; Peisner-Feinberg et al., 2001).

As researchers have identified elements of program quality that promote children's learning, states are increasingly building systemic supports for high-quality programs, including early learning standards, quality rating systems, and elevated teacher education requirements, while encouraging or mandating assessment data collection and professional development at the program level. The possible impact of classroom composition on children's learning, however, remains largely unexplored.

SOCIOECONOMIC COMPOSITION AND CHILDREN'S LEARNING

State pre-K programs have begun to alter the historical separation of low and higher income children in preschool settings (Cahan, 1989; Cohen, 1996). Both universal and targeted programs have the potential to expand access to socioeconomically diverse classrooms. Universal programs can create socioeconomic diversity if they successfully enroll children from higher income families. Targeted programs that use a demand-side approach can produce diverse classrooms if they allow children to enroll in programs that also serve private payers (Levin & Schwartz, 2007). In 2009, one third of state-funded pre-K children attended programs that also received private funding (Barnett, Epstein, Friedman, Sansanelli, & Hustedt, 2009). An analysis of 169 pre-K classrooms found that in half of all classrooms, 38% or less of the children were poor (family income up to 150% of the poverty line; Dotterer et al., 2009).

These changes have occurred as the research base on school composition has grown significantly. In the decades since the Coleman report (Coleman et al., 1966), education researchers have exploited the advantages of multilevel modeling and found that the effect of school socioeconomic composition on children's learning equals or even rivals the impact of children's own family background in a given year of schooling. Borman and Dowling (2010) used a two-level model with Coleman's ninth-grade data and found that the SES composition of schools was almost *twice* as important as students' own SES in predicting students' academic achievement. Other studies further support the finding that school SES is an important determinant of children's academic success (Konstantopoulos, 2006; Konstantopoulos & Borman, 2011; Lee & Bryk, 1989; Perry & McConney, 2010; Rumberger & Palardy, 2005).

Early childhood researchers have only begun to explore the extent to which socioeconomic composition affects early learning. Aikens and Barbarin (2008) examined children's reading trajectories from kindergarten through third grade and found that although family background made the largest contribution to initial reading disparities, school composition and neighborhood conditions were more important in predicting SES-related differences in learning rates. Student composition appeared to be more important than teacher experience, teacher preparation, and the quality of classroom literacy instruction. Other studies have produced similar findings about early learning and primary school composition (Benson & Borman, 2010; Kainz & Vernon-Feagans, 2007).

These studies, however, are subject to questions regarding selection bias because children who attend predominantly middle-class schools may have parents who nurture their children's learning in unmeasured ways. Answering this critique, Schwartz (2010) used a data set of 850

low-income children who had been randomly assigned to elementary schools in Montgomery County, Maryland, and found that children who attended the district's most advantaged schools (as measured by free or subsidized lunch status) over a period of 5 to 7 years outperformed children in math and reading who attended the district's least advantaged schools. By the end of elementary school, the initial achievement gap between children in public housing who attended the district's most advantaged schools and the nonpoor students in the district was cut by half for math and one third for reading.

Far less attention has been devoted to exploring how classroom composition may relate to children's learning in preschool settings. In a relatively small-scale analysis of income diversity and preschool learning, Schechter and Bye (2007) assessed the receptive language growth of two groups of low-income children, one attending preschools with high concentrations of low-income families and the other attending economically mixed preschools. By the spring of preschool, children in the integrated programs learned more than children in low-income programs. For children who spoke English at home, the gains were so substantial in the diverse programs that students' spring scores did not differ significantly from those of their more affluent peers. Yet the study used a small sample ($n = 85$) and was unable to control for an array of child and family characteristics that may have affected the results.

Together, these studies suggest that the relationship between the socioeconomic composition of children's classrooms and how much students learn extends down to kindergarten and perhaps to preschool, the focus of this study.

OPERATIONAL PATHWAYS FOR A COMPOSITIONAL EFFECT

Though empirical research suggests that classroom socioeconomic composition influences children's learning, the causal pathways that connect classroom SES and learning are not well understood, particularly in early childhood. Findings from K–12 research and other research in early childhood, however, suggest four possible mechanisms that may operate in early childhood: differences in teaching and curriculum that are related to school SES, direct peer effects associated with cognitive learning, direct peer effects that support social development, and increased parent involvement associated with higher SES classrooms.

Teaching and Curriculum

Resource disparities between lower and higher SES schools are well documented. High-poverty K–12 schools are less likely to attract and retain qualified teachers (Boyd, Lankford, Loeb, & Wyckoff, 2005; Education Trust, 2008; National Center for Education Statistics, 2006). Low-SES schools also tend to have less advanced coursework, less curricular emphasis on higher order cognitive skills, less homework, lower teacher expectations, and less positive disciplinary climates than middle-SES schools (Konstantopoulos, 2006; Raudenbush, Fotiu, & Cheong, 1998; Rumberger & Palardy, 2005).

Similarly, several studies suggest that the quality of preschool teachers varies by the socioeconomic composition of their classrooms. In pre-K settings, high-poverty classrooms attract teachers with fewer qualifications (Clifford, Barbarin, et al., 2005) and tend to offer lower quality instruction (Justice, Mashburn, Hamre, & Pianta, 2008; Pianta et al., 2005). Some preschool

teachers favor didactic instruction in nominal skills for children from low-income and racial minority families (Delpit, 1995; Early et al., 2010; Stipek, 2004). Though direct instruction may improve the short-term scores of children (Camilli et al., 2010; Stipek, Feiler, Daniels, & Milburn, 1995), children's academic success may wane when the curriculum requires more analytic and problem-solving skills (DeVries, Reese-Learned, & Morgan, 1991; Stipek et al., 1995).

If higher SES preschools attract better teachers who use more demanding curricula, then sociocomposition could, albeit indirectly, promote children's early learning. Recent efforts to increase teacher education levels and compensation may alter this imbalance in pre-K settings (Holochwost, DeMott, Buell, Yannetta, & Amsden, 2009). But if such programs follow the pattern found in K–12 schools, then higher SES settings are more likely to offer low-SES children the quality of teaching that effectively prepares them for kindergarten.

Cognitive Peer Effects

Several studies have found positive relationships between aggregate peer achievement and K–12 student learning (Hanushek, Kain, Markman, & Rivkin, 2003; Henderson, Mieszkowski, & Sauvageau, 1978; Hoxby, 2000; Summers & Wolfe, 1977; Zimmer & Toma, 2000). Although there is little consensus regarding the precise mechanisms for peer effects in later childhood and adolescence, some studies suggest that direct contact with skilled peers stimulates language, social, and problem-solving skills among less skilled children (Harris, 2010). The presence of more skilled children may also increase teacher expectations and, consistent with social cognitive theory, provide academic role models and a positive disciplinary environment, all of which may enhance the learning of less skilled students. An alternative theory suggests that children with less skilled peers have more opportunities to distinguish themselves as successful learners than children with more skilled peers, citing a ''frog pond effect'' (Goldsmith, 2011). More skilled peers would thus be more of a liability than an asset.

Although early childhood researchers have long studied the relationship between peer interactions and social skills learning (Bowman et al., 2001; Coolahan, Fantuzzo, Mendez, & McDermott, 2000). they have only recently begun to focus on whether and how the cognitive skills of peers in preschool, especially those related to language and literacy, may affect children's own cognitive development. The results indicate a positive association between the average ability of preschool peers and how much children learn (Henry & Rickman, 2007; Justice et al., 2011; Mashburn et al., 2009). Whereas Mashburn et al. (2009) found that more skilled peers benefitted the most from exposure to highly skilled peers, others have found that less skilled children learn more from such interactions and that more skilled peers are relatively impervious to peer effects (Connor, Morrison, & Slominski, 2006; Justice et al., 2011).

Despite the growing research base on early peer effects, the early childhood literature has not yet answered the question of how socioeconomic composition may differentially affect children's learning. It is known that during the early years, children are nurtured by emotionally sensitive and stimulating interactions with others (Shonkoff & Phillips, 2000). Both cognitive and noncognitive learning, and language acquisition in particular, is grounded in a social context (Carroll, 2008; Vygotsky, 1978), in which children accomplish important developmental milestones that are foundational for later learning. These aspects of early learning may support and even magnify the possible effects of socioeconomic composition in preschool classrooms,

where teachers often emphasize play and collaborative activities. Children may initiate, model, and expand language, literacy, and math skills among their peers (Bulotsky-Shearer et al., 2012).

Some research suggests that language acquisition may be especially susceptible to the influence of peers who model language use, broaden exposure to vocabulary and syntax, and use different discourse styles (Dickinson & Tabors, 2001). Early vocabulary growth, for example, is related to the amount and type of speech to which children are exposed, such as the use of open-ended questions, expansions, and recasts (Hart & Risley, 1995; Justice et al., 2008). Language-rich preschool settings may thus promote children's language skills, particularly when children come from home environments with lower levels of language stimulation. Peer interactions could be especially beneficial to children who are learning English as a second language when they offer opportunities to hear and test communication skills, expand understanding of the sociolinguistic rules of a particular culture, form cross-cultural friendships, and assume positions of authority in the context of play (Genesee & Nicoladis, 1995; Grant, 1995).

Children from higher SES families may also enjoy cognitive benefits in socioeconomically diverse preschools. The argument that diverse postsecondary classrooms encourage students to avoid ''automatic thinking'' (Gurin, Dey, Hurtado, & Gurin, 2002) is not unlike Piaget's theory of early cognitive development in which young children learn when their knowledge constructs are pushed into disequilibrium by new experience (Piaget & Inhelder, 1969). A preschool classroom with children from diverse socioeconomic backgrounds could stimulate this cognitive growth through social interactions and collaborative learning.

Social Peer Effects

Children from all socioeconomic backgrounds may benefit socially from interactions with diverse peers in ways that are enduring and even profound. Exposure to racially diverse peers in K–12 schools can reduce the prejudices and social isolation of children by race and class and promote cross-cultural relationships that have long-term benefits, such as greater social capital, employment opportunities, and comfort in multiracial settings (Bowen & Bok, 1998; Braddock & Gonzalez, 2010; Carter, 2010; Goldsmith, 2010; Linn & Welner, 2007; Stearns, 2010; Wells, Duran, & White, 2008; Wells, Holme, Revilla, & Atanda, 2009).

Research in this area in early childhood is relatively sparse. By kindergarten, children have generally formed beliefs regarding racial, ethnic, and socioeconomic identities (Bigler & Liben, 2007; Chafel & Neitzel, 2005; Finkelstein & Haskins, 1983; Raabe & Beelman, 2011; Ramsey, 1995; Spencer & Markstrom-Adams, 1990) and developed skills of social comparison (Howes, Rubin, Ross, & French, 1988; Nesdale & Flesser, 2001). Exposure to peers from disparate backgrounds could inform children's early social categorizations and thereby destabilize emergent prejudices (Derman-Sparks, 1989; Howes & Wu, 1990). In the context of preschool, children who befriend and collaborate with diverse peers may develop skills and beliefs that could alter both their academic and social lives.

Parental Involvement

Another important resource that may vary by school demographics is parental involvement. By definition, low-SES schools have parents with lower average levels of education and family

income, which can create childrearing challenges faced less often by parents in higher SES schools. Related in part to these resource inequalities, authors have also identified fundamental differences in the parenting approaches used by socioeconomically advantaged and disadvantaged parents. In her seminal study of parental involvement, Lareau (2003) found that low-SES parents often feel a separation between school and home and delegate the job of educating children to the schools. Conversely, high-SES parents more often practice what Lareau termed ''concerted cultivation,'' which entails careful organization of children's daily lives to promote opportunities for social and cognitive growth.

High-poverty schools are more likely to have parents who experience mental health issues and stressful lives that hinder participation in their children's education (Barton & Coley, 2007; Brooks-Gunn & Duncan, 1997; Yeung, Linver, & Brooks-Gunn, 2002) and families that are more mobile, which has been linked to lower achievement (Hogrebe & Tate, 2010). Proponents of socioeconomic integration further argue that middle- and high-SES schools enjoy more stable financing, drawing on the political influence of their parents (Kahlenberg, 2001). Such resource advantages could plausibly emerge in preschools that enroll children of middle-SES parents.

THEORETICAL FRAMEWORK

This study is guided by a bioecological theoretical perspective of child development in which children's development is viewed as taking place in multiple interconnected contexts (Bronfenbrenner, 2004). Beginning with a child's own biology, this perspective recognizes the importance of various contexts for the child's growth, including family, neighborhood, and schools, and posits that a change in one of these contexts can reverberate through the others and influence the child's developmental course. At the heart of this theory is an understanding of proximal processes, or interactions that the child has in these contexts, which then influence learning and development in ways that may depend on other contextual factors in the child's life. The contextual focus here is the socioeconomic background of children's classroom peers, which may interact with other family, biological, and contextual factors. Multilevel modeling is well suited to this theoretical framework because it can analytically distinguish among the multiple contexts that influence children's growth.

RESEARCH QUESTIONS

To explore the relationship between socioeconomic classroom composition and children's social and cognitive development, we asked three research questions. First, how is the socioeconomic composition of children's preschool classrooms associated with children's language, mathematics, and social skills development, above and beyond the associations between children's own SES, the racial/ethnic composition of the classroom, and their preschool learning? Second, to what extent do aspects of preschool quality, such as instructional quality, teacher education, and class size, explain the relationship between classroom socioeconomic composition and children's learning? And third, does the relationship between socioeconomic composition (defined as classroom SES) and children's learning vary by classroom characteristics, such as income diversity, instructional quality, and teacher education?

METHOD

Using empirical data on 2,966 children in 704 classrooms across 11 state pre-K programs for 4-year-olds, this study used hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002) to specify two-level models in which children's learning was modeled simultaneously as a function of children's own characteristics and the characteristics of the classrooms they attended. For each research question, we considered four outcomes: receptive language skills, expressive language skills, mathematics skills, and social competence, measured on spring assessments. Using an analysis of covariance approach with fall scores as covariates, we interpret the coefficients as estimates of children's learning during the 5 months, on average, between the two assessments.

We built models in several steps that were purposefully ordered to address the three research questions. Each set of multivariate analyses—one for each of the four outcomes—began with a child-level (Level 1) model that established the relationship between children's characteristics and their preschool learning, unadjusted for classroom-level characteristics. All measures were grand-mean-centered, with their effects fixed and held constant across schools.

The classroom-level (Level 2) models explored the extent to which classroom socioeconomic composition was associated with children's preschool learning, controlling for children's individual characteristics and the racial/ethnic composition of the classroom (Research Question 1). Then we added variables representing aspects of preschool quality to assess whether they explained the relationship between socioeconomic composition and preschool learning (Research Question 2) and Level 2 interaction terms to explore whether socioeconomic composition was particularly important in certain classroom contexts (Research Question 3).[1]

The reliability and significance of HLM estimates depend strongly on the number of Level 2 units, which in this case is 704 classrooms. Although this number is sufficient to allow for a multilevel analysis, it is small enough to raise issues of statistical power. When the Level 2 sample is relatively small, the extant literature that uses multilevel methods often uses somewhat less stringent parameters to denote statistical significance (see, e.g., Lee & Burkam, 2003; Rumberger & Palardy, 2005; Xue & Meisels, 2004). In keeping with this practice, the class-level

[1]The final model was as follows:

$$
\begin{aligned}
Y_{ij} &= \beta_{0j} + \beta_{1j}(\text{Fall Assessment Score}_{ij}) + \beta_{2j}(\text{SES}_{ij}) + \beta_{3j}(\text{Black}_{ij}) + \beta_{4j}(\text{Latino}_{ij}) \\
&\quad + \beta_{5j}(\text{Asian}_{ij}) + \beta_{6j}(\text{Other}_{ij}) + \beta_{7j}(\text{Single Parent}_{ij}) + \beta_{8j}(\text{English Language Learner}_{ij}) \\
&\quad + \beta_{9j}(\text{Individualized Education Plan}_{ij}) + \beta_{10j}(\text{Female}_{ij}) + \beta_{11j}\left(\text{Age}_{ij}\right) + r_{ij} \\
\\
\beta_{0j} &= \gamma_{00} + \gamma_{01}\left(\text{SES Composition}_{j}\right) + \gamma_{02}\left(\text{Income Diversity}_{j}\right) + \gamma_{03}(\%\text{White}_{j}) \\
&\quad + \gamma_{04}\left(\text{Instructional Quality}_{j}\right) + \gamma_{05}\left(\text{Teacher Has a Bachelors Degree}_{j}\right) \\
&\quad + \gamma_{06}\left(\text{Teacher Has More Than a Bachelors Degree}_{j}\right) + \gamma_{07}(\text{Small Class}_{j}) \\
&\quad + \gamma_{08}\left(\text{Full} - \text{Day Program}_{j}\right) + \gamma_{09}(\text{Head Start Class}_{j}) + \gamma_{10}(\text{Interaction Term}_{j}) + u_{0j},
\end{aligned}
$$

where Y_{ij} is the spring assessment score of child i in preschool j, β_{0j} is the expected outcome (spring assessment score) for child i in preschool j when values of the Level 1 covariates are equal to the grand mean, β_{1j} through β_{11j} are Level 1 coefficients for child i in preschool j, r_{ij} is the Level 1 error term for child i in preschool j (random effect), γ_{00} is the expected outcome (spring assessment score) for child i in preschool j when values of the Level 2 covariates are equal to zero, γ_{01} through γ_{09} are Level 2 coefficients for child i in preschool j, and u_{0j} is the Level 2 error term for child i in preschool j (random effect).

models here note when particular estimates are significant at the $p < .10$ level in addition to the conventional $p < .05$, $p < .01$, and $p < .001$ levels.

DATA

The data came from two studies conducted by the National Center for Early Development and Learning (NCEDL): the Multi-State Study of Pre-Kindergarten, sponsored by the U.S. Department of Education; and the State-Wide Early Education Program Study (SWEEP), sponsored by the National Institute for Early Education Research, Pew Charitable Trusts, and Foundation for Child Development. Incorporating data from 11 state pre-K programs, the two studies had the same research team and measures, similar sampling designs, and the common goal of understanding the relationship between features of pre-K programs and child outcomes (Early et al., 2005). For both studies, ''pre-K'' programs included center-based programs that were explicitly focused on ''school readiness'' for 4-year-olds, were at least partially funded by state education agencies, and operated in schools or under the direction of state and local education agencies. Both studies included extensive classroom observations and child assessments in the fall and spring of the pre-K year. The average number of days between the two assessments was 157.1 ($SD = 23.8$).

From 2001 to 2003, the Multi-State study took place in six states (California, Illinois, Georgia, Kentucky, New York, and Ohio) chosen from 19 states that had devoted substantial resources to pre-K initiatives (Early et al., 2005). Within each state, NCEDL chose a stratified random sample of 40 centers/schools to maximize variation in teacher credentials, program setting, and intensity. Within each center/school, NCEDL chose one classroom and then randomly selected four children for study participation; when possible, two girls and two boys were chosen. Children were eligible for assessment if they were old enough for kindergarten in the fall of 2002, if they did *not* have an individualized education plan (IEP) in the fall of 2001, and if their teacher reported that they could follow simple instructions in English or Spanish. Because the average class size was 17.55, the children assessed represented, on average, 22.79% of all children in the class.

NCEDL collected the SWEEP data in 2003–2004 and followed a similar sampling procedure in five states (Massachusetts, New Jersey, Texas, Washington, and Wisconsin), with the goal of combining the two data sets. The SWEEP data were collected for 100 programs in each state (four children assessed on average in each classroom), producing a combined sample of 704 classrooms and 2,966 children. Though the 11 states in the two studies represented 80% of the national pre-K population at the time the studies were conducted (Mashburn et al., 2008), the sample was not meant to be nationally representative (Clifford, Bryant, et al., 2005).

In both the Multi-State and SWEEP studies, before selecting four children for participation, NCEDL distributed a questionnaire to the parents of all children in the classroom regarding their sociodemographic characteristics, with an average response rate of 60.28%.[2] The responses from

[2]The 60.28% response rate may have implications for these analyses given the potential biases it introduces into the classroom-level measures. Although the data do not include information on the backgrounds of nonresponders, it seems reasonable to conclude that lower SES families were less likely to respond to the survey. This arguably suggests that variability in both the classroom SES and classroom income measures is artificially reduced. As a result, the associated HLM estimates would be biased toward zero, which means that the results presented here may reflect conservative estimates.

this broader sample of parents were used to calculate classroom measures such as average family income, the mean level of mothers' education, and the percentage of children in the class who were racial/ethnic minorities or English language learners (ELLs).

As is typical with large data sets, data were incomplete on some measures, most commonly on the outcome variables. On the spring assessment measures, for example, up to 17.90% of all values were missing. We used multiple imputation within SPSS to impute five complete data sets with 2,966 children in each (Graham, 2009; Schafer, 1999). We then conducted the multivariate analyses on each data set within HLM, which averages the parameters and computes the standard errors across the results (Allison, 2002; Raudenbush & Bryk, 2002; Rubin, 1987). For the descriptive analyses, we used only one data set, as recommended by Graham (2009).

Of the 2,966 children in the combined data set, 397 did not pass an English language screen in the fall of the preschool year and were given language, literacy, and math assessments in Spanish; 316 did not pass the screen in the spring and were again given the assessments in Spanish (Preschool Language Assessment Scales [PreLAS], 2000; S. E. Duncan & DeAvila, 1998). Because the constructs measured by the Spanish and English assessments are not equivalent, they cannot be analyzed simultaneously (Mashburn et al., 2008). The lack of a Chinese assessment also apparently contributed to the small percentage (2.9%) of Asian American children in the sample. Ideally, such dual-language children would be assessed in both their first language and English to obtain a robust inventory of their skills (Espinosa, 2010).

In the absence of dual assessments in the Multi-State and SWEEP studies, researchers must decide whether to exclude these dual-language children from the analysis, which would incur the bias associated with nonrandom attrition that imputation seeks to remedy. Given that missing outcomes for ELLs are unlikely to follow a random pattern, some researchers have imputed English-language outcomes (Farnia & Geva, 2011; Ross, 2005). Even so, conceptual concerns about assessing ELLs with low proficiency in English are well documented (Espinosa, 2010) and suggest that the scores of children who are thus assessed should be used with great caution. It is important to note that the imputed scores are not used here to capture children's language proficiency or vocabulary knowledge. Rather, they reflect a more narrow evaluation of English vocabulary growth between two time points and how it may relate to classroom composition. We therefore imputed English-language scores for these children (403 in the fall and 316 in the spring) under the assumption that their data are missing at random (Ake, 2005; Allison, 2002; Graham, 2009).[3]

MEASURES AND COVARIATES

Outcome Measures

In the fall and spring, children in the data set participated in three direct assessments of their receptive language, expressive language, and math skills. The Peabody Picture Vocabulary Test

[3]For missing data to be missing at random, their missingness must be explained by variables in the data set. In this instance, we conducted a logistic regression using a measure of whether children took the test in Spanish (1 = yes, 0 = no) as the dependent variable, with race/ethnicity, poverty status, mother's level of education, and whether the child was an ELL as independent variables. Together, these covariates correctly predicted whether a child took the test in Spanish in 92.9% of cases, indicating that the missing data satisfied the requirements for being missing at random (Graham, 2009).

is a norm-referenced instrument for measuring children's receptive vocabulary. Test–retest reliability is .92 (Dunn & Dunn, 1997). The Oral Expression Scale from the Oral and Written Language Scales is a norm-referenced assessment of children's comprehension and use of spoken language. Test–retest reliability is .86 (Carrow-Woolfolk, 1995). The Woodcock–Johnson III Applied Problems Subtest is a norm-referenced instrument that measures children's basic math skills, such as counting, numeracy, comparisons, and word problems. Test–retest reliability is .90 (Woodcock, McGrew, & Mather, 2001).

In addition to these three direct assessments, in both fall and spring teachers completed the Hightower Teacher-Child Rating Scale, a behavioral rating scale that seeks to measure social and emotional skills (Hightower et al., 1986). Following directions from the scale authors, NCEDL created a social competence scale for the Multi-State and SWEEP studies with four subscales: assertiveness, peer social skills, task orientation, and frustration tolerance. Internal reliability was high: .95 in the fall of pre-K and .94 in the spring of pre-K (NCEDL, 2005). Scores from the Hightower Teacher-Child Rating Scale—as well as the three direct assessments described previously—were standardized (z-scored; $M = 0$, $SD = 1$), which allows us to report results as effect sizes (ESs; SD).

Class-Level Measures

The primary variables of interest here were two measures of classroom socioeconomic composition: class mean family income and class mean level of mothers' education. For both variables, the data were positively skewed. We transformed each with a natural log to improve the distribution and z-scored the result ($M = 0$, $SD = 1$). To produce a measure of class mean SES, or socioeconomic composition, we then averaged both measures. To test for nonlinear relationships, we created a quadratic term for this measure.

The models also used a measure of the standard deviation of family income *within* classrooms, an indicator of income diversity. Whereas high-poverty classrooms by definition have a narrow distribution of family income, as class mean income rises, so does the potential for income diversity. In the Multi-State and SWEEP data, class mean income and the standard deviation of within-class income were moderately correlated ($r = .473$, $p < .001$). By including both class mean SES and the standard deviation of income in the models, we were able to consider what portion of compositional effects might relate to having higher SES classrooms and what portion might relate to having a broad distribution of income within the class.

Additional classroom composition covariates included the percentage of children in the class who were White or racial/ethnic minorities, the percentage who were poor, and whether 15% or more were ELLs (1 = yes, 0 = no) or had IEPs or referrals for IEPs by the spring of the pre-K year (1 = yes, 0 = no). Most children (67%) attended classrooms with fewer than 15% ELLs. Similarly, most children (77%) attended classrooms in which fewer than 15% of the children had IEPs or IEP referrals in the spring. Both distributions suggested the use of a dummy variable with 15% as the threshold.

Measures of structural quality included indicators of the child:teacher ratio (1 = 10:1 or lower, 0 = 11:1 or higher); class size (1 = below the mean of 18 children per classroom, 0 = 18 or more); whether the program was full day (1 = yes, 0 = no); whether the class was part of a Head Start program (1 = yes, 0 = no); whether the class was located in a public school

(1 = yes, 0 = no); and whether the program offered meals (1 = yes, 0 = no), family services (such as before- and after-school care, parenting education, and transportation; 1 = yes, 0 = no), and/or health services (such as health care offered collaboratively by hospitals and other service agencies; 1 = yes, 0 = no).

We included measures of teacher education (teacher had a bachelor's degree [BA; 1 = yes, 0 = no] and teacher had more than a BA [1 = yes, 0 = no], with teacher had no BA [1 = yes, 0 = no] as the comparison group); whether the teacher had a Child Development Associate credential (CDA; 1 = yes, 0 = no); whether the teacher had been certified for less than 4 years (1 = yes, 0 = no); whether the teacher spoke Spanish (1 = yes, 0 = no); and whether the teacher used a comprehensive curriculum, such as the High/Scope or Creative Curriculum (1 = yes, 0 = no).

We also considered two measures of process quality from the Classroom Assessment Scoring System (CLASS), an instrument that measures dimensions of teacher–child interactions in classrooms (Pianta, LaParo, & Hamre, 2007). The CLASS observes both social/emotional interactions (teachers' sensitivity and responsiveness) as well as instructional approaches (the extent to which teachers promote children's concept development and provide quality feedback and language modeling). Each feature is rated on a scale of 1 to 7 (1 or 2 = low quality; 3, 4, or 5 = a mid-range of quality; and 6 or 7 = high quality). The results of the CLASS provide two measures of classroom interactions: Emotional Support and Instructional Support. Reliability in the Multi-State study on the CLASS was 89% in the fall and 93% in the spring (Clifford, Bryant, et al., 2005).

Finally, we used a global measure of classroom quality, the Early Childhood Environment Rating Scale (ECERS), which includes 36 items that capture several dimensions of classroom quality: space and furnishings, routines, language reasoning, activities, interactions, and program structure (Harms, Clifford, & Cryer, 1998). The average of the 36 items provides a single overall measure; scores range from 1 to 7 (1 = inadequate quality, 3 = minimal quality, 5 = good quality, and 7 = excellent quality). Reliability in the Multi-State study on the ECERS was 83% in the fall of pre-K and 87% in the spring of pre-K (Clifford, Bryant, et al., 2005).

In the final models, we included only those class-level covariates that were statistically significant for at least one of the four outcomes.

Child-Level Measures

The child-level models included covariates that are associated with children's social and cognitive development and/or with the sociodemographic composition of their preschools. To control for SES, we used measures of children's family income and mother's education. The variable on family income was coded in $5,000 increments, from ''zero to $5,000'' to ''more than $85,000,'' which rendered 18 categories; we treated it as a continuous variable. The measure was positively skewed, along with a cluster in the ''more than $85,000'' category that included 7.9% of the sample. To approximate a normal distribution, we transformed the measure by taking its square root and *z*-scored the result ($M = 0$, $SD = 1$). The data on mothers' education were coded in 2-year increments, from 8 to 22 years of education, rendering eight categories; we also treated it as a continuous variable. Because the data were positively skewed, we transformed the variable with a natural log and *z*-scored the result ($M = 0$, $SD = 1$).

As we did at the class level, we averaged the two measures and called it *SES*. The child-level models also controlled for age, gender (1 = female, 0 = male), race/ethnicity (a series of dummy variables [1 = yes, 0 = no] that captured whether the child was Black, Latino, Asian, or other [Native Americans and children of mixed races], with non-Latino Whites as the comparison group), single-parent status (1 = yes, 0 = no), ELL status (as determined by parental report that the child first learned a language other than English; 1 = yes, 0 = no), IEP status in the spring (1 = yes, 0 = no), days absent from preschool, and the number of days between the fall and spring assessments.

Again, in the final models, we included only those child-level covariates that were statistically significant for at least one of the four outcomes.

RESULTS

Descriptive Analysis

A threshold requirement for a study of classroom socioeconomic diversity is that a sufficient number of classrooms in the available data are indeed socioeconomically diverse. The mean of the classroom-average family income was $32,574, and the median was $26,583. About half of the children (51.35%) attended classrooms in which most children (more than two thirds) were poor. But a quarter of the children (25.15%) attended classrooms that were more mixed (one third to two thirds of children were poor), and another quarter of the children (23.50%) were in classrooms in which poor children were in the minority (a third or less of children were poor). Although most children attended classrooms with a preponderance of poor children, the data contained a remarkable level of income diversity within preschool classrooms.

The standard deviation of income within classrooms is another way to assess classroom diversity. We found that half of the children attended classrooms with standard deviations of family income greater than $15,927. This finding suggests that in those classrooms, if income levels were normally distributed, roughly a third of the children were more than $31,854 apart in family income. Again, these analyses suggest that although at least half of all children attended high-poverty classrooms, a large number attended classrooms with substantial income diversity.

Table 1 displays differences across low-, middle-, and high-SES classrooms in terms of the children they served and aspects of classroom quality. It is not surprising that children living in poverty made up 85.17% of children in low-SES classrooms and only 17.54% of those in high-SES classrooms ($p < .001$). However, note that in high-SES classrooms, 1 in 6 children was poor. As expected, the standard deviation of family income within classrooms was lowest in low-SES classrooms ($p < .001$); low-SES classrooms were likely to represent a concentration of children whose families were poor, whereas middle- and high-SES classrooms were likely to offer more economic diversity. Children in low-SES classrooms were also more likely to be racial/ethnic minorities ($p < .001$) and ELLs ($p < .001$).[4]

[4]It would also be worth exploring how the distribution of children by age might differ among classrooms and how any differences might relate to their learning. Unfortunately, we do not have class-level data regarding the distribution of children by age. We do know that the average age of children in the Multi-State/SWEEP studies, and its standard deviation, did not vary significantly by whether children were in low-SES, middle-SES, or high-SES classrooms.

TABLE 1
Descriptive Statistics for Preschool Classrooms by Their Socioeconomic Composition
($N = 2,966$ Children in 704 Classrooms)

Variable	*Low-SES classrooms*[a] *(n = 265)*	*Middle-SES classrooms*[a] *(n = 265)*	*High-SES classrooms*[a] *(n = 174)*
Class composition[b]			
Class mean family income ($)	17,300***	30,686	58,711***
(*SD*)	(4,567)	(9,155)	(14,486)
Standard deviation of incomes within classrooms ($)	11,876***	18,820	21,269***
(*SD*)	(4,862)	(6,972)	(7,217)
Class mean mothers' education (years)	11.68***	12.71	14.64***
(*SD*)	(0.59)	(0.54)	(1.25)
Percent poor	85.17***	58.50	17.54***
(*SD*)	(13.98)	(22.35)	(17.53)
Percent White	22.99***	40.42	68.90***
(*SD*)	(32.06)	(36.53)	(28.20)
Percent ELL	30.10***	15.47	7.85*
(*SD*)	(36.51)	(25.82)	(15.65)
Percent IEP	9.79	10.26	8.53
(*SD*)	(12.13)	(14.57)	(13.58)
Global quality			
ECERS (*z*-scored)	−0.20	0.00	0.31**
(*SD*)	(0.99)	(0.95)	(1.01)
Process quality			
Instructional quality (*z*-scored)	−0.05	−0.02	0.12
(*SD*)	(0.98)	(1.00)	(1.02)
Emotional support (*z*-scored)	−0.26*	0.02	0.42***
(*SD*)	(1.04)	(0.98)	(0.82)
Teacher has no BA (%)	36.98**	25.66	22.99
Teacher has a BA (%)	27.92	24.91	29.89
Teacher has more than a BA (%)	35.09***	49.43	47.13
Teacher has a CDA (%)	24.15*	15.85	13.22
Young teacher (%)[c]	35.09**	48.30	50.00
Teacher speaks Spanish (%)	49.43***	30.19	14.94***
Comprehensive curriculum (%)	66.42	59.25	39.66***
Structural quality			
Class size	17.75	17.68	17.02
(*SD*)	(3.91)	(4.87)	(4.74)
Child:teacher ratio is 10 or less (%)	86.79	83.77	89.08
Full-day program (%)	40.38*	50.19	48.28
Hours per week	22.21*	23.58	23.85
(*SD*)	(11.79)	(12.18)	(13.52)
Head Start classroom (%)	27.17***	12.45	2.87***
Public school location (%)	63.02	64.53	55.17*
Provides meals (%)	96.23***	83.77	48.85***
Provides family services (%)	89.43	84.53	63.22***
Provides health services (%)	58.11*	49.06	31.03***

Note. SES = socioeconomic status; ELL = English language learner; IEP = individualized education plan; ECERS = Early Childhood Environment Rating Scale; BA = bachelor's degree; CDA = Child Development Associate credential.

[a]Classroom SES is the average of two *z*-scored variables: class mean family income and class mean mothers' education. Low-SES classrooms have SES values that are less than 0.5 *SD* below the mean for all classrooms; high-SES classrooms have SES values that are more than 0.5 *SD* above the mean for all classrooms; middle-SES classrooms have SES values between the two.

[b]Significance tests compare low- and high-SES classrooms to middle-SES classrooms.

[c]Teacher has had a teaching certificate for less than 4 years.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Low-, middle-, and high-SES classrooms differed significantly in terms of quality, affirming concerns that despite concerted policy efforts to standardize levels of quality across publicly funded classrooms, more work remains to be done. As measured by the ECERS, the average quality of high-SES classrooms was almost one third of a standard deviation higher than that found in middle-SES classrooms ($p < .01$) and one half of a standard deviation higher than in low-SES classrooms ($p < .001$). Low-SES classrooms appeared to be most likely to have teachers who lacked a BA and least likely to have teachers who had earned more than a BA ($p < .01$). However, low-SES classrooms appeared most likely to have teachers with a CDA ($p < .01$) and teachers who spoke Spanish ($p < .001$).

Classroom size, child:teacher ratio, full-day versus half-day program, and location in a public school did not differ significantly by class mean SES. Yet children in low-SES classrooms attended pre-K for fewer hours per week, which previous analyses have found to be associated with less learning (Ready, 2010). As might be expected, low-SES classrooms were twice as likely to offer meals, 1.4 times more likely to offer family services, and 1.9 times more likely to offer health services than high-SES classrooms.

In terms of process quality, the level of emotional support in high-SES classrooms, on average, was almost one half of a standard deviation higher than the level of emotional support in middle-SES classrooms and two thirds of a standard deviation higher than the level in low-SES classrooms ($p < .001$). Although the differences in the quality of instructional support in high-, middle-, and low-SES classrooms followed the same pattern, they were not statistically significant. What is surprising is that the use of a comprehensive curriculum was 1.7 times more common in low-SES classrooms than in high-SES classrooms ($p < .001$), where teachers may have followed a flexible curricular path for their more advantaged students.

Multivariate HLM Analysis

The first set of HLM analyses partitioned the variance in several key measures into the proportion that lay between children within classrooms and the proportion that lay between classrooms. Only the proportion of outcome variance that resides systematically between classrooms (the intraclass correlation) can be modeled as a function of class-level characteristics (Lee, 2000). With most large data sets, the majority of variability in child outcomes lies among children nested within the first analytic level rather than between upper level contexts. This is indeed what we find here: 18.85% to 31.13% of the variance in the four outcomes lay between classrooms ($p < .001$). We also established the reliability of the intercept, which reflected an average of the reliability of each class mean, and ranged from 0 to 1.0, with 1.0 representing the highest level of confidence. The intercepts were estimated with a moderate degree of reliability (between 0.49 and 0.65), suggesting that HLM was reasonably confident in its ability to discriminate among Level 2 classrooms (Raudenbush, Bryk, Cheong, Congdon, & Toit, 2004).

The next step was to construct a within-classroom model that was unadjusted for any covariates at the class level. This allowed us to establish the relationship between child-level variables and the outcome measures before we considered how class-level measures related to children's learning between the two assessments (see Table 2). Again, as expected, we found a highly significant relationship between children's own SES and their pre-K learning. A 1 *SD* increase in children's SES was associated with an almost 0.08 *SD* increase in both receptive and expressive

TABLE 2
The Relationship Between Children's Characteristics and Their Preschool Learning ($N = 2{,}966$)

Children's characteristics[a]	*Receptive language learning*	*Expressive language learning*	*Math learning*	*Social skills learning*
SES (*z*-scored)[b]	0.077***[c]	0.078***	0.122***	0.057***
Black[d]	−0.293***	−0.142***	−0.224***	−0.077†
Latino[d]	−0.313***	−0.182***	−0.082	−0.030
Asian[d]	−0.108	−0.241**	−0.007	0.019
Other[d]	−0.123**	−0.063	−0.007	−0.008
Single parent	−0.062†	−0.021	−0.021	−0.049
ELL	−0.119*	−0.103†	0.029	0.049
IEP	−0.171**	−0.224***	−0.148*	−0.251***
Age	−0.070	−0.091†	−0.164**	0.181***
Female	0.018	0.059†	0.076*	0.156***
Fall skills (*z*-scored)	0.618***	0.640***	0.584***	0.625***
Intercept	0.000	0.000	0.000	0.000

Note. SES = socioeconomic status; ELL = English language learner; IEP = individualized education plan.
[a]All variables are centered on the grand mean.
[b]SES is the average of two *z*-scored variables: child's family income and mother's education.
[c]Coefficients are empirical Bayes estimates.
[d]Comparison group is White.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

language learning ($p < .001$). The link between children's SES and their learning was stronger for mathematics (ES = 0.122, $p < .001$) and somewhat weaker for social competence (ES = 0.057, $p < .001$).

Table 2 also indicates that racial/ethnic minority children learned less, on average, than White children. Regardless of SES and the other measured aspects of children's background, Black children learned fewer receptive language (ES = −0.293, $p < .001$), expressive language (ES = −0.142, $p < .001$), math (ES = −0.224, $p < .001$), and social competence (ES = −0.077, $p < .10$) skills than White children. Latino children similarly learned fewer receptive language skills (ES = −0.313, $p < .001$) and expressive language skills (ES = −0.182, $p < .001$) than White children. Asian children also learned fewer expressive language skills than White children (ES = −0.241, $p < .01$). It is noteworthy that children with special needs, as indicated by an IEP or IEP referral in the spring, learned significantly less than non-IEP children on all four outcomes.

Research question 1: Socioeconomic composition and children's learning. In the first set of models, we estimated the relationships between socioeconomic composition and each of the four outcomes while controlling for children's SES, the other child-level covariates, and the racial/ethnic composition of children's classrooms. Although we tested a multitude of child-level variables, the final models presented here include only those variables that were statistically significant for at least one of the four outcomes.

The Level 2 models suggested significant and positive relationships between classroom socioeconomic composition and three of the four outcomes (see Table 3). A 1 *SD* increase in class mean SES was associated with a 0.042 *SD* rise in receptive language learning ($p < .10$), a 0.052 *SD* increase in expressive language development ($p < .05$), and a 0.058 *SD* improvement

TABLE 3
The Relationship Between the Socioeconomic Composition of Preschool Classrooms and Children's Learning ($N = 2{,}966$)

Variable	*Receptive language*[a]	*Expressive language*	*Math skills*	*Social skills*
Child-level equation: within-class effects[b]				
SES (z-scored)[c]	0.051*[d]	0.047*	0.092***	0.073***
Black[e]	−0.196***	−0.080	−0.186**	−0.140**
Latino[e]	−0.218***	−0.120†	−0.043	−0.090
Asian[e]	−0.062	−0.235**	0.001	−0.010
Other[e]	−0.065	−0.040	0.014	−0.043
Single parent	−0.056†	−0.017	−0.017	−0.052†
ELL	−0.106*	−0.094	0.034	0.038
IEP	−0.165**	−0.219***	−0.143*	−0.256***
Female	0.016	0.061†	0.076*	0.157***
Age	−0.074	−0.095*	−0.168**	0.183***
Fall assessment score (z-scored)	0.609***	0.637***	0.580***	0.626***
Class-level equation: between-class effects[f]				
Socioeconomic composition (z-scored)[g]	0.042†	0.052*	0.058*	−0.031
Percent White (z-scored)	0.059**	0.133†	0.012	−0.045†
Quadratic term of percent White (z-scored)		−0.108†		
Intercept	0.001	0.001	0.001	0.000

Note. SES = socioeconomic status; ELL = English language learner; IEP = individualized education plan.
[a]Outcome is the z-scored spring assessment score.
[b]At the child level, all variables are centered on the grand mean.
[c]SES is the average of two z-scored variables: child's family income and mother's education.
[d]Coefficients are empirical Bayes estimates adjusted for all child- and class-level measures.
[e]Comparison group is White.
[f]At the class level, all continuous variables are centered on the grand mean, and all dummy variables are left uncentered.
[g]Socioeconomic composition (i.e., classroom SES) is the average of two z-scored variables: class mean family income and class mean mothers' education.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

in mathematics skills ($p < .05$). It is noteworthy that with the receptive and expressive language outcomes, the estimates for socioeconomic composition are comparable to those associated with children's own SES. In contrast, we did not find a significant relationship between socioeconomic composition and social skills learning.

The racial/ethnic composition of the class, as measured by the percentage of White children, was also positively associated with children's receptive language (ES = 0.059, $p < .01$) and expressive language (ES = 0.133, $p < .10$), even after we accounted for class mean SES. What is interesting is that the percentage of White children in the classroom first-order term was positively related to expressive language development, but the quadratic term was negative (ES = −0.108, $p < .10$). This nonlinear relationship implies that racial/ethnic diversity improves children's expressive language learning when neither Whites nor minorities are the overwhelming majority, once classroom SES is controlled.

Conversely, with the social competence outcome, the results indicated a significant and negative relationship between White children's enrollment and children's social skills learning

(ES = −0.045, $p < .10$). A possible explanation is that nonminority children entered the classroom with higher social skills, on average, and thus had less room for growth on the assessment of social competence. However, the negative correlation between initial skills and gains, which would indicate a ceiling effect, was not stronger on this outcome than on the other three.

On all four outcomes, we first entered class mean income and the standard deviation of income within classrooms at the class level to assess the degree to which income diversity might explain some of the relationship between the class mean SES and children's learning. In each case, income diversity was not significant by itself, although for receptive language, it was strong enough to render nonsignificant the coefficient for class mean income. Because the measure of income diversity was not significant by itself, we excluded it from subsequent models until we considered interactions at the class level.

Research question 2: Socioeconomic composition, classroom quality, and children's learning. In the second set of models, we added measures of classroom quality to explore the extent to which they explained the socioeconomic composition estimates from the previous model. If the inclusion of instructional quality, for example, reduced the coefficient for socioeconomic composition, the implication would be that higher teacher quality partially explained the relationship between classroom SES and children's learning. Again, although we tested a multitude of class-level variables, we include in the final models presented here only those variables that were statistically significant for at least one of the four outcomes. In the final models, six class-level covariates were significant for at least one outcome.

The results indicated that measures of structural and process quality did not explain the relationship between socioeconomic composition and children's receptive language, expressive language, and math learning (see Table 4). Including these measures did not substantially alter the size of the socioeconomic composition estimates that had been reported in the previous set of models (see Table 3). Note, however, that with receptive language, the socioeconomic composition coefficient was now significant at the $p < .05$ level; and for math, socioeconomic composition was significant at only the $p < .10$ level. For expressive language learning, the inclusion of these measures, and in particular the variable for instructional quality (ES = 0.061, $p < .001$), rendered the measure of racial/ethnic composition nonsignificant. This finding suggests that the association between the percentage of White children and expressive language learning may be explained, at least in part, by the preponderance of higher quality instruction in classrooms with more White children.

Research question 3: Interactions at the class level. To address the third research question, we also tested interaction terms between the variables of interest (socioeconomic composition and income diversity) and other aspects of classroom quality to assess whether compositional aspects of preschool learning are more important in certain classroom contexts. Though the standard deviation of income within classrooms was not significant in earlier models, we included it here to test whether it interacted with measures of classroom quality to promote children's learning. For each of the four outcomes, only one interaction term was significant and therefore included in the final models presented here.

Table 4 indicates that socioeconomic composition and income diversity interacted to promote receptive language learning (ES = 0.046, $p < .01$). Figure 1 provides a graphic display of these interaction effects for three hypothetical classrooms: a low-SES, low–income diversity classroom; a high-SES, low–income diversity classroom; and a high-SES, high–income diversity

TABLE 4
The Socioeconomic Composition of Preschool Classrooms, Classroom Quality, and Children's Learning: Interactions at the Class Level ($N = 2{,}966$)

Variable	*Receptive language*[a]	*Expressive language*	*Math skills*	*Social skills*
Child-level equation: within-class effects[b]				
SES (*z*-scored)[c]	0.049*[d]	0.048*	0.093***	0.075***
Black[e]	−0.186***	−0.085	−0.180**	−0.125*
Latino[e]	−0.211***	−0.127†	−0.046	−0.092
Asian[e]	−0.062	−0.237**	−0.012	−0.014
Other[e]	−0.065	−0.040	0.007	−0.040
Single parent	−0.052	−0.018	−0.007	−0.045
ELL	−0.117*	−0.097	0.032	0.034
IEP	−0.164**	−0.230***	−0.143*	−0.259***
Female	0.017	0.060†	0.077*	0.158***
Age	−0.074	−0.089†	−0.173***	0.178***
Fall assessment score (*z*-scored)	0.607***	0.630***	0.579***	0.626***
Class-level equation: between-class effects[f]				
Socioeconomic composition (*z*-scored)[g]	0.057*	0.054*	0.059†	−0.020
Standard deviation of family income (*z*-scored)	−0.004	0.015	−0.032	0.016
Percent White (*z*-scored)	0.055*	0.018	0.002	−0.073**
Instructional quality (*z*-scored)	0.031†	0.061***	0.033†	0.041*
Teacher has a BA[h]	0.035	−0.024	0.022	0.098*
Teacher has more than a BA[h]	0.001	−0.049	0.007	0.154**
Small class (less than 18 children)	−0.048	−0.043	−0.053	0.026
Full-day program	−0.019	0.004	−0.041	−0.073†
Head Start classroom	0.019	0.059	−0.022	0.111†
Socioeconomic Composition × Standard Deviation of Family Income	0.046**			
Socioeconomic Composition × Instructional Quality		0.032*		−0.033†
Standard Deviation of Family Income × Teacher Has More Than a BA			0.089*	
Intercept	−0.002	0.037	0.035	−0.088†

Note. SES = socioeconomic status; ELL = English language learner; IEP = individualized education plan; BA = bachelor's degree.

[a]Outcome is the *z*-scored spring assessment score.

[b]At the child level, all variables are centered on the grand mean.

[c]SES is the average of two *z*-scored variables: child's family income and mother's education.

[d]Coefficients are empirical Bayes estimates adjusted for all child- and class-level measures.

[e]Comparison group is White.

[f]At the class level, all continuous variables are centered on the grand mean, and all dummy variables are left uncentered.

[g]Socioeconomic composition (i.e., classroom SES) is the average of two *z*-scored variables: class mean family income and class mean mothers' education.

[h]Comparison group is no BA.

†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

classroom. We define *low* as −1 *SD* below the sample classroom average and *high* as 1 *SD* above the sample classroom average. We do not include a low-SES, high–income diversity classroom, as these data included virtually no such classrooms. Classrooms with both high SES and high income diversity were associated with an additional 0.103 *SD* receptive language development compared to average-SES classrooms with average income diversity.

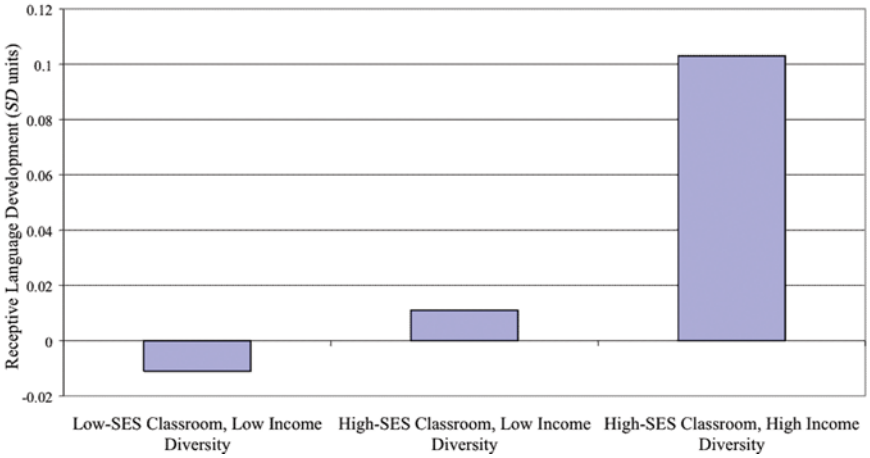

FIGURE 1 Interactions between classroom socioeconomic status (SES), classroom income diversity, and receptive language development ($N = 2{,}966$). *Source*: Multi-State Study of Pre-Kindergarten and State-Wide Early Education Program Study data (National Center for Early Development and Learning, 2001–2004) (color figure available online).

For expressive language, the results indicate that socioeconomic composition and instructional quality interacted to promote children's learning (ES = 0.032, $p < .05$). When socioeconomic composition and instructional quality were both 1 *SD* above the mean, expressive language learning improved by 0.147 *SD* compared to learning in classrooms in which both measures were only average. Together, these findings suggest that classrooms in which average SES, income diversity, and instructional quality were relatively high enjoyed an advantage that promoted children's language development, regardless of children's own SES and the racial/ethnic composition of the classroom.

For children's math learning, the diversity of income within classrooms interacted positively with teachers who had more than a BA (ES = 0.089, $p < .05$), suggesting that in classrooms in which income diversity was above average and teachers had more than a BA, children's math learning improved.

DISCUSSION

The Substantive Significance of the Findings

The descriptive finding that lower SES and racial/ethnic minority children learned less, on average, than higher SES and White children during pre-K is an urgent policy concern, given the near-universal goal of investing public funds in pre-K to help close the substantial sociodemographic readiness gaps present at kindergarten entry. A common explanation for this troubling finding is that low-SES and minority children are more likely to attend lower quality programs (Magnuson & Waldfogel, 2005), an argument that finds some support in the descriptive findings here. The obstacle remains, then, to identify the components of quality that allow lower SES and minority children to learn as much as, or more than, higher SES and White children. The results

here suggest that the socioeconomic composition of preschool classrooms represents a potentially important aspect of preschool quality. With the exception of social competence, socioeconomic composition was a reliable predictor of children's learning, even with the inclusion of numerous classroom measures. Only one other aspect of the classroom, instructional quality, was an equally consistent predictor.

Although statistically significant, the relationships reported between socioeconomic composition and children's receptive language, expressive language, and mathematics learning are small. However, one would not expect socioeconomic composition estimates to be particularly large, given how little time children spent in their pre-K classrooms. On average, children experienced only 5 months of preschool between the fall and spring assessments, and more than half of the students (54.08%) were in preschool for half-days, an average of 2.66 hr per day. This small dose of preschool may support fewer cognitive gains than one of longer duration (Lee, Burkam, Ready, Honigman, & Meisels, 2006; Logan, Piasta, Justice, Schatschneider, & Petrill, 2011; McGinty, Breit-Smith, Fan, Justice, & Kaderavek, 2011; Ready, 2010; Reynolds, Temple, Ou, Arteaga, & White, 2011; Walston & West, 2004).

Moreover, the findings suggest that expanding access to higher SES classrooms might moderate SES disparities in children's pre-K development. On each outcome, the skills gap between children from low- and high-SES families widened between the two assessments. But for receptive and expressive language learning, this disadvantage for low-SES children was effectively erased in above-average-SES classrooms, where the positive effects of increased socioeconomic classroom composition compensated for the negative effects of child socioeconomic disadvantage (see Table 4). Moreover, on all three language and math outcomes, the estimates for socioeconomic composition were similar in size to the estimates for instructional quality, which multiple studies have found to be an important predictor of children's learning.

Nevertheless, the descriptive analyses indicate that children in low- and high-SES classrooms were, on average, a full standard deviation apart in receptive language skills when they began pre-K and more than three quarters of a standard deviation apart on expressive language and math skills. The findings here suggest that low-SES children who attend relatively high-SES classrooms learn 0.05 to 0.06 *SD* more than their counterparts in average-SES classrooms (see Table 4), small progress in the context of such wide gaps in skills. At the same time, however, the disparities between children in low- and middle-SES classrooms were one third of a standard deviation (0.322 *SD*) in receptive language, one fifth of a standard deviation (0.208 *SD*) in expressive language, and one quarter of a standard deviation (0.249 *SD*) in math when the children began pre-K. In this context, a 0.05 to 0.06 coefficient looks more substantial. If the classrooms also offered high-quality instruction, income diversity, and highly educated teachers, the benefits were larger. If such increases were cumulative over several years, they could represent important improvements in low-SES children's achievement (Harris, 2009).

The negative association between social skills learning and racial/ethnic composition demands further exploration. Because we could find no evidence that a ceiling effect caused this apparent anomaly in the results, the explanation may relate to the fact that the social competence assessment was the only instrument of the four that relied on teacher ratings. Perhaps teachers in predominantly White classrooms held higher expectations for their students and were less generous in their assessments of children's growth in the social domain (Han & Thomas, 2010; Ready & Wright, 2011). Different teacher expectations for children of varying racial/ethnic backgrounds could thus produce more social skills learning on the measure for children

in high-minority classrooms. We also found that among the final models for the four outcomes, the model for social competence was relatively unsuccessful at explaining the variance in the dependent variable, further evidence that the relationship between class-level features of preschool quality and the development of social competence requires more study.[5] To clarify the association between social skills development and class composition, future research could explore this relationship with instruments that rely on independent observations, rather than teacher assessments.

Operational Pathways for the Compositional Effect

The enduring socioeconomic composition estimates suggest that the relationship between classroom composition and children's receptive language, expressive language, and mathematics learning was neither structural nor instructional. Children who benefited from higher SES classrooms were not learning more purely because they enjoyed better teachers, for example. Nor does the use of a comprehensive curriculum explain the apparent advantage of higher SES classrooms, as this variable was not significant on any of the four outcomes. Socioeconomic composition promoted children's learning through some other pathway.

One plausible explanation for the differential effect of class mean SES is that greater parental involvement in higher SES classrooms helps to explain the compositional effect. In analyses beyond those reported here, when we separated the two variables embedded in the measure of class SES, we found that class-level maternal education was a more consistent predictor of children's learning than was class-level family income, and higher levels of parental education may support more active involvement in children's school communities. It is plausible that the tendency of higher SES parents to engage in concerted cultivation with their own children also supports learning more broadly within higher SES classrooms and in the social interactions that occur outside them.

Another feasible explanation is that socioeconomic composition relates to children's learning through direct peer effects. Other research on preschool peer effects supports this possibility (Henry & Rickman, 2007; Justice et al., 2011; Mashburn et al., 2009). The mechanisms for such direct effects are not clearly understood. As discussed previously, the theoretical literature on peer effects in early childhood is sparse, even while the empirical base is growing. Still, the mechanisms for cognitive peer effects in early childhood are easier to conceptualize for language learning than for math learning. Whereas peer modeling of language use and vocabulary could easily permeate children's daily interactions in the classroom, math skills may be less prominent and explicit. Even so, the frequency of cooperative play and activities in preschool settings may create multiple opportunities for children who possess stronger math skills to engage less skilled peers with their verbalization of math skills and conceptual thinking, such as estimation and problem solving. They may also hasten the pace of math instruction in the classroom. Clearly, replication of the findings, and exploration of the peer effects that might explain them, would be

[5]When we compared the residual class-level variance in the fully unconditional model and final model for each of the four outcomes, we found that the models explained nearly all the variability between classrooms in spring receptive language scores (97.97%) and expressive language scores (92.21%) and slightly less in spring math scores (83.60%). The model was far less successful at explaining variance between classrooms in the spring assessment of social competence (48.17%), indicating that unmeasured variables are likely to relate significantly to this aspect of children's development.

a valuable direction for future research. The implications are important because if peers are the primary mechanism for the compositional effects found here, then policy efforts to improve the quality of high-poverty programs cannot offer the apparent benefits of higher SES classrooms.

Interactive Effects Between Classroom SES, Income Diversity, and Teaching Quality

The strength of the relationship between socioeconomic composition and children's language and math learning depends on other aspects of preschool quality. For receptive language, high-SES classrooms that are also diverse in family income are associated with more language learning than high-SES classrooms in which family income is homogenous. Capturing these benefits would require a careful balance, because introducing lower SES children to higher SES classrooms necessarily lowers the SES average. The finding that above-average SES and above-average income diversity combine to promote learning suggests that there is a tipping point above which class SES and income diversity promote learning and below which income diversity pulls down the SES average so much that it no longer confers an advantage.

For expressive language, socioeconomic composition interacts positively with instructional quality to improve learning; on the math outcome, income diversity and teachers who have more than a BA interact positively. Although other research has not found teacher education to be a reliable predictor of children's learning (Early et al., 2007; Howes et al., 2008; Mashburn et al., 2008; Palardy & Rumberger, 2008), it appears that in socioeconomically diverse classrooms, teachers with postgraduate degrees may be better able to promote the math development of their children. Yet given the inconsistent relationship between even secondary education for teachers and children's learning, many have argued that preparing preschool teachers demands sustained and cohesive professional development (Early et al., 2007; Hardin et al., 2010; Kagan, Kauerz, & Tarrant, 2008; Rothstein-Fisch, Trumbull, & Garcia, 2009).

Professional development could support teacher skills and strategies to manage the disparate skill levels and cultural norms in socioeconomically diverse classrooms while nurturing positive peer relations and the learning opportunities they offer. Substantial research indicates that teachers play an important role in nurturing the social skills and peer interactions that support children's learning in the social setting of preschool, and this challenge may be even more important in socioeconomically diverse classrooms (Buysse, Goldman, & Skinner, 2003; Dowsett et al., 2008; Howes et al., 2011; Palermo, Hanish, Martin, Fabes, & Reiser, 2007).

It is not clear why income diversity, instructional quality, and teacher education would differentially affect children on the three outcomes. One can posit how income diversity might enhance language modeling in higher SES classrooms, and how instructional quality, or the teacher education that may support it, could improve language or math learning in higher SES classrooms by facilitating peer interactions and individualized instruction. Yet the differential effects are somewhat surprising and may reflect the relatively small sample and duration of exposure to preschool that necessarily limited the magnitude of the results.

Limitations of the Study

The data used in the analyses here contain only short-term preacademic outcomes measured in the spring of the preschool year, a valuable but not sufficient measure of children's growth.

Indeed, the experience of socioeconomically diverse classrooms could offer longer term outcomes apart from academic achievement. For example, if positive interactions with diverse peers support children's early cognitive and social development, the possible academic, social, and economic benefits would be hard to gauge in a short-term study. Diverse preschool classrooms could further support parental interactions across social classes that may ease the social isolation and structural inequalities that characterize segregated communities.

Another limitation of the sample was the relatively small number of children assessed within each classroom. This made it difficult to explore, using a slopes-as-outcomes approach, the possibility that classroom composition differentially affects low- and high-SES children. Similarly, ELL children may benefit more or less than their peers who speak English as their first language (Schechter & Bye, 2007). To explore these and other important questions, future research should consider samples that include classrooms that are diverse in ELL composition, children with IEPs at preschool entry, and assessments in more than one language for dual-language learners. The use of observational assessments of social development might further support this research, which would have important pedagogical and policy ramifications.

In addition, as with any nonexperimental study, selection or omitted variable bias is a concern. Without random assignment, it is difficult to know whether one has disentangled the effect of classroom composition from factors with which composition may be correlated. Parents who seek out socioeconomically diverse preschool programs may be different in ways that positively affect their child's learning and thus inflate the apparent effect of socioeconomic composition. At the same time, parents may seek higher quality programs beyond their neighborhoods to serve their children's special needs, which could suppress any effect of socioeconomic composition if those children land in diverse programs but tend to learn less (G. J. Duncan & Gibson-Davis, 2006; Schneider, Carnoy, Kilpatrick, Schmidt, & Shavelson, 2007). Moreover, though the Multi-State and SWEEP data collectors randomly chose children for assessment, they could choose only from children whose parents had allowed them to participate. How these varieties of self-selection may have affected the results is difficult to discern.

It is also possible that the measure of school composition was capturing unmeasured variables that related to how much children learn. For example, because many families value proximity in their choice of a preschool, school composition may in part reflect the influence of children's neighborhoods. However, given the residential segregation by social class that exists in many urban and rural areas (Dreier, Mollenkopf, & Swanstrom, 2004), the likelihood that at least some children in a socioeconomically diverse preschool classroom may not reside in the same neighborhood makes the omission of this variable somewhat less troubling.

In addition, the models here controlled for a wide variety of children's background characteristics, including maternal education, which has been found to account for a large portion of the relationship between child care quality and children's learning (G. J. Duncan & Gibson-Davis, 2006). We also used an analysis of covariance approach to help address nonequivalency between families in low- and high-SES preschools (Reichardt, 1979). Even so, the results should be interpreted with caution given the uncertainty of how selection or omitted variable bias may have affected the results. At the same time, we encourage future researchers to explore the causal mechanisms that may explain these findings and, in particular, to build the empirical foundation for understanding of how and when direct peer effects can enhance children's early learning.

Researchers play an important role in identifying the necessary components of preschool programs that foster positive outcomes. The results from this study suggest that socioeconomic

composition is a significant aspect of quality that is frequently missing from the policy dialogue. The presence of children in socioeconomically diverse classrooms in the Multi-State and SWEEP data demonstrates that state pre-K systems are already fostering such diversity. The findings here indicate that children may be learning more as a result.

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