The Ecology of Early Reading Development for Children in Poverty

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Abstract

In this study we investigated reading development from kindergarten to third grade for 1,913 economically disadvantaged children from the Early Childhood Longitudinal Study–Kindergarten Cohort. Characteristics of the child, the family, classroom instruction, and school composition were used to model influences from multiple levels of children's ecologies. The analytic model proposed that child and family characteristics (e.g., age at kindergarten entry, family literacy practices) would influence reading skills at kindergarten entry and rate of reading growth, whereas characteristics of classrooms and schools (e.g., comprehensive literacy instruction, racial and economic segregation) would constrain or enhance reading performance at specific times. Significant model parameters and effect sizes indicated that child and family characteristics were more predictive of initial reading skills than of reading development over time. Minority segregation in elementary schools was associated with lower student reading performance after accounting for child and family background, classroom instruction, and school-level poverty.

Currently, children in the United States are expected to learn to read during the earliest years of elementary school, if not before. For many children, reading development progresses predictably in the context of supportive child (e.g., health, language development), family, and classroom factors. However, the "disruption of any of these factors increases the risk that reading will be delayed or impeded, a phenomenon particularly prevalent in impoverished urban and rural neighborhoods and among disadvantaged minority populations" (Snow, Burns, & Griffin, 1998, p. 315). A delay in reading development can be especially precarious because the elementary classroom curriculum moves away from basic reading

instruction after first grade, and subsequent learning in core subjects depends on independent reading. Others have described this education phenomenon as a pivotal transition from *learning to read* to *reading to learn* (Chall, 1983; Leach, Scarborough, & Rescorla, 2003). It is well documented that children living in poverty are overrepresented among children with reading delays (for reviews, see Hosp & Reschly, 2003; Losen & Orfield, 2002). Yet, more research is needed to determine how pertinent systems inhibit the reading development of economically disadvantaged children, particularly during the earliest years of elementary school.

Since its inception in 1965, Title I of the Elementary and Secondary Education Act has drawn national attention to the reading development of economically disadvantaged children in early elementary school (kindergarten through third grade). The current education policy climate is highly attuned to early reading development, and Title I initiatives focus on improving reading instruction in the preschool and early elementary classroom. Certainly, effective reading instruction matters for children's reading development, and policy such as Title I should lead to improvements in instruction. However, the issues that affect children in poverty extend beyond instruction (Rothstein, 2004), and more comprehensive models of reading development are needed to lend precision to policy intended to improve outcomes for economically disadvantaged children.

The current study was based on contextual theories of child development and methodological advances in the measurement of change. The central investigation was rooted in an ecological framework for child development. Ecological frameworks acknowledge that children develop within a set of nested contexts, referred to as levels of the environment, that shape and are shaped by the developing child (Bronfenbrenner, 1979; Bronfenbrenner & Crouter, 1983; Bronfenbrenner & Morris, 1998; Ford & Lerner, 1992; Lerner, 1998; Pianta, Hamre, & Stuhlman, 2003). Moreover, ecological frameworks prompt researchers to consider simultaneous developmental influences from multiple sources. By considering simultaneous influences from characteristics of children and of the contexts in which they develop—family, classroom, and school—the ecological validity of existing reading models might be improved and multiple, appropriate intervention targets could be identified to enhance the academic success of economically disadvantaged children in the United States.

In combination, ecological perspectives on reading development and methodological advances such as latent growth modeling promote understanding of change over time in relation to multiple influences. The central investigation in this study examined three aspects of reading development for economically disadvantaged children: (1) reading development trajectories—defined by initial status and rates of growth—from kindergarten to third grade, (2) characteristics of the child and family associated with children's initial status and rates of growth in reading, and (3) characteristics of classrooms and schools that affect children's reading performance at specific times along the developmental trajectory.

Contextualizing Reading Development

Contextual theories of development (Bronfenbrenner & Morris, 1998; Ford & Lerner, 1992; Magnusson & Stattin, 1998) that incorporate influences from multiple systems at different levels of the ecology emphasize the importance of the individual contexts in which children develop and also the influence of these contexts over time. Consequently, these models provide a broader framework for studying development in which the acquisition of reading skills is not situated exclusively within child cognition, or within family processes, or within classroom or school processes. Rather, the ac-

quisition of reading skills is the result of the dynamic interaction among child, family, classroom, and school systems: we represent this dynamic interaction as the literacy ecology (see Fig. 1). Consequently, performance on a reading test is not so much an assessment of the child as it is an assessment of literacy ecology, which is simultaneously influenced by and influences the child. Further, growth in reading performance reflects the direction and acceleration of reading skills supported by the literacy ecology. Therefore, studying growth in children's reading skills demands exploration of child, family, classroom, and school variables that, in combination, influence reading. We should note that exploration of these variables is not sufficient for capturing the full nature of ecologies. Further, modeling dynamic processes is limited by existing analytic methods. Still, simultaneous exploration of multiple contexts in relation to reading development increases the ecological validity of analyses, thereby enhancing opportunity for the generation and implementation of effective education policy.

Developmental systems theory (Ford & Lerner, 1992; Lerner, 1998; Pianta et al., 2003) and ecological systems theory (Bronfenbrenner, 1979; Bronfenbrenner & Crouter, 1983; Bronfenbrenner & Morris; 1998) portray human development as dynamic and embedded in context. Such definitions of development emphasize processes over discrete outcomes and depict the synergy between individuals and environments.

As individuals interact with multiple systems in the environment, emerging trajectories of development are shaped by affordances within systems. The term "affordance" refers to the processes within systems that facilitate action and consequently enhance or constrain development (Gibson, 1979; Pianta et al., 2003). For example, one can imagine two healthy children with similar language and emergent literacy skills at kindergarten entry. One child enters a kindergarten classroom where the availability of print is limited,

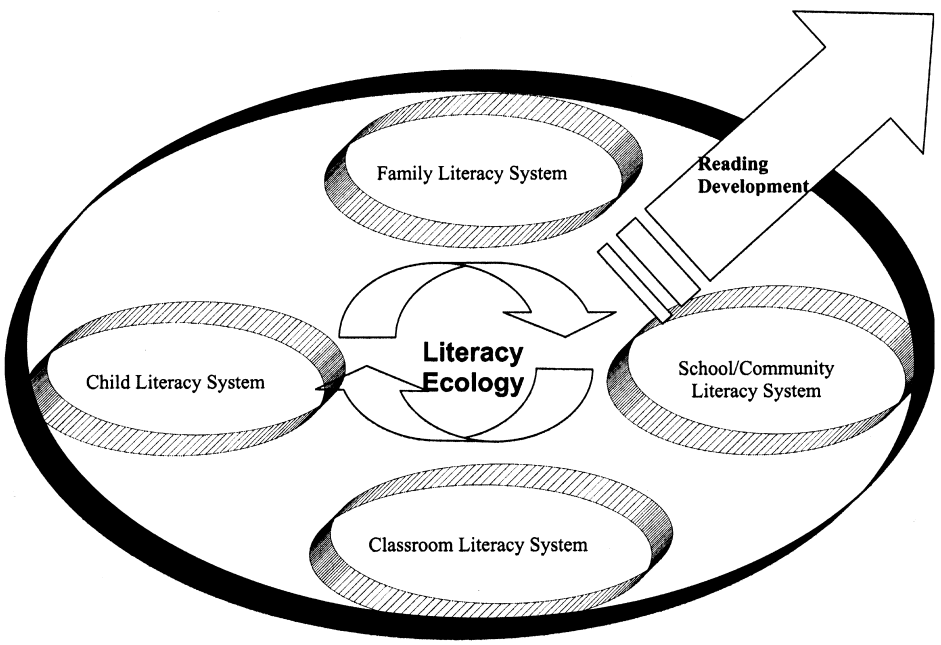

FIG. 1.—Reading development emerges from the literacy ecology

there are few opportunities for children to work meaningfully with letters and words, and classroom time is organized so that social language exchanges between children are infrequent and simple. The other child enters a kindergarten that promotes language exchanges through social play with adults and peers, explicitly teaches sublexical content, and frequently provides opportunities for children to work with words and a variety of books in meaningful ways. These kindergartens differ in terms of reading-specific affordances in such ways that the reading development of students in each class may be enhanced or constrained.

The issue of affordances is essential for understanding systems implications for developmental trajectories. Moreover, theory and research have revealed that patterns of early academic affordances are associated with social address variables such as race and economic status (Entwisle & Alexander, 1988; Lee & Burkam, 2002). An ecological framework may be especially important for understanding the academic trajectories of children experiencing economic disadvantage because it goes beyond social address to identify the salient education contexts related to economic status. Addressing this gap, Garcia Coll et al. (1996) proposed a model of child development in which social address variables such as gender, race, and social class affect children's development through specific contextual pathways, including (1) the experiences of discrimination and segregation, and (2) promoting and inhibiting environments. In developmental systems terms, Garcia Coll et al. described the relevant systems and embedded processes that interact to produce developmental competencies. Additionally, Garcia Coll et al. made clear that the real context for developmental competencies is not the social address but the ecology of child, family, school, and community systems related to the social address. Consequently, understanding children's reading development is tied to understanding the systems and related affordances associated with children's social addresses.

Translating Theory and Research into Ecological Models of Reading Development

Reviews of early reading development have indicated that there are multiple influences on early reading proficiency (Snow et al., 1998). Also, a number of recent large-scale studies have examined the multiple influences, including poverty, that affect children's reading and academic development (National Institute for Child Health and Human Development—Early Childcare Research Network [NICHD-ECRN], 2004, 2005).

Like earlier work (Lee & Burkam, 2002; McLoyd, 1998), recent studies have continued to demonstrate that there are multiple influences on academic development and that economic disadvantage constrains children's academic development in the early grades. Unfortunately, it is less clear how variation in child and family characteristics predicts reading development for economically disadvantaged children. Investigating the contexts and processes relevant to children experiencing economic disadvantage should yield important information for education policy. Consequently, our project considered reading development in a sample of children from low-income families.

Model 1, depicted in figure 2, reflects a partial model of reading development for children from low-income families where four repeated measures of reading skills are modeled as a developmental trajectory, and child and family characteristics influence children's initial reading status at kindergarten entry and rates of reading growth through third grade. Child social address variables in the model reflect existing research on the correlates of reading development. For instance, analyses of nationally representative samples of kindergarten children indicate that children who are white and female (Lee & Burkam, 2002) begin kindergarten with higher reading skills compared to students who are black and male,

respectively. Additionally, children who are older as they begin kindergarten (Walston & West, 2004) make greater gains in reading across the kindergarten year. Finally, the partial model proposes that family characteristics such as income, parent education, and family literacy practices influence children's reading development above and beyond social address characteristics of the child (Ackerman, Brown, & Izard, 2004; Christian, Morrison, & Bryant, 1998).

Of course, children's social address and associated family characteristics do not explain adequately the interrelations between social address and learning contexts outside of the home. For instance, kindergartners who are black and who have parents with less education attend schools where the average reading performance is lower and the percentage of students from impoverished homes is higher, on average, compared to white students and students from families with higher parent education (Lee & Burkam, 2002). Also, compared to children in suburban settings, children in rural and urban settings enter kindergartens where their peers have lower reading skills (Aikens & Kainz, 2006). Finally, children from families with low incomes are more likely to attend high-poverty schools with disproportionate numbers of students from minority backgrounds (Orfield & Lee, 2005). In other words, children from low-income families are more likely than are their more affluent peers to attend economically and racially segregated schools. These patterns of association between children's social address and their learning contexts reveal moments of tangled adversity and invite investigations into the effects of schooling above and beyond social address.

Model 2, depicted in Figure 3, represents an ecological model of reading development for children from low-income families, a model that incorporates simultaneous influences from child, family, classroom, and school. As in Model 1, four repeated measures of reading skills are modeled as a developmental trajectory, and child and family characteristics influence children's initial reading status at kindergarten entry and rates of reading growth through third grade. However, unlike the previous model, Model 2 allows characteristics of the classroom and school to account for variation in children's performance at specific times above and beyond what can be accounted for by under-

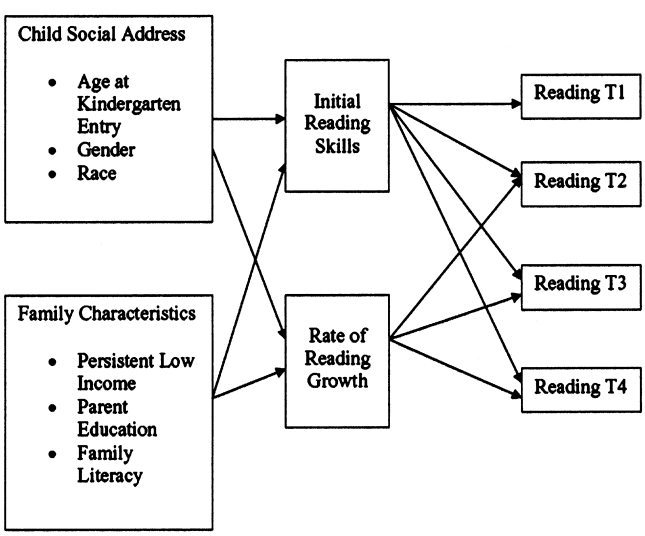

FIG. 2.—Model 1: Partial model of reading development from kindergarten to third grade

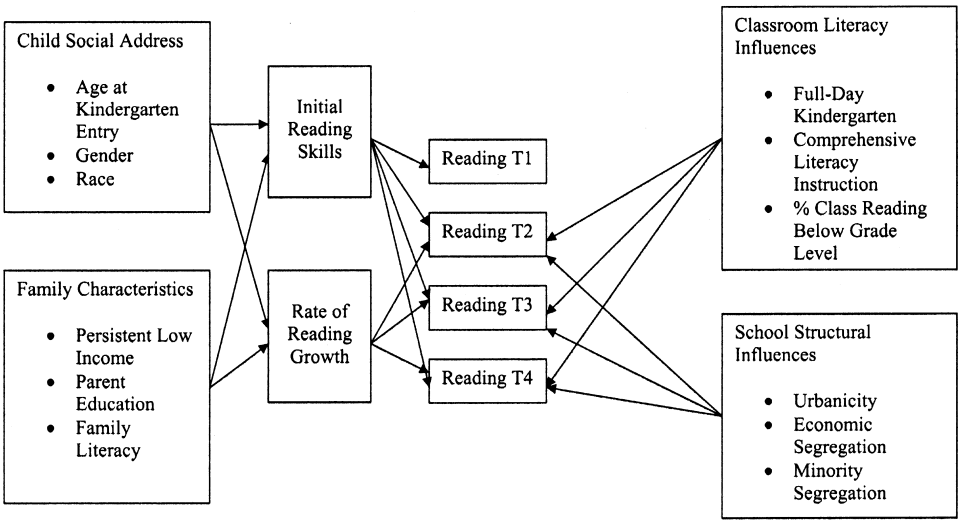

FIG. 3.—Model 2: Ecological model of reading development from kindergarten to third grade

lying trajectories. More specifically, Model 2, the ecological model, acknowledges that children's development is malleable and influenced by environmental affordances. Consequently, Model 2 allows for estimation of time-specific influences from aspects of classrooms and schools that may affect children's reading performance.

Classroom literacy influences, including the amount and quality of instruction and the reading abilities of peers in kindergarten, first, and third grades, may affect children's reading performance at specific times along the trajectory. For instance, attendance in full-day kindergarten programs, as opposed to half-day programs, is associated with more growth in reading in kindergarten, on average (Walston & West, 2004), and in first grade for children demonstrating slow growth in reading (Kaplan, 2002). Major syntheses of reading instruction in the early grades have indicated that effective reading instruction is comprehensive and includes explicit instruction on reading mechanics, reading comprehension, writing, and opportunities for reading practice (NICHD, 2000; Snow et al., 1998). Subsequent empirical investigations of comprehensive literacy instruction have continued to affirm its value (Guthrie, Schafer, & Huang, 2001; Xue & Meisels, 2004). Recent research has also shown that elementary school children attending classes where the average reading level is low may be at risk for constrained reading development (Aikens & Kainz, 2006; Lee & Burkam, 2002).

Certainly classroom structures and processes matter for children's learning. Yet, teachers and the act of teaching exist in specific school contexts. Therefore, the relation between classroom processes and children's reading development is more precisely understood when school contexts are considered. Characteristics of children, classrooms, and schools are intertwined: "The lowest quality schools are in America's large cities. Not quite so consistent, but still striking, is that low-quality schools—as defined by many measures we investigated here—also typify the educational institutions in small towns and rural areas. The highest quality schools are located in the suburbs, where the most affluent citizens reside" (Lee & Burkam, 2002, p. 77). When one considers that children from urban and rural schools are at increased risk for reading delays (Snow et al., 1998), it is impor-

tant also to consider that poverty rates for children in rural and urban schools might be higher than for children residing in the suburbs. Thus, it is difficult to understand the true effects of urbanicity without simultaneously addressing the effects of schoolwide poverty. Also, patterns of school minority segregation, which likely reflect neighborhood minority segregation, can contribute to children's elementary school achievement (Borman et al., 2004; Mickelson, 2001). Because children from low-income families are more likely than their affluent peers are to attend minority-segregated schools (Orfied & Yun, 1999), minority segregation is incorporated in our model to increase the ecological validity.

It is clear from the research reviewed above that child, family, classroom, and school variables are important correlates of children's reading development. However, it is not clear whether and how classroom and school variables in combination contribute to reading development for children living in poverty. Nor is it clear which influences from the tangled child, family, classroom, and school systems emerge as especially predictive of reading development when considered simultaneously. This study provides needed information on reading development for children from low-income families and gives insight into characteristics of classrooms and schools that emerge as particularly salient for children's reading development in the context of economic disadvantage.

Method

Sample

The Early Childhood Longitudinal Study—Kindergarten Cohort (ECLS-K) is a nationally representative sample of over 22,000 children who enrolled in approximately 1,000 kindergarten programs during the 1998–1999 school year. The National Center for Education Statistics (NCES) will continue to follow the sample through eighth grade. Researchers are collecting data from children, families, teachers, and school administrators to examine multiple variables in the ecology of early schooling. The sample reflects the racial, ethnic, and economic diversity of kindergartners in the United States. Additionally, the design includes oversampling of students reporting Asian-Pacific Islander (API) ethnicity and students attending private schools.

The analytic sample for this article contained 1,913 students from the ECLS-K who (1) entered public kindergarten for the first time in 1998, (2) progressed to third grade in the same school by 2002, (3) lived in families with incomes below 200% of the poverty threshold in 1998, (4) did not have an individual education plan (IEP) on record at school in kindergarten, and (5) performed their assessments in English. Children whose families earned up to 200% of the poverty threshold were included in the sample because earnings up to 200% provide minimal necessities (Gershoff, 2003), and families with low incomes experience many of the same school-related difficulties as families living at the poverty threshold.

Unweighted descriptions of the analytic sample are provided in Table 1. Aside from family income and school sector differences by design, this analytic sample differed from the full sample of first-time kindergartners in the ECLS-K by gender and race. The analytic sample contained fewer boys (47.36% vs. 51%), fewer white students (46.16% vs. 59%), and more black students (22.84% vs. 15%) than did the full sample of first-time kindergartners—public and private school students—in the ECLS-K. The percentage of Hispanic students in the analytic sample, 17.98%, was similar to the full sample of first-time kindergartners (full sample estimates obtained from Rathbun, West, & Germino-Hausken, 2003).

Instrumentation

Data for this project come from child, parent, teacher, and school administrator responses gathered during the school years

TABLE 1. Analytic Sample Characteristics (n = 1,913)

Characteristic	Percent
Female	52.64
Black/not Hispanic	22.84
White/not Hispanic	46.16
Hispanic	17.98
Asian	4.44
Native Hawaiian/Pacific Islander	3.08
American Indian/Native Alaskan	2.77
Multiracial/not Hispanic	2.72
Persistent low income through third grade	79.93
Attending schools in the suburbs	30.53
Attending schools with full-day kindergarten	58.34
Attending economically segregated schools	25.77
Attending minority segregated schools	30.84
Black students in economically segregated schools	51.03
Black students in minority segregated schools	57.21
White students in economically segregated schools	8.72
White students in minority segregated schools	3.62

NOTE.—Economic and minority segregation defined by school enrollment of students receiving free or reduced-price meals and enrollment of students from racial and ethnic minorities greater than or equal to 75%.

1998–1999, 1999–2000, and 2001–2002. A description of the data sources follows.

Reading. The reading portion of the direct cognitive assessment includes items to assess children's basic skills (e.g., sublexical skills, familiarity with print, letter knowledge), vocabulary, and progressively complex reading comprehension. To ensure children's positive experiences during the assessment process, no child was expected to complete the entire assessment. Rather, trained assessors administered the reading assessment battery at children's schools in a two-stage process within a 2-month data-collection period at each assessment time. All children eligible for assessment completed the same first-stage routing test consisting of 20 items. Performance on the routing test determined the difficulty of the second-stage forms. This method yielded necessary information to generate item response theory (IRT) scale scores. The IRT scale scores represented children's likely score on the entire assessment, had they completed it (U.S. Department of Education, NCES, 2002). The IRT scale scores were rescaled after each assessment time to ensure appropriate scores for longitudinal analysis. Full sample reliability estimates for the reading IRT scale scores range from .93 to .96 for all four rounds of assessment (NCES, 2004).

Child variables. Child gender, race, and age at first assessment are provided in the ECLS-K dataset. Child gender first was determined by researchers at the school-based assessment and then confirmed with items on the initial parent interview. The variable name "female" replaces the original name, "gender," and is coded dichotomously (0 = boy, 1 = girl). Parents provided information on child race in the parent interview, and eight categories of race are available in the ECLS-K. Children of all races will be included in the analyses, and a separate dichotomous variable for white children will be modeled as a predictor of reading development. Child age indicates children's ages in months at the time of the first kindergarten assessment.

Family variables. Children's primary caregivers participated in telephone interviews during the fall and spring of their children's kindergarten, first-grade, and third-grade years. Translators and bilingual researchers were hired to gather data from parents who spoke languages other than English. During the interview, primary caregivers, overwhelmingly mothers, provided information on child characteristics, family structure, employment patterns, and income. We used data from the kindergarten fall and spring parent interviews in this project to determine household size, family income, and family literacy practices. Parent reports of education attainment recoded in the ECLS-K to represent a nine-point scale of highest parent education level were used as a continuous measure of parent education.

Two variables were derived from data provided by parents. Family literacy is the sum of the frequency with which (1) parents

read books to children, (2) children looked at books independently, (3) children read or pretended to read to self or others, and (4) families visited libraries during the kindergarten year. Persistent low income is a dichotomous variable indicating that the family's income was below 200% of the poverty threshold at the end of third grade.

Classroom variables. Children's teachers completed pencil-and-paper questionnaires in the fall and spring of kindergarten and then the spring of first and third grades. Teachers reported the number of children in their classes reading below grade level at each data-collection point. Percent low readers reflects the percentage of children in a classroom reading below grade level in the kindergarten, first-grade, and third-grade classes attended by sample children and was obtained by dividing the number of low readers in each class by class size. Full day is a dichotomous variable from teacher reports indicating that the kindergarten classroom was a full-day program.

Teachers also reported how frequently they taught specific literacy concepts and how often students participated in specific literacy activities. At each grade level, a sum score was created for the frequency of instruction and activities that represented four elements of comprehensive literacy instruction: reading mechanics, reading comprehension, writing, and reading practice relevant to the grade level (Snow et al., 1998). Comprehensive literacy instruction scores at kindergarten, first, and third grades are the sum of 14, 17, and 12 items, respectively. Because items from the teacher questionnaire at a single time and across times had different scales, each item was rescaled to reflect a common scale and equal contribution to the sum score (1 = never or infrequently, 2 = sometimes, 3 = daily or almost daily). Higher comprehensive literacy instruction scores reflect higher frequency of activities and instruction mapping onto a comprehensive literacy framework. A summary of the items included in the comprehensive literacy sum at each grade level is included in the appendix.

School variables. In most cases, we used the school administrators' responses at kindergarten to describe the school context. However, when school variables at kindergarten were missing, we substituted administrator responses at first or third grades to reduce the effect of missing school data. To understand how rural and urban education settings compare to suburban in terms of children's reading development, we created a dichotomous variable, suburban, from the ECLS-K variable KURBAN_R based on census tract determination of school urbanicity. This variable represents the differential effect on reading development of suburban compared to rural and urban locations. Other school-level variables come from school administrators' reports gathered in the spring of each data-collection year (1998–1999, 1999–2000, 2001–2002). Economic segregation is a dichotomous variable indicating that the number of children receiving free and reduced-price lunch in a school is greater than or equal to 75%. Minority segregation is a dichotomous variable indicating that the number of children from ethnic and racial minorities attending the school is greater than or equal to 75%.

Analytic Method

Latent curve models (LCM), an extension of structural equation modeling (SEM), have proven useful tools for examining the processes of change in multiple contexts. In this project, we investigated patterns of change in children's repeated measures of reading. Hussong, Curran, Moffitt, Caspi, and Carrig (2004) provided an elegant extension of the LCM that allows incorporation of complex developmental theory in the practice of precise hypothesis testing. Essentially, Hussong et al. distinguished two underlying processes within a conditional LCM (i.e., an LCM with covariates as predictors). The first process is the individual's growth trajectory. The trajectory is

modeled as an intercept and growth factors underlying a set of repeated measures. When covariates are added as predictors of the intercept and growth factors, the resulting model indicates that the individual's underlying growth trajectory mediates the relation between the covariates and the repeated measures. That is, a particular predictor indirectly affects a test score at a specific time through the developmental trajectory.

The second process Hussong et al. (2004) depicted reflects time-specific deviations from the individual's growth trajectory. These deviations are represented as the direct effect of covariates on a test score at a specific time above and beyond what can be accounted for by the individual's growth trajectory. For example, recall that LCM identifies an average growth trajectory across the sample. Individuals' trajectories may deviate from the average trajectory, and those deviations are represented in the variation around the mean intercept and growth factors. Hussong et al. allow for another form of deviation to be represented as individuals' deviations from their own trajectories accounted for by the effect of covariates. In the context of reading development, time-specific deviations from individuals' trajectories reflect enhanced or constrained performance at a specific time relative to the expected trajectory.

Analytic Strategy

At the outset, we examined the functional form of reading development from kindergarten to third grade by contrasting two unconditional latent curve models of reading growth. At this initial step, we identified sufficient variability across children that warranted further investigation through conditional modeling. To understand the value of an ecological perspective of reading development, we estimated two nested, conditional latent curve models of children's reading development from kindergarten to third grade. The initial model, a partial model, allowed child and family characteristics to predict children's reading development (i.e., initial status and growth) while fixing the effects from classrooms and schools to zero. The subsequent model, an ecological model, allowed children's classroom and school characteristics to predict time-specific reading performance beyond development accounted for by children's expected trajectories and child and family characteristics.

The results are organized in three sections: descriptive statistics, unconditional models, and conditional models. Please note that all model fitting was performed in Mplus Version 3.11 using the ECLS-K sampling weight for kindergarten through third-grade longitudinal analyses. Additionally, clustering within schools was accounted for by using a sandwich estimator to generate appropriate standard errors (Muthen & Muthen, 1998–2006). Missing data were addressed through a full information maximum-likelihood technique that used all available information per case, resulting in no case exclusion due to missing items.

Results

Descriptive Statistics

Distributional characteristics of unweighted continuous model variables are presented in Table 2. Overall, mean reading achievement increased across the four testing times, as did the standard deviations of tests. The testing points were not equidistant, and the amount of change between tests increased across points.

Unconditional Models of Reading Growth

The unconditional model established the average pattern, or functional form, of reading growth in the sample, as well as calibrating the magnitude of individual differences in reading development. Two-factor and three-factor unconditional models of reading development were contrasted. The two-factor model represented reading development as a function of an underlying initial status (intercept) and straight-line

reading growth (linear slope). The three-factor model represented reading development as a function of initial status (intercept), straight-line reading growth (linear slope), and acceleration/deceleration (quadratic slope). The resulting fit indexes from two unconditional models are presented in Table 3 and indicate that a three-factor model provided superior fit to the data: Tucker-Lewis and comparative fit indexes (TLI and CFI) can range from 0 to 1.00, with values above .95 indicating exceptionally good fit. The root mean square error of approximation (RMSEA) indicates exact fit at .00, close fit between .00 and .05, and adequate fit between .05 and .08. The standardized root mean square residual (SRMR) is the standardized average residual across values of the implied and observed covariance matrices, and smaller numbers are better, with values below .05 most desirable (Byrne, 2001).

Parameter estimates for the preferred, three-factor unconditional model are provided in Table 4. All parameters in the three-factor unconditional model were significantly different from zero. On average, children answered 24.94 questions correctly when the reading test was administered at the beginning of kindergarten. Their scores increased by 11.63 points per calendar interval with an overall deceleration of .36 points per calendar interval (each calendar year was divided into three intervals to define the time coding of the slope). On average, children who began school with

Table 2. Variable Distributions

Variable	*N*	Mean	*SD*
Age (in months) at Time 1	1,912	68.32	3.96
Reading:			
Time 1	1,912	24.92	7.88
Time 2	1,911	36.60	11.07
Time 3	1,911	65.61	17.59
Time 4	1,903	105.48	17.51
Parent education[a]	1,913	3.92	1.46
Family literacy	1,912	11.41	2.99
Comprehensive literacy:			
Kindergarten	1,681	23.71	2.90
Grade 1	1,774	25.94	3.73
Grade 3	1,578	18.48	2.86
Percent low readers:			
Kindergarten	1,700	19.33	14.34
Grade 1	1,686	24.90	15.71
Grade 3	1,459	27.69	6.83

[a]Parent education categories were 1 = < grade 8, 2 = 9–12, 3 = high school diploma, 4 = vocational/technical, 5 = some college, 6 = bachelor's degree, 7 = some graduate school, 8 = M.A., M.S., 9 = Ph.D./M.D./J.D.

Table 3. Fit Indexes across Four Models (n = 1,913)

	Two-Factor Unconditional	Three-Factor Unconditional	Model 1 Partial Model	Model 2 Ecological Model
χ^2	1237.274	5.654	178.897	85.438
(df)	(5)	(1)	(47)	(25)
Comparative fit index	.636	.999	.961	.981
Tucker-Lewis index	.563	.992	.941	.943
Root mean square error of approximation	.359	.048	.038	.038
Standardized root mean square residual	.163	.009	.032	.021

TABLE 4. Parameter Estimates for the Unconditional Latent Curve Model

	Parameter Estimate	Standard Error
Intercept	24.94***	.24
Linear slope	11.63***	.15
Quadratic	−.36***	.01
Intercept variance	56.40***	6.96
Slope variance	17.14***	1.81
Quadratic variance	.12***	.01
Intercept with linear slope	9.78***	1.33
Intercept with quadratic	−.90***	.12
Linear slope with quadratic	−1.37***	.15

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

higher reading scores made steeper gains in reading initially and their growth decelerated at a greater rate, according to the significant correlations between the intercept, linear slope, and quadratic factors.

There was significant variation around the mean intercept, linear slope, and quadratic slope, indicating that reading trajectories varied across children. This variation provided a warrant for conditional modeling with the addition of covariates.

Conditional Models of Reading Growth

Two conditional models of reading development were contrasted. The partial model, nested within the ecological model, allowed child and family characteristics to predict children's reading trajectories while restricting the effects of classrooms and schools to zero. Results from the partial model indicated good model fit and significant relations between the growth factors and child and family covariates. Parameter estimates for the partial model are presented in Table 5. Note that, at this step in the modeling, children who were (1) older at kindergarten entry, (2) white, and (3) from families with higher levels of education and family literacy practices began school with higher reading skills. Children from families that experienced persistent low income across the early years of elementary school had lower reading scores at kindergarten entry. Compared to boys, girls made higher gains in reading initially, and the rate of their gains decreased more over time. Also, compared to other races in the sample, white children made more growth in reading over time, and there was no evidence for a deceleration in their rates of growth. We scrutinized these preliminary estimates of influence from child and family variables further within the ecological model that allowed for estimation of classroom and school influences.

To gauge the benefit of simultaneous estimation of child, family, classroom, and school characteristics, we estimated the ecological model and performed a formal contrast of the partial and ecological models. The model fit indexes for the partial and ecological models are presented in Table 3. A scaling correction was performed (Mu-

TABLE 5. Parameter Estimates for the Partial Model (n = 1,913)

	Intercept		Linear Slope		Quadratic Slope	
Child and Family Covariates	*PE*	*SE*	*PE*	*SE*	*PE*	*SE*
Age at kindergarten entry	.36***	.05	.02	.04	−.00	.00
Female	.08	.43	.76**	.27	−.06**	.03
White	1.25**	.44	.72*	.31	−.02	.03
Persistent low income	−1.59***	.47	−.04	.38	−.03	.03
Parent education	.72***	.13	.14	.09	−.00	.01
Family literacy	.34***	.07	.02	.05	−.00	.00

NOTE.—Classroom and school effects on time-specific reading performance restricted to 0. *PE* = parameter estimate; *SE* = standard error.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

then, 2004) to generate values appropriate for chi-square difference testing in light of the estimation method used for clustered analyses. The resulting difference test indicated that the partial and ecological models were significantly different ($TR_d(24) = 53.192$, $p = .0006$), in which case the ecological model was preferred. Parameter estimates for the ecological model are provided in Table 6.

Child and family characteristics. When child, family, classroom, and school variables were considered simultaneously, child and family variables more often were associated with children's initial skills at kindergarten entry than with patterns of growth over time. In the ecological model, children who were (1) older at kindergarten entry, (2) white, and (3) from families with higher levels of parent education and family literacy practices continued to have higher reading scores at kindergarten entry. Also, children from families who experienced persistent low income during early elementary school demonstrated lower reading skills at kindergarten entry.

When compared to boys, girls demonstrated elevated rates of initial growth and deceleration over time. A notable deviation from the partial model occurred. As we incorporated classroom and school characteristics in the ecological model, children who were white no longer demonstrated elevated rates of reading growth over time.

Classroom characteristics. Classroom and school literacy systems demonstrated contemporaneous and lagged effects on children's time-specific reading performance above and beyond what could be predicted by children's underlying reading trajectories and child and family variables. Contemporaneous effects indicated that the literacy system covariates at a particular grade affected performance at the end of that grade

TABLE 6. Parameter Estimates for the Ecological Model ($n = 1{,}913$)

	Intercept		Linear Slope		Quadratic Slope	
Covariates	*PE*	*SE*	*PE*	*SE*	*PE*	*SE*
Child and family covariates:						
Age at kindergarten entry	.36***	.05	.01	.03	−.02	.00
Female	.08	.43	.81**	.26	−.07**	.02
White	1.26**	.44	.40	.33	−.02	.03
Persistent low income	−1.60***	.47	.06	.38	−.04	.03
Parent education	.71***	.13	.09	.10	−.00	.01
Family literacy	.34***	.07	.01	.26	.00	.00
	Time 2 Reading		Time 3 Reading		Time 4 Reading	
Classroom covariates:						
Full day	1.64***	.41	1.04	.82	−.66	.91
Percent low readers at kindergarten	−.04*	.02	−.05	.03	−.04	.04
Comprehensive literacy at kindergarten	.14**	.05	.09	.15	−.01	.19
Percent low readers at grade 1			−.06**	.02	−.09**	.03
Comprehensive literacy at grade 1			.30***	.08	.19	.11
Percent low readers at grade 3					−.02	.02
Comprehensive literacy at grade 3					−.14	.14
School covariates:						
Suburban location	.06	.42	−.25	.82	−.60	.98
Economic segregation	.96	.50	.24	1.10	.68	1.39
Minority segregation	−1.23*	.50	−2.43*	1.01	−5.02***	1.34

NOTE.—*PE* = parameter estimate; *SE* = standard error.
*$p < .05$.
**$p < .01$.
***$p < .001$.

alone. Lagged effects showed that literacy system covariates at a particular grade affected performance at that grade and beyond.

Children who attended full-day kindergarten evidenced enhanced reading performance at the end of kindergarten only. Children attending kindergarten classrooms with higher percentages of students reading below grade level demonstrated constrained performance in reading at the end of kindergarten. Children attending kindergarten classrooms with higher levels of comprehensive literacy instruction demonstrated higher performance in reading at the end of kindergarten.

Children attending first-grade classrooms with higher percentages of students reading below grade level demonstrated lower reading performance at the end of first and third grades. Children attending first-grade classrooms with higher levels of comprehensive literacy instruction demonstrated enhanced reading performance at the end of first grade. There was no evidence that class reading abilities or comprehensive literacy instruction at third grade affected children's reading scores above and beyond child, family, and school variables and the predicted reading trajectory.

School characteristics. Neither suburban location nor economic segregation explained children's time-specific reading performance above and beyond children's predicted reading trajectories and child, family, and classroom characteristics. However, minority segregation significantly accounted for children's reading performance at the end of kindergarten, first, and third grades. The raw parameter estimates indicated that, on average, the reading performance of children attending minority segregated schools was constrained by 1.23, 2.43, and 5.02 points at the end of kindergarten, first, and third grades, respectively, relative to peers attending nonsegregated schools after accounting for child, family, and classroom variables and children's predicted reading trajectories.

Effect sizes. To understand the magnitude of influence from specific variables, and the relative saliency of variables in the model, it is valuable to provide some gauge of effect size. Partial correlations provided a standardized estimate of unique influence from specific variables, controlling for contributions from all other variables in the model. The partial correlations for only significant parameters in the full model are reported in Table 7. Considering that a partial

Table 7. Partial Correlations for Significant Parameters in the Ecological Model

	Partial Correlations		
Predictor	Intercept	Linear Slope	Quadratic
Child age	.19		
Female		.10	−.11
White	.08		
Persistent low income	−.09		
Parent education	.14		
Family literacy	.13		
	Time 2	Time 3	Time 4
Full day	.07		
Percent low readers at kindergarten	−.05		
Comprehensive literacy at kindergarten	.04		
Percent low readers at first grade		−.05	−.07
Comprehensive literacy at first grade		.07	
Minority segregation	−.05	−.06	−.13

Note.—Cells are blank where parameter estimate was not significantly different from zero.

correlation of .10 represents a modest effect, .30 a moderate effect, and .50 a large effect (Cohen, 1992), most of the unique effects for variables in the model were modest. The partial correlations also indicated that the negative effect of minority segregation on children's time-specific reading performance increased over time, such that the effect was more than twice as large at the end of third grade compared to the end of kindergarten.

Discussion

To address the multiplicity of factors that affect children's reading development, we used a literacy ecology framework in this study. From this perspective, we posited that children's reading development emerges from a literacy ecology, or system of systems. The literacy ecology includes, at a minimum, effects from the child, family, classroom, and school literacy systems. A majority of research to date has examined the influences of child and family characteristics on children's academic development, using samples with diverse socioeconomic status, and less is known about how classroom and school characteristics influence reading development for economically disadvantaged children. Data from the Early Childhood Longitudinal Study—Kindergarten Cohort provide a unique opportunity to examine children's academic development in relation to multiple levels of children's ecologies.

The results from this study highlight the importance of considering multiple domains of influence on children's initial skills at school entry and growth in skills over time. Many of our findings were not surprising, with persistent poverty as a negative influence on reading skills and literacy-rich family experiences as a positive influence, and were well aligned with existing research using the ECLS-K data (Denton & West, 2002; Lee & Burkam, 2002). Our findings related to classroom and school influences provided unique contributions to the research on early reading development and have direct policy implications.

Child and Family Literacy System Effects

In general, our findings indicated that child and family characteristics are better predictors of initial reading skills at kindergarten entry than of reading development through third grade. These findings are in line with recent research on early reading achievement (Fryer & Levitt, 2004) indicating that the influence of nonschool factors on reading development decreases over time and that school-related factors become the leading predictors of children's school-related achievement. That is, aspects of the family are especially predictive of reading skills at kindergarten entry. However, over time, characteristics of schools and classrooms may become stronger determinants of children's reading development.

Classroom Literacy System Effects

To investigate the merit of policies intended to improve reading instruction, we estimated the effects of comprehensive literacy instruction within a larger model to enhance the ecological validity of the findings. There was evidence that increases in comprehensive literacy instruction at kindergarten and first grade enhance children's reading performance in those grades relative to their expected reading development trajectories. The positive effects for comprehensive literacy instruction are small and similar in magnitude to the negative effects due to classroom composition of children reading below grade level. That is, children attending classrooms with higher percentages of students reading below grade level underperform in reading on par with the benefits provided by comprehensive literacy instruction. Consequently, findings from the current research support policies that promote comprehensive reading instruction yet indicate that equal attention should be paid to reducing the classroom

concentrations of children reading below grade level.

In a recent address to the International Reading Association, Pressley (2006) reflected on the past, present, and future of reading research. With compelling evidence from years of qualitative and quantitative research, Pressley argued that current policies for reading instruction, notably Reading First, focus on a limited set of instructional content and pay less attention to instructional methods and classroom environments that are characteristic of teachers who facilitate excellent reading and writing skills in students.

His research on effective reading teachers led Pressley to cultivate a holistic emphasis on effective classrooms. In effective early elementary classrooms one would observe frequent and explicit instruction in word recognition, comprehension strategies, and other reading skills; frequent opportunities for authentic reading and writing; frequent teaching using multiple grouping strategies; student-centered, individualized instruction; and high levels of student engagement and motivation. Moreover, effective classrooms emerge in schools that communicate a strong value for reading, writing, and academic achievement.

This holistic emphasis on effective classrooms is equally important, if not more important, for economically disadvantaged students (Taylor, Pearson, Clark, & Walpole, 2000). Consequently, it is disheartening to consider that the percentage of struggling readers in classrooms negatively influences student reading performance on par with the benefits of comprehensive literacy instruction, as measured in this study. It may be that, in classrooms with many struggling readers, teachers adjust the nature and pace of instruction such that average reading performance is constrained. If this is the case, effective reading policy for economically disadvantaged students should leverage funding not only to improve the content of instruction but to increase instructional support (e.g., specialists and teaching assistants) and resources (e.g., fiction and nonfiction trade books, leveled books, effective literacy software and computers) in classrooms. With the addition of instructional support and resources, teachers might have more opportunity to vary instructional groupings and individualize instruction, thereby maintaining a rigorous and appropriate learning pace for all students while promoting achievement for struggling readers.

Also notable, by third grade neither comprehensive literacy instruction nor concentrations of children reading below grade level in the classroom accounted for children's reading performance beyond the expected trajectory. This lack of finding may be due to imprecise measurement in survey data. For instance, instruction in third grade may be very important, but subjectivity in teacher responses to general instruction items may yield weak information on classroom practices. However, this does not explain why we obtained effects for kindergarten and first-grade covariates but not for third-grade covariates. Early instruction and early schooling contexts may create a channeled effect on reading performance, such that children's pattern of development becomes more difficult to disrupt over time through general classroom instruction. If so, this finding only strengthens the mandate for maximally effective reading instruction and classroom environments in the early grades.

School Literacy System Effects

A single school-level variable explains children's performance in reading above and beyond their expected trajectories. Children attending minority segregated schools—schools where the minority population exceeds 75% of the student enrollment—underperform even after controlling for the quality of their literacy instruction, the reading abilities of the classroom peer group, and characteristics of the students and their families.

As Fryer and Levitt (2004) pointed out,

black children are more likely than white children to attend minority segregated schools, and, for the most part, children's public school attendance is dictated by neighborhood residence. Consequently, it is difficult to separate the effects of minority segregated schools from the larger effects of minority segregated and impoverished neighborhoods. Minority segregation in schools may be a proxy for a host of variables at the school and neighborhood levels. For instance, due to the confluence of minority and economic segregation, minority segregation may be associated with characteristics of impoverished neighborhoods such as environmental toxicity, high unemployment rates, low grocery store quality, and lack of availability of early childhood programming (Evans, 2004). At the school level, minority segregation may be associated with teacher quality, teacher turnover, school leadership, curricular emphasis, and school resources. These intertwined contextual realities of segregation reflect the tangled adversity that underlies disparity. What is known from the analyses conducted is that the negative effect of minority segregation on children's reading performance doubles from the end of kindergarten to the end of third grade.

Limitations

Although our study provides needed information on reading development for economically disadvantaged children, there are several limitations of the research. For example, the current project relied on teacher reports of literacy instruction within classrooms. More precise information about the nature and effects of instruction would be gained from frequent observations of literacy instruction.

Another limitation of this research is that the analytic sample inclusion criteria may compromise the generalizability of the results. For example, approximately 15% of elementary-age children change residence each year (U.S. Department of Commerce, 2001), and close to 30% change schools (U.S. General Accounting Office, 1994). Student mobility results in lower reading performance during elementary school (Mehana & Reynolds, 2004) and changes the composition of schools and the pace of classroom instruction (Kerbow, 1996). Consequently, mobility is a challenge to longitudinal analyses of student achievement. In this study, we excluded movers to allow for more precise estimation of school effects on reading development over time.

Finally, it should be noted that the findings reported in this article provide a unique description of reading development for children from low-income families with an emphasis on ecological validity. However, this research is not a causal analysis of the determinants of reading development. Consequently, the potential for policy recommendations is limited.

Evidence for Reading-Specific Affordances

Returning to the theoretical orientation for this model, the intent of the current study was to (1) investigate influences of child and family characteristics on reading development for children in poverty and (2) establish aspects of classrooms and schools that emerged as sources of enhanced or constrained performance for these children. The classroom and school variables that emerged as salient reflect specific reading affordances within children's literacy ecologies and warrant consideration for policy to enhance the reading development of children experiencing economic disadvantage. In that light, this research suggests that the reading-specific affordances relevant for economically disadvantaged children include full-day kindergarten, comprehensive literacy instruction in the earliest grades, reduced concentrations of children reading below grade level in classrooms, and integrated rather than minority segregated schools.

Conclusion

In the end, we join others (Lee, Loeb, & Lubeck, 1998; Orfield & Lee, 2005; Rothstein,

2004; Rumberger & Palardy, 2005) in a call for continued policy attention to social institutions and practices that lead to economic, minority, and ability segregation within classrooms, schools, and neighborhoods. In order for Title I to make good on its founding promise and generate equitable academic environments and achievement across income lines, education and social policy should account for the tangled adversity children from low-income families experience. Several school districts across the nation are undertaking promising socioeconomic integration efforts to promote student achievement (Chambers, 2005). Scholarly attention to the policy and political processes underlying successful integration efforts and associated student outcomes will be important steps toward widespread socioeconomic integration in schools.

In terms of future research, more needs to be known about the unique classroom and school contexts that economically disadvantaged students experience. Constructing models of reading development that account for influences from multiple levels of the literacy ecology leads to a more precise vision of important targets for education and social policy. The important findings from this research indicate that more work should be done to understand how recommended curricula and instructional methods affect children attending schools with varying levels of minority segregation, economic segregation, and overall student achievement.

Appendix

Summary of Comprehensive Literacy Items at Three Grades

Kindergarten:
- Reading mechanics:
  - Students work on letter names
  - Conventions of print are taught
  - Letter recognition is taught
  - Matching letters to sounds is taught
  - Rhyming words and families are taught
  - Students work on phonics
- Reading comprehension:
  - Students work on new or difficult vocabulary
  - Teacher reads books to students and print is visible (big books)
  - Teacher reads books to students and print is not visible
- Writing:
  - Students practice writing the letters of the alphabet
  - Students write using inventive spelling
  - Students write stories or reports
- Reading practice:
  - Students read silently in class
  - Students choose their own books to read

First grade:
- Reading mechanics:
  - Rhyming words and families are taught
  - Students work on phonics
  - Reading multisyllabic words is taught
  - Reading fluently is taught
  - Students practice reading aloud
- Reading comprehension:
  - Students discuss new or difficult vocabulary
  - Students work on vocabulary
  - Teacher reads books to students and print is not visible
  - Identifying the main idea of a story is taught
  - Making predictions about text is taught
- Writing:
  - Conventional spelling is taught
  - Students write using inventive spelling
  - Students write stories or reports
  - Writing complete sentences is taught
  - Composing and writing stories is taught
- Reading practice:
  - Students read silently in class
  - Students choose their own books to read

Third grade:
- Reading mechanics:
  - Students discuss new or difficult vocabulary
  - Students read aloud
- Reading comprehension:
  - Students talk with each other about what they read
  - Students discuss different interpretations of what they read
  - Students explain or support their interpretation of what they read
- Writing:
  - Spelling and grammar are taught
  - Writing process is taught
  - Students write in journals or logs
  - Students produce multiple drafts of their writing
  - Students edit their work for spelling and punctuation

Reading practice:
Students read silently in class
Students choose their own books to read

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