Developmental Ecology in Early Childhood: Implications for School Readiness*

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RUNNING HEAD: Developmental Ecology in Early Childhood

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Children enter the critical transition to school with sociodemographic disparities firmly established. Domain-specific focuses (e.g., poverty and family structure) on understanding these disparities at macro and micro levels of analysis have yielded important knowledge, but broader operationalizations of children's environments are needed. Building on existing theory, this study articulates the concept of developmental ecology—interrelated proximal features of a child's environment, distinct from interactions and individuals, which shape development and health. By modeling proximal environments, developmental ecology links structural and demographic factors on one hand, with interactional, psychological, and genetic factors on the other, building our understanding of the early emergence of developmental and health disparities. Using the U.S. Early Childhood Longitudinal Study-Birth Cohort of 2001-2007 (ECLS-B), this study conducts second-order latent class analyses to identify prevalent developmental ecologies from the domains of household resources, health risks, and ecological changes. Because it shows how a wide variety of factors co-occur in actual children, this method allows an approximation of the most common lived environments of young children. Findings illuminate powerful relationships between race/ethnicity, parental age, socioeconomic background, and nativity and the developmental ecology experienced by a child, as well as associations between developmental ecology measured in preschool and children's kindergarten readiness in cognition, behavior, and health. Developmental ecology represents a major pathway through which demographic characteristics shape school readiness. Because specific factors have different implications depending on the ecologies in which they are embedded, findings support the usefulness of a broad ecological approach to understanding school readiness.

Keywords: resources, health risks, ecological change, early childhood, latent class analysis, ECLS-B

"To explain social behavior it is necessary to represent the structure of the total situation and the distribution of the forces in it." Lewin 1939:868

Introduction

The transition to school is a critical point in the life course because academic success at this time is highly correlated with achievement in middle and high school and beyond (Butler et al. 1985, Entwisle, Alexander and Olson 2004, Weller, Schnittjer and Tuten 1992). Yet we also know that children enter school with major socioeconomic, racial/ethnic, and other disparities already in place (Entwisle, Alexander and Olson 2004). The years preceding school start have now been acknowledged as an important research focus for addressing a variety of social problems (Duncan, Ludwig and Magnuson 2007), but only in recent years have nationally representative longitudinal survey data from early childhood become available in the United States. The "black box" of children's proximal environments throughout early life is being opened, with emerging literatures focusing on distinct aspects of these contexts such as family structure changes and experiences of poverty (Cavanagh and Huston 2006, Duncan et al. 1998, Fomby and Cherlin 2007, NICHD Early Child Care Research Network 2005).

Sociologists and demographers have done important work within these specific domains and theoretical constructs like capital and habitus have made conceptual strides, but a broader empirical perspective on understanding co-occurring features of proximal environments in early childhood is needed to advance sociological research in early childhood. The typical approach to informing policies is to isolate the effects of one aspect of an environment while controlling for others. But that aspect may have different implications depending on the multitude of other factors in which it is embedded, and policy solutions that ignore this possibility may have limited success. Thus, a broader approach is needed that approximates children's lived everyday environments in a holistic way. My goal in this study is to integrate these domain-specific investigations by articulating an overarching conceptualization of a child's developmental ecology—defined as interrelated features of a child's proximal social environment that are distinct from but influence children's social interactions and individual characteristics. The developmental ecology is shaped by social structural and demographic factors and shapes interactional and psychological factors, building our understanding of the emergence of developmental and health disparities in the life course. This concept builds on previous theoretical developments with an eye toward empirical measurement.

Using longitudinal survey and child assessment data from the first several years of life provided by the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B), this study conducts second-order latent class analyses to operationalize the most prevalent developmental ecologies experienced by U.S. children born in 2001 using interrelated features from three domains: household resources, health risks, and changes in social environment. Because it shows how a wide variety of factors co-occur in actual children, this method allows an approximation of the most common lived environments of young children. Findings illustrate powerful relationships between demographic factors (race/ethnicity, parental age, socioeconomic background, and nativity) and the developmental ecology experienced by a child, as well as associations between developmental ecology measured in preschool and children's kindergarten readiness in the areas of cognition, behavior, and health. Developmental ecology represents a major pathway through which demographic factors (particularly race/ethnicity, parental age, and socioeconomic background) shape child outcomes. Because specific factors have different implications depending on the ecologies in which they are embedded, findings support the usefulness of a broader ecological approach for understanding school readiness.

Theory and Background

The Concept of Developmental Ecology

This study introduces the concept of a child's *developmental ecology*, defined as interrelated features of children's everyday proximal environments that impact their development and health. The interrelatedness of developmental ecology features is an important part of the concept, making it distinct from prior research that has sought to isolate the effects of single indicators. A child's developmental ecology is shaped by more distal influences, such as the community's social organization and economic circumstances and demographic categories such as parental age, socioeconomic background, nativity, and race. Developmental ecology in turn affects children's individual characteristics and their interpersonal interactions with family members, teachers, and peers. This study acknowledges the importance of macrolevel influences on children's development and health, but like others studying similar issues (e.g., Becker 1991, Elder 1974), retains a primary focus on more proximal environments represented in a child's developmental ecology. Developmental ecology is not intended to include children's interpersonal interactions (such as parenting styles) or individual factors such as personality or biology. Instead, it measures interrelated features of mesolevel environments that shape interactions and individuals. Examples include the resources, physical features, and health risks found in children's households, child care settings, and immediate neighborhoods, as well as changes children experience in these environments over time. For example, a family's current socioeconomic resources are part of a child's developmental ecology, but the socioeconomic background of the parents is not—instead, like race, it is a demographic factor that shapes the current developmental ecology. In operationalizing developmental ecology here, I include just three interrelated domains that are important aspects of children's everyday environments: household resources, household health-related risks, and repeated ecological changes in the household and child care. These domains are included in the initial operationalization of developmental ecology because extensive literatures support their importance for school readiness. A child with a benign developmental ecology across a variety of interrelated domains is expected to score more highly on measures of cognitive and behavioral development and health than a child with a more harmful developmental ecology.

The *first* aspect of a child's developmental ecology studied here is the *material and social resources* available in the child's household. Research has increasingly focused on socioeconomic resources in early childhood because of their implications for school readiness. By kindergarten, children from the lowest socioeconomic quintile have reading, mathematics, and general knowledge scores that are a full standard deviation behind those in the highest quintile (Burkam et al. 2004). Material and social resources beyond socioeconomic status are also likely to be important for understanding children's development (e.g., Gershoff et al. 2007, Mayer 1997). Financial, material, and social resources may improve children's school readiness directly; for example, experiencing hunger compromises children's cognitive and behavioral development (Kleinman et al. 1998). Other influences of resources on child outcomes may work indirectly through different pathways and vary across individuals (Guo and Harris 2000). The dataset used here permits a multifaceted conceptualization of resources.

A *second* aspect of developmental ecology is the *health-related risk factors* in the child's household, including food insecurity, diet, sleep habits, secondhand smoke, and violence exposure, and threats to safety. These risk factors have been linked to compromised longer-term health outcomes (Bair-Merritt, Blackstone and Feudtner 2006, Cook et al. 2004, Reilly et al. 2005, Sadeh, Gruber and Raviv 2003, Silverstein et al. 2006). Research on "health lifestyles" emphasizes that health risks do not occur in a vacuum, but tend to cluster in ways that have implications for individuals' health and identities (Cockerham 2005, Laaksonen, Prättälä and Lahelma 2003). Limited previous work on health lifestyles in early childhood suggests that health risks have important consequences for children's school readiness (author citation 2014).

A *third* important facet of a child's developmental ecology is repeated *changes in children's proximal environments*. This domain echoes the literature's newer focus on dynamic and time-dependent processes shaping child development (DiPrete and Eirich 2006, Duncan et al. 1998, Wagmiller et al. 2006). Even before the adjustment that the transition to school entails, children have begun to experience changes in their environments that are consequential for their development. Parents' partnerships and households dissolve and re-form, families move to new homes and neighborhoods, children change child care arrangements, and parents enter or exit the labor force. Among young children, such changes in family and social environments are often associated with the emergence of early behavior problems that compromise children's readiness at school entry (Cavanagh and Huston 2006, Cooper et al. 2009, Joshi and Bogen 2007, NICHD Early Child Care Research Network 2002). However, changes in multiple domains of children's environments have not been evaluated *together* in the context of early childhood. To frame the analysis of changes in children's environments, I draw from the literature on union instability, which has shown that the repeated entry and exit of a parent's romantic partners from a child's household has far-reaching and deleterious consequences for many children's development, including school readiness (Cavanagh and Huston 2006, Cooper et al. 2009, Fomby and Cherlin 2007, Osborne and McLanahan 2007). In explaining why union instability matters for children, much of the literature has focused on internal family processes like mother-partner conflict, parenting behavior, maternal stress, father involvement, and unequal investments in children by nonbiological parents in blended families. While these largely interactional processes are undoubtedly important, I argue that the picture they provide is incomplete. The reported effects of repeated change in mothers' unions may be a marker for the consequences of more wide-ranging instability. I propose an ecological perspective that considers concurrent and cascading environmental changes throughout early childhood. This conceptualization can contribute to theory on the early life course by broadly defining children's environments and by considering how changes in those environments condition children's initial engagement with social institutions.

Although more specific in its focus on children's proximal environments rather than interpersonal interactions, individual characteristics, or distal influences, this study's conceptualization of developmental ecology has been informed by three important theoretical perspectives. The first is the School Transition Model, a theoretical framework for studying cognitive preparedness in the transition to school (Entwisle, Alexander and Olson 2004). This model identifies social structural circumstances that influence children's life circumstances, which in turn affect three proximal influences on children's cognitive preparedness for school: social psychological factors (interpersonal interactions) experiential factors (experiences other than family relationships), and personal factors (child attributes). Crosnoe's (2006) extension of the School Transition Model incorporates health as a key component of school readiness. The developmental ecology concept highlights some of the same influences and takes the same child outcomes as its goal.

The second theoretical influence, in which the term "developmental ecology" was first introduced in reference to children, is Bronfenbrenner's (1979) ecological model of child development. Emphasizing the importance of social environments for expanding developmental psychologists' understanding of children's outcomes, Bronfenbrenner's model has a multilevel focus on intraindividual factors, "multiperson systems of interaction" (1979:21), the proximal settings of interactions, and sociocultural influences. My study's developmental ecology concept is narrower, emphasizing what Bronfenbrenner calls "microsystems," or the environments in which children's interactions with others take place. Isolating these environments from both more proximal (interpersonal interaction and individual characteristics) and more distal (sociodemographic and macrocultural) influences increases theoretical precision, allowing estimation of their unique contributions to child development and encouraging integration with other midrange theory.

Finally, the concept of developmental ecology is similar in scope to Lewin's (1939) idea of a child's "life-space." Also intended as a way of integrating disparate social influences, a life space is defined by Lewin as subjective and bounded by a child's perceived experiences. In contrast, a developmental ecology is objectively defined based on measurement of factors in a child's social environment. But like a life space, a developmental ecology is limited to the environment that is most proximal to a child and to the interpersonal interactions she experiences.

Other related constructs such as capital and habitus (Bourdieu 1986a,b), and recent influential studies articulating how they play out in children's everyday lives (e.g., Lareau 2003), are also related to developmental ecology. But developmental ecology focuses on proximal environments rather than also including interpersonal interactions or individual dispositions, describing aspects of children's immediate settings within which interactions and dispositions play out. Ethnographic approaches to children's everyday settings, such as Lareau's (2003), have begun to empirically capture the breadth of interrelated factors in these environments and the different settings in which children's interpersonal interactions take place. The operationalization of developmental ecology in this study mirrors that holistic approach using nationally representative quantitative data.

Hypotheses

The three selected domains of developmental ecology (household resources, health risks, and ecological changes) are interrelated, with risks in one domain tied to risks in another. Developmental ecology may also be an important pathway through which major demographic dividing lines, such as race/ethnicity, socioeconomic background, nativity, and teen parenthood, shape school readiness. The relationships between these demographic factors and school readiness have been established (Crosnoe 2006, Entwisle, Alexander and Olson 2004, Mollborn and Dennis 2012). School readiness is important because it is a very strong long-term predictor of academic achievement and adult socioeconomic outcomes (Duncan et al. 1998, Duncan et al. 2007). Thus, understanding how and why disparities in school readiness emerge in early childhood is an important theoretical and policy goal. This study's hypotheses are illustrated by a conceptual model in Figure 1.

FIGURE 1 HERE

Hypothesis 1: Major demographic dividing lines (race/ethnicity, nativity, socioeconomic background, and teen parenthood) influence a child's developmental ecology (represented by household resources, health-related risks, and repeated ecological changes).

Hypothesis 2: Developmental ecology in early childhood predicts kindergarten readiness in the domains of cognition, behavior, and health.

Hypothesis 3: Developmental ecology is a primary pathway through which major demographic dividing lines shape children's kindergarten readiness.

Developmental ecology is not expected to perfectly predict kindergarten readiness or fully mediate the links between demographic characteristics and child outcomes. Even if all aspects of a child's developmental ecology were captured here, other important and complementary influences are at work in shaping school readiness. To better understand children's development and health, the ecological perspective can be integrated with theories on residential segregation, labor force participation, kinship, and other extra-household processes, as well as interactional, psychological, and genetic processes internal to the child and family. The articulation of developmental ecology can help fill the mesolevel gap between interactions and individuals on the one hand, and societal and cultural influences on the other hand, in understanding child development.

Outcomes and Empirical Approach

This study analyzes three domains of child development that have been shown to be important for children's successful transitions to school and their long-term outcomes (Entwisle, Alexander and Olson 2004, Halonen et al. 2006, Weller, Schnittjer and Tuten 1992): *cognition*, *behavior*, and *health*. Crosnoe (2006) has identified children's health as being a key component of the transition to school, affected by social structural conditions and life circumstances and influencing children's early educational outcomes. Health and education in childhood work hand in hand to influence socioeconomic attainment and health in adulthood (Haas 2007, Hayward and Gorman 2004, Palloni 2006).

Household resources, health-related risks, and changes to a child's environment are all multifaceted phenomena. Within and across these three domains, factors compromising children's kindergarten readiness are expected to shape outcomes in a highly interrelated way. To capitalize on the strengths of the data and to understand the dynamic nature of these factors, I conducted latent class analyses (LCA) (Jung and Wickrama 2008, Vermunt and Magidson 2002). Broadly speaking, latent class analysis classifies cases into subgroups, or classes, based on predominant patterns in multivariate, categorical data (Clogg, Petkova and Haritou 1995). LCA is an exploratory method because the researcher derives latent classes from the observed data, rather than imposing classes on the data *a priori*. As a data reduction technique, LCA allows the inclusion of many variables while retaining parsimony. It also distils naturally occurring interactions among variables in the latent classes, rather than requiring each indicator to have an isolated effect on the outcome. As such, LCA is an excellent exploratory technique for operationalizing complex notions of a child's developmental ecology and identifying the predominant patterns in which developmental ecology factors co-occur in a population.

Rather than a typical latent class analysis identifying prevalent patterns in a particular domain such as household resources or health risks, this study's analysis needs to model predominant patterns in three different domains as well as their co-occurrence across domains. Previous researchers have addressed similar empirical goals in related but distinct types of statistical models.

For example, Luyckx and colleagues (2008) estimated sets of latent trajectories over time for identity formation and adjustment among emerging adults. They then conducted bivariate chi-squared tests to estimate the strength of the relationship between these two sets of categories. In a more complex approach, Fanti and Henrich (2010) predicted latent trajectories over time of children's externalizing and internalizing problem behaviors, then went on to predict the probability of membership in multiple classes across these two domains in a subsequent statistical model. My approach more closely follows Fanti and Henrich's, but I conducted latent class analyses rather than trajectory models. I first estimated a set of latent classes for each developmental ecology domain (first-order latent classes), then conducted a second-order latent class analysis using the first-order latent classes as inputs. This latter analysis modeled developmental ecology across the three domains.

Method

Data

Data came from the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B), which surveyed and directly assessed a nationally representative sample of about 10,600 children born in the United States in 2001 from infancy through the fall of kindergarten (U.S. Department of Education 2007).[1] As the first nationally representative longitudinal study of early childhood ever conducted in the United States, these data are the best available for predicting multiple dimensions of school readiness and assessing a variety of items capturing different aspects of young children's developmental ecology, including repeated changes over time. The sample was drawn from all 2001 births registered in the National Center for Health Statistics vital statistics system using a clustered (96 counties and county groups), list frame design. A very small number of children with mothers below age 15 at their birth were excluded because of confidentiality reasons.

[1] To meet ECLS-B confidentiality requirements, all *N*s have been rounded to the nearest 50.

This study used data from all waves of the survey, collected at about 11, 24, and 52 months old and in the fall of the kindergarten year at an average of 66 months old. The primary parent, who was almost always the biological mother, completed interviews in person. For budgetary reasons, the kindergarten wave was conducted on a random subsample of about 85% of the children who had completed the previous wave (Snow et al. 2009). The weighted response rates for the parent interview were 74, 93, 91, and 92-93% respectively at each wave. The sample was restricted to children with valid weights at the kindergarten wave. I retained these approximately 6450 children by conducting multiple imputation in Stata (20 imputations using all analysis variables, all developmental ecology indicators, and earlier child outcomes to inform imputation models); latent class analyses in SAS automatically retained all eligible cases.[2] All analyses adjusted for complex survey design using probability weights; latent class analyses in SAS adjusted for clustering within primary sampling units, and all other analyses in Stata adjusted for clustering and stratification using *svy* and *mi* commands.

Measures

Developmental ecology. This study's approach in operationalizing each child's developmental ecology was to select as many items as possible to include in the initial latent class analyses of three domains: household resources, health risks, and ecological changes.[3] Except for ecological changes which covered all of early childhood, all indicators were measured in the preschool wave (typically the fall before kindergarten start), and all were dichotomous unless otherwise noted. *Household resources* were represented in three areas. Socioeconomic resources were measured by: household income-to-needs ratio (income as a percentage of the federal poverty line adjusted for household size, with missing values imputed by ECLS-B staff and coded as below the

[2] About 700 children received one or more imputed values for all analyses except those of teacher-reported behavior, for which an additional 1500 children received imputed values because fewer teachers completed the teacher supplement.
[3] This wave was chosen because the measures of health risks were more comprehensive than in earlier waves and resource measures were similar to those in earlier waves.

poverty line, near poverty at between 100 and 200% of the poverty line, or above), household assets (separate indicators for car ownership, home ownership, investments or retirement savings, and having a checking or savings account), food insecurity (uncertain food provision in the household), uninsured child (no private or government-supported health insurance), and maternal educational attainment (coded as less than a high school degree, high school degree, some college, and Bachelor's degree or higher). Social support was measured by indicators of: the biological father's coresidence, number of other coresident children (conceptualized as a drain on social support and coded as 0, 1, and 2 or more), any coresident grandparent, any coresident other adult, and whether a household member besides the study child had special needs (another drain on social support). Everyday activities that require or provide resources were captured by indicators of: mother not working for pay, mother not enrolled in school, mother currently married, and child care/preschool type (coded as none, Headstart, other center-based care, kin-based care, or other noncenter care).

Health risks were represented in five areas; see (author citation 2014) for more details. Diet was measured by indicators of: household food security comparing households with uncertain food provision to others; consumption at least daily of milk, soda or sugary drinks less than 100% juice, sweet snacks, and salty snacks; and consumption of 5 or more servings of fruits and vegetables a day (per nutritional guidelines). Sleep was represented by indicators of insufficient sleep (less than 10 hours per night) and late bedtime (after 10 p.m.). Secondhand smoke exposure was represented by having a family member who smoked inside the home. Safety was operationalized by: a working smoke detector in the home, always wearing a helmet during activities such as skating and biking, always sitting in a car seat or booster seat, always sitting in the back seat of a vehicle, and having an unlocked gun in the home. Violence was measured by indicators of the child having witnessed a violent act in the home (such as property destruction or physical fights) and the child having been the victim of violence in the home.

Ecological changes were represented by counts of the number of changes children had experienced throughout the ECLS-B survey. I subsequently recoded each count variable into three categories, with cutoffs as close to the first and third quartiles as possible. A first set of variables was measured by capturing a child's situation at each wave and identifying changes between waves. Thus, these variables ranged from 0-3 total changes. Such measures included changes in the mother's coresident spouse or partner (coded as 0, 1, or 2-3), the presence of a coresident grandparent (none versus any), the presence of a coresident other adult (none versus any), the number of coresident children (coded as 0, 1, or 2-3), and the type of child care (based on the five categories detailed above and coded into 0-1, 2, or 3). Maternal paid work hours and child care hours were first coded into three categories (0, 1-29, or 30 or more hours per week), then changes from one category to another were counted and recoded into 0, 1, or 2-3 transitions for mother's paid work and 0-1, 2, or 3 transitions for child care hours. Residential moves were tracked in greater detail in the survey, asking about moves since the child's birth (at wave 1) and since the previous wave (at subsequent waves). This variable ranged from 0 to 25 and was recoded into 0, 1-2, and 3 or more moves.

Sociodemographic variables. Children's ages at the kindergarten and wave 1 assessments were included as controls. Analyses also included background factors from before the child's birth, such as maternal educational experiences, social disadvantage, and exposure to physiological risks in utero, that could be related both to developmental ecology and child outcomes. The parent's own report was included when possible, with missing data filled in from other sources. Child gender and race/ethnicity (Hispanic or non-Hispanic Black, White, and other/multiracial) were constructed by ECLS-B. An indicator captured whether the child was born to a mother or father who was younger than 20. Mothers who started receiving prenatal care after the first trimester or not at all were identified, as was the child's birth weight (normal $\geq$2500 g, moderately low <2500 g and $\geq$1500 g, or very low <1500 g). Maternal alcohol (at least one drink per week) and tobacco (any) consumption during the third trimester of pregnancy were measured. Dichotomous variables indicated whether the mother was foreign-born, whether she lived with both biological parents until age 16, whether she ever repeated a grade in school, whether her family ever received welfare when she was between the ages of 5 and 16, and whether she had been born to a teen mother. Finally, wave 1 cognitive and behavior assessment scores and parent-reported child health (very good or excellent versus others) were included to control for the possibility that early development and health shaped subsequent resources, health risks, or ecological changes.

Dependent variables. Analyses focused on six outcome variables capturing the cognitive, behavioral, and health dimensions of children's kindergarten readiness. Kindergarten information was taken from the year the child first enrolled in kindergarten. The two *cognitive* outcomes (early reading and math) were the result of one-on-one child assessments adapted from reputable assessment batteries developed for other child development studies or for the ECLS-B.[4] See Snow and colleagues (2009) for more information on the kindergarten assessments. The cognitive scales, in particular, are a major improvement over assessments of young children that were available in the past (Rock and Stenner 2005). The early *reading* assessment was a 35-item test covering age-appropriate areas such as phonological awareness, letter recognition and sound knowledge, word recognition, and print conventions (ECLS-B-reported reliability=0.84). The early *math* two-stage assessment was routed after the first stage depending on the child's score and evaluated number sense, geometry, operations, counting, pattern understanding, and measurement (ECLS-B-reported reliability=0.89). I standardized the ECLS-B-constructed scale scores for both variables.

Behavior was measured by creating separate scales from parent and teacher reports (parents and teachers become familiar with different dimensions of children's behavior and have different

[4] These included the Test of Early Mathematics Ability-3, the Peabody Picture Vocabulary Test, the Preschool Comprehensive Test of Phonological and Print Processing, the PreLAS® 2000, and sister study Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K). The assessment items were often copyrighted and thus not available to ECLS-B users, so we relied on ECLS-B-constructed scores based on item response theory (IRT) modeling.

frames of reference). I reverse-coded negative behaviors so that higher scores represent more positive behavior. Children's *parent-reported* behavior was captured by a standardized index of 24 items that asked the parent how frequently the child behaved in certain ways, using a 5-point scale ranging from "never" to "very often" (Cronbach's alpha=0.86). The parent report items came from the Preschool and Kindergarten Behavior Scales—Second Edition, the Family and Child Experiences Study, and the Social Skills Rating System, and questions were developed for the ECLS-B. Sample questions asked how often the child is physically aggressive or acts impulsively and how often the child shares belongings or volunteers to help other children. The *teacher-reported* behavior measure came from the kindergarten teacher and included some of the same questions as those parents were asked. The 16 items came from the Family and Child Experiences Study, the Social Skills Rating System, the Preschool and Kindergarten Behavior Scales—Second Edition, and new questions developed for the ECLS-B (Cronbach's alpha=0.93). Sample items asked how often the child displayed positive emotion, frequency of social interaction, and cooperative behavior.

Health was measured using two dichotomous variables. The broader operationalization used the primary parent's report of the child's *general health status* (very good or excellent compared to good, fair, or poor).[5] *Asthma diagnosis* was coded as 1 if the parent reported at any wave up through kindergarten that a medical professional had diagnosed the child with asthma.[6]

Analysis Plan

Separate latent class analyses for each of the three domains produced five classes of respondents based on their household resources, five classes based on health risks, and six classes based on ecological changes. The second-order latent class analysis then used these sixteen latent class indicators to derive four overarching classes of prevalent developmental ecology. Descriptive

[5] This dichotomization was necessary because of the small proportion of children in fair or poor health.
[6] As this question was not asked in the last survey wave, the wave 4 indicator of asthma was filled in for children who did not enrol in kindergarten until wave 5.

analyses compared averages for each of these four classes on each of the sociodemographic and outcome variables. Multinomial logistic regression models predicted the likelihood of membership in the developmental ecology classes based on sociodemographic variables. Further multivariate analyses predicted children's kindergarten readiness (using OLS regressions for cognition and behavior and binary logistic regressions for health) on the basis of developmental ecology class membership and sociodemographic variables. Predicted values derived from these models illustrated differences in kindergarten readiness by developmental ecology class for an average child. Finally, graphs presented analyses of developmental ecology classes as a mediator of major demographic influences on kindergarten readiness (socioeconomic background, race/ethnicity, nativity, and having a teen parent).

Results

Developmental Ecology Latent Classes

I conducted latent class analyses using PROC LCA in the SAS statistical software package, accounting for probability weights and clustering. Latent class analysis uses categorical items and assumes underlying discrete groups, or "classes," of respondents. The underlying groups identified are a function of the items chosen for the analysis. Analyses were conducted using all eligible cases, assigning latent class probabilities to each case even if data were missing on some indicators. The best-fitting number of classes was determined using the Bayesian Information Criterion (BIC) and the Akaike Information Criterion (AIC). First, three separate sets of latent classes were created from the indicators for each domain described above (household resources, health risks, and ecological changes). For each of these domains, I selected the most parsimonious model with a good fit as indicated by little incremental improvement in BIC or AIC for higher-order solutions: five classes for household resources and for health risks, and six classes for ecological changes.[7] Each case was assigned a probability of membership in each class, and I assigned the class with the highest probability of membership to each child. See Table 1 for posterior probabilities and population shares for the three domain-specific latent class analyses.

TABLE 1 HERE

Second-order latent class analyses used the 16 latent class indicators from the three domains to create an overarching set of latent classes representing each child's developmental ecology. A four-class solution emerged as clearly the best fit according to both BIC and incremental improvements in AIC. Table 2 reports the class-conditional response probabilities for these developmental ecology classes, and Table 3 displays means on the control variables and child outcomes for each class as well as significance tests comparing means for the "privileged" class to each of the others. The one-word class labels are intended as mnemonic devices rather than full descriptors of the class characteristics.

TABLES 2 AND 3 HERE

Class 1 (privileged) comprised the largest proportion of the sample at 43% (see Table 2). Its mnemonic comes from the greater resources and reduced health risks and ecological changes generally experienced by these children. The children's families tended to have high levels of assets and educational attainment, and very few lived in or near poverty. The biological father was nearly always coresident and married to the mother, and 78% of the children attended center-based preschool. 74% of children in Class 1 belonged to the "consistently positive" health risk class, which represented the lowest levels of health risk in every domain. These children experienced the highest stability in all developmental contexts except for child care, for which their levels of stability fell in

[7] The lowest absolute BIC solution was 10 classes for resources, 8 classes for health risks, and 7 classes for ecological change, but these solutions often generated very small classes with little incremental improvement in fit from the more parsimonious good-fitting solutions I ultimately selected.

the middle. Control variables in Table 3 also indicated lower risks from background factors. With the exception of a slightly elevated risk of the mother drinking alcohol during pregnancy, these children were significantly overrepresented among the more privileged categories for every background variable. Their outcomes were significantly better than those of other classes for every kindergarten outcome, with cognitive scores about 0.4 standard deviations above the sample mean.

Class 2 (vulnerable), a stark contrast to the "privileged" class in its relatively lower resources and greater health risks and ecological changes, comprised 22% of the sample. These children were likely to live in or near poverty with single mothers whose educational attainment was low and assets were few; 37% of their households experienced food insecurity. Extended households and household members with special needs were also relatively prevalent. All four of the more problematic health risk classes, but especially nutrition/sleep problems and food insecurity/violence/smoking, were strongly overrepresented in this class, with just 14% of children not falling into a problematic health risk class. Their environments were characterized by overarching high instability, with the highest instability of any class for coresident child and other adult transitions, moves, and work and child care transitions. Beyond the developmental ecology risks implied by these descriptive statistics, Table 3 shows that this class represented children with higher levels of risk based on demographic background factors ($p<.05$). Their mothers were more likely to have smoked during pregnancy and received inadequate prenatal care, and they were more frequently born at low or very low birth weight. Children in the "vulnerable" class had the most compromised outcomes of any developmental ecology class for all indicators except parent-reported health. Their reading and math scores were half a standard deviation below the sample mean, their teacher-reported behavior scores were one third of a standard deviation below, and 27% had been diagnosed with asthma.

Class 3 (traditional) comprised 20% of the sample (see Table 2). The mnemonic for this class comes from its family structure, maternal work, and child care patterns that resemble a typical family from decades past. These children tended to live in or near poverty at preschool age, with the biological father present in the household and married to the mother. Their mothers were typically high school-educated, and about half had nonworking mothers and did not attend preschool or child care in the fall before kindergarten. These children were overrepresented in health risk classes that had neither the best nor the worst developmental implications. Their ecological change histories fell in the middle for every domain except child care, which evidenced the highest stability levels of any class. Children in the "traditional" class had significantly compromised early reading and math scores at about one quarter of a standard deviation below the sample mean, as well as slightly lower parent-reported behavior scores. Just 80% of children were reported to be in very good or excellent health, the lowest of any class.

Finally, *Class 4 (nontraditional)* comprised 15% of the sample. In terms of nuclear and extended household structure, child care, and maternal activities, these children's families differed from typical families of past decades, reflecting new family forms that are increasingly prevalent in the United States. These children tended to live with single mothers whose socioeconomic resources in terms of assets, income, education, and other measures were moderately high. The children often lived in extended households (frequently without having siblings) and attended center-based preschool, and 85% of their mothers were working or enrolled in school. Children in the "nontraditional" class fell in the middle in their distributions of health risks, except that their sleep patterns were as problematic as those in the "vulnerable" class. Their mothers were more likely to have experienced multiple partner transitions than those in other classes, and they also experienced multiple residential moves. The prevalence of other ecological changes fell in the middle compared to other classes. Children in this category often looked demographically similar to that of the "traditional" class, tending to have less risky backgrounds than those in the "vulnerable" class. Their outcomes were neither the highest nor the lowest of any latent class for any of the measures. They had the second highest reading, math, and parent-reported behavior scores and proportion in very good or excellent health (after "privileged"). In contrast, their teacher-reported behavior scores and asthma prevalence were second lowest, just behind "traditional."

Hypothesis 1: Major demographic dividing lines (race/ethnicity, nativity, socioeconomic background, and teen parenthood) influence children's developmental ecology.

Table 4 reports odds ratios from multinomial logistic regression analyses predicting the likelihood of developmental ecology class membership. Each class is compared to the modal "privileged" class. The results reinforced the descriptive statistics, which suggested that powerful processes sort children from different sociodemographic groups into different developmental ecologies. As in the descriptive results from Table 3, children's assessment age and gender were not significant predictors of class membership. Only one control variable, birth weight, was significant in bivariate analyses but not in multivariate models.

TABLE 4 HERE

Race/ethnicity was a very strong predictor of developmental ecology class. Bivariate analyses in Table 3 found the class with the highest proportion of Black children was the "vulnerable" class (35%) and of Hispanic children was the "traditional" class (42%). In contrast, multivariate analyses in Table 4 found that both groups had the highest likelihood of being in the "vulnerable" class, with odds ratios of 29 and 11 respectively compared to White children. Black and Hispanic children also had significantly higher odds of being in the "traditional" and "nontraditional" classes compared to "privileged." Children with foreign-born mothers were most likely to be in the "traditional" class and were significantly less likely than others to be in the "nontraditional" class.

Socioeconomic background was another predictor of developmental ecology. Children whose mothers received welfare benefits in childhood were twice as likely to be either in the “vulnerable” or the “traditional” class compared to “privileged.” Children whose mothers repeated a grade in school were significantly more likely to be in any class besides “privileged,” with an odds ratio over 4 for “vulnerable.” Finally, children of teen parents were fully 42 times more likely to be in the “vulnerable” than the “privileged” class, 20 times more likely to be in the “nontraditional” class, and 9 times more likely to be in the “traditional” class ($p<.05$). In sum, each of the hypothesized demographic dividing lines significantly predicted children’s developmental ecology classes, often with large odds ratios. Thus, findings supported Hypothesis 1.

Hypothesis 2: Developmental ecology in early childhood predicts kindergarten readiness in the domains of cognition, behavior, and health.

Multivariate analyses predicting children’s kindergarten readiness on the basis of their developmental ecology are summarized in Table 5. I estimated OLS regression models for the continuous outcomes (early reading and math and teacher-reported behavior—parent-reported behavior was analyzed supplementally), and binary logistic regressions predicted the likelihoods of being in very good or excellent health and of having received an asthma diagnosis. Echoing bivariate analyses, Model 1 for each outcome found that children in Classes 2, 3, and 4 all had significantly compromised outcomes in every domain compared to children in the “privileged” class. The “vulnerable” class had by far the most problematic outcomes for every measure except health status. Pairwise comparisons reported at the bottom of Table 5 showed that their outcomes were significantly more problematic from those of children in every other class for all other outcomes. Children from the “nontraditional” class had significantly higher reading and math scores and lower odds of asthma diagnosis and higher odds of very good or excellent health than those from the “traditional” class, but their teacher-reported behavior scores were significantly lower and their odds of asthma significantly higher those of the “traditional” class.

TABLE 5 HERE

Each of these relationships was somewhat reduced by the introduction of controls in Model 2, but very few lost significance. These findings supported Hypothesis 2. To illustrate the net relationships between developmental ecology classes and outcomes, Figure 2 reports predicted scores and probabilities varying the developmental ecology class for an otherwise typical hypothetical child with average values on control variables. The consistent developmental advantages experienced by children in the "privileged" class and consistent disadvantages for the "vulnerable" class are apparent, as is the variable pattern of disparities between children in the "traditional" and "nontraditional" classes. The overall consistency of the findings across multiple measures from the cognitive, behavioral, and health domains is striking.

FIGURE 2 HERE

The magnitudes of these differences in Table 5, Model 1 were particularly noteworthy when compared to major demographic predictors of school readiness—developmental ecology classes mattered much more than demographic factors for children's cognitive and behavioral outcomes and just as much for health. The leftmost sets of bars in Figure 3 display comparable coefficients and odds ratios from bivariate analyses for several major demographic dividing lines that are known for their strong relationships with school readiness: teen parenthood, socioeconomic background, race/ethnicity (here, Black and Hispanic compared to White), and maternal nativity. The leftmost bars in Figure 3 can be compared directly to the coefficients/odds ratios in Table 5, Model 1. The gap between the "privileged" and "vulnerable" developmental ecology classes was 0.85 standard deviations for kindergarten reading scores in Table 5, Model 1, compared to less than half a standard deviation for teen parenthood, socioeconomic background, and race/ethnicity and ¼ standard deviation for nativity. Although the demographic disparities were slightly higher for math scores, they were still considerably smaller than the 0.92 standard deviation developmental ecology disparity. The developmental ecology gap of 0.57 standard deviations for teacher-reported behavior was double or more the coefficient size for the demographic variables. Supplemental analyses found a developmental ecology gap of 0.37 standard deviations for parent-reported behavior, which was considerably larger than the significant disparities by socioeconomic background, race/ethnicity, and nativity. Developmental ecology indicators alone explained 14% of the variation in children's kindergarten reading scores (as evidenced by R-squared in Table 5), 16% for math, and 6% for teacher-reported behavior.

FIGURE 3 HERE

Although comparisons of effect sizes across binary logistic regressions should always be approached with caution, results suggest that developmental ecology classes were at least as important for children's health as major demographic dividing lines. Children from the "vulnerable" and "traditional" classes were one third as likely as those in the "privileged" class to be in very good or excellent health, a relationship that was similar to that between health status and Hispanic ethnicity and stronger than those between health status and teen parenthood, socioeconomic background, Black race, and nativity. The nearly threefold difference in the odds of having been diagnosed with asthma between the "vulnerable" and "privileged" classes was similar to the Black-White disparity and much stronger than other demographic relationships with asthma diagnosis. In sum, this operationalization of developmental ecology as a four-category variable was at least as powerful (and usually more so) for understanding kindergarten readiness in the cognitive, behavioral and health domains as socioeconomic background, race/ethnicity, nativity, and teen parenthood.

Because of its parsimony and predictive power, I assert that this classification of developmental ecology is preferable to more complicated operationalizations. Supplemental analyses found that the proportion of variance explained in Table 5, Model 2 using the four-category developmental ecology measure was only slightly lower than when replacing it with the 16 first-order latent class indicators from the three domains or the 41 individual developmental ecology factors.

Multicollinearity was greatly reduced by using the 4-category operationalization. But perhaps the most important advantage of the latent class approach is that a specific factor can vary in its implications for development and health depending on the cluster of developmental ecology factors in which it is embedded. Without introducing very complicated interaction models, this nuance would not be possible when including the 41 factors individually in a multivariate model.

Hypothesis 3: Developmental ecology is a primary pathway through which major demographic dividing lines shape kindergarten readiness.

The final sets of analyses moved beyond comparing the influences of developmental ecology classes with those from major demographic variables, to investigating whether developmental ecology is a major pathway through which factors such as socioeconomic background, race/ethnicity, nativity, and teen parenthood shape kindergarten readiness. The measurement of two of the developmental ecology domains at a single time point in early childhood made these analyses conservative—the explanatory power of developmental ecology when viewed across the prekindergarten years is likely to be higher. Even so, findings strongly supported Hypothesis 3. Figure 3 presents results from separate multivariate models for each demographic measure that first included only the demographic factor in question; then added the controls used in Table 5, Model 2; then introduced the four developmental ecology classes. Only statistically significant coefficients were included in the figure. These findings, in combination with results presenting the relationships between each demographic factor and developmental ecology indicators from Table 4, conducted the required tests for mediation laid out in Baron and Kenny (1986).

Significant demographic effects to be mediated were represented by the middle set of bars in Figure 3, which show coefficients/odds ratios from variables that included the relevant demographic measure and all controls. The rightmost set of bars shows significant coefficients/odds ratios after including developmental ecology classes as mediators of the relevant demographic measure. If there is no middle bar, then there was no significant relationship between the demographic factor and the outcome after including controls. If there is a middle bar but no rightmost bar for a variable, it means that developmental ecology fully mediated that demographic factor. If the rightmost bar is smaller than the middle bar, the demographic factor was partially mediated by developmental ecology classes.

Figure 3 shows that for every demographic factor and every child outcome, net demographic relationships represented by the middle bars were partially or fully mediated by developmental ecology classes in the rightmost set of bars. For teen parenthood, the significant net relationships with early reading and teacher-reported behavior scores were fully mediated by developmental ecology, and most of the effect on math scores was mediated. For mother's welfare background, the significant associations with children's reading and math scores and asthma odds were fully mediated by developmental ecology, as was the relationship between the mother repeating a grade and teacher-reported behavior scores. The relationships between mother's grade repetition and reading, math, and parent-reported behavior scores and odds of very good health were partially mediated by developmental ecology. Developmental ecology indicators fully mediated the Black-White gap in reading and teacher-reported behavior scores and partially mediated the relationship with math scores, general health, and asthma diagnosis, as well as uncovering a previously suppressed positive relationship between Black race and parent-reported behavior. The only fully mediated Hispanic-White association was for teacher-reported behavior, but relationships with reading and math scores and health status were partially mediated by developmental ecology. In contrast, developmental ecology indicators did little to mediate disparities between children of foreign-born mothers and others in parent-reported behavior and health status. The disparities in parent-reported behavior and health status and the significant advantage in asthma diagnosis experienced by children of foreign-born mothers were partially mediated by developmental ecology.

It is interesting that some disparities in child outcomes on the basis of these demographic factors remained after controlling for developmental ecology classes. These differences may stem from unmeasured aspects of developmental ecology, more distal aspects of children's social contexts such as neighborhood features, possible cultural bias in the assessments of children's health and development, interpersonal interaction processes, or unmeasured social psychological factors such as discrimination and stigma.

Discussion

In this study, I build on previous theories to articulate the concept of "developmental ecology." This concept encompasses interrelated features of children's proximal social environments. Developmental ecology shapes interpersonal interactions and individual characteristics such as personality, but these factors are not part of developmental ecology. Integrating recent domain-specific work in areas such as poverty, health lifestyles, and partner instability, the idea of developmental ecology is intended to connect sociologists' and demographers' typical focus on distal influences and demographic characteristics on one hand, with psychologists' and behavioral geneticists' emphasis on social interactions and intraindividual processes on the other hand. Three interrelated domains of developmental ecology—household resources, health risks, and ecological changes—were the focus of this study. Using the nationally representative Early Childhood Longitudinal Study-Birth Cohort, I identified prevalent developmental ecology types among preschool-aged children using latent class analyses and linked them to kindergarten readiness in the areas of cognition, behavior, and health.

Four predominant developmental ecology categories emerged from second-order latent class analyses based on five latent classes constructed from household resource measures, five from health risks, and six from changes to children's environments. These four classes (called "privileged," "vulnerable," "traditional," and "nontraditional") were starkly differentiated in all three domains. As expected, the major demographic dividing lines of socioeconomic background, race/ethnicity, maternal nativity, and teen parenthood were strongly related to children's membership in a particular class. Developmental ecology classes predicted each of the six kindergarten outcomes, with children in the "vulnerable" class having nearly one third as high odds of very good or excellent health and three times the asthma risk of children in the "privileged" class. Disparities between these groups were close to a full standard deviation for early math and reading and more than half a standard deviation for behavior. The strength of these relationships was as great as, and often substantially greater than, the associations between the major demographic dividing lines and kindergarten readiness. "Traditional" and "nontraditional" classes fell in the middle, with the former group experiencing more compromised outcomes for cognition and health status and the latter for behavior and asthma. Developmental ecology classes were a primary mediating pathway through which race/ethnicity, socioeconomic background, and teen parenthood influenced children's cognitive and behavioral development and health.

Although it is important to consider finer-grained facets of child development in future research, the consistency of the relationships between developmental ecology classes and cognitive, behavioral, and health outcomes was noteworthy. These findings suggest that disparate developmental domains are sometimes shaped by the same overarching processes, supporting the promise of broad theoretical approaches to understanding child development. Yet the sometimes different implications of developmental ecology classes even within domains, such as for health versus asthma, simultaneously supports the value of more specific arguments.

Research informing policy, even the gold standard of randomized trials, tends to isolate a "policy lever," or a single factor in a child's environment, and study its average effect on outcomes. This study suggests such approaches may well provide imperfect and inefficient policy solutions. Analyzing separate variables, or even statistically interacting two or three variables, does not capture the interrelatedness of factors that is part of the power of the developmental ecology construct. When many facets of developmental ecology are examined together in predominant empirical clusters of cases, it becomes clear that specific policy levers can have very different implications depending on the other factors with which they co-occur. For example, family scholars have emphasized the importance of family structures and family structure changes for understanding children's development (Fomby and Cherlin 2007, Osborne and McLanahan 2007). Single motherhood is a common target for broad policies such as marriage promotion. Nesting union status within a broader developmental ecology complicates the standard story about the negative consequences of single motherhood—this factor has strikingly different implications depending on the developmental ecology in which it is embedded. I found that children from the same family structures (e.g., living with a single mother, or with two parents) were categorized into different subgroups depending on the resources, health risks, and contextual changes they experienced. Depending on these other facets of developmental ecology, the same family structure could predict very different child outcomes. Both the "nontraditional" and "vulnerable" classes were overwhelmingly comprised of single-mother families, yet the former group's development was usually close to the national average. Thus, narrow policies aimed at reducing single motherhood miss the diversity of environments experienced by these children and may not be effective.

In another example of the importance of situating individual environmental factors within their developmental ecology context, repeated ecological changes were not always detrimental to children as the literature would expect, and they sometimes even predicted favorable development depending on the developmental ecology in which they were embedded. For example, children in the high-performing "privileged" class tended to experience multiple child care transitions, and the often more developmentally beneficial "nontraditional" class had higher levels of partner and coresident grandparent transitions than either the "vulnerable" or "traditional" classes.

This evidence supports the usefulness of the developmental ecology idea and other broad conceptualizations of children's proximal environments, as a complement to the variable-focused analytical approaches so prevalent in the quantitative literature. As the examples above show, the implications for kindergarten readiness of one facet of developmental ecology cannot be fully understood without using a dynamic and multifaceted conceptualization and linking it to other facets. Although there is clear value in isolating the effects of specific factors in a child's social environment, it is also important to recognize the predominant multifaceted developmental ecology patterns that exist among contemporary preschoolers and examine the implications of those patterns for different domains of school readiness.

Developmental ecology is a major pathway through which demographic factors like race/ethnicity and socioeconomic background shape children's development and health at kindergarten start, but as Figure 1 suggests, proximal unobserved mechanisms also link developmental ecology to child outcomes. These mechanisms, represented by the gray box, need to be fleshed out. For example, Guo and Harris (2000) found that cognitive stimulation and parenting style mediated the relationship between poverty and children's intellectual development. These factors may be shaped by developmental ecology as well. Alternatively, developmental ecology may shape children's health, behavior, and cognition in the first years of life, which could then translate into later kindergarten readiness through cumulative disadvantage processes (Bast and Reitsma 1998, DiPrete and Eirich 2006). Aspects of a child's personality or social interactions, perhaps interacted with genetic propensities, could also mediate the relationship between developmental ecology and school readiness. Future research should rely on increased cooperation among demographers, sociologists, behavioral geneticists, and psychologists to document the mechanisms through which distal processes influence more proximal ones and subsequently shape child development and health, thus addressing the social problems they impact.

Beyond the theoretical implications of this study's articulation of developmental ecology and the subsequent empirical support for its value, there may be interesting implications for social policy. First, the findings emphasize that working to address developmental and health disparities in early childhood, when they are just beginning to take root, is a smart and cost-efficient policy strategy compared to efforts later in the life course. Research suggests that every dollar invested in early childhood education returns $8-14 later on (Duncan, Ludwig and Magnuson 2007) because early childhood influences the rest of the life course. Increasing governmental investments in early childhood education are taking this approach. Second, some factors that shape kindergarten readiness are more policy amenable than others. Changing a child's socioeconomic background or race is not possible, but intervening in a major pathway that relates these demographic characteristics to school readiness—a child's developmental ecology—is more feasible. At least in some cases, key resources can be supplemented, health risks can be mitigated, and policies can support stability in children's social environments. Evidence suggests that social programs can improve children's health and school readiness (e.g., Barham 2012, Gertler 1994). Randomized interventions should build on this study's findings to target interrelated clusters of developmental ecology factors that put children at risk.

This study has laid out an initial conceptualization of developmental ecology and documented its empirical strength, but further development and operationalization of the idea is needed. There are likely to be other useful developmental ecology domains beyond the three analyzed here that largely focused on households (household resources, health risks, and ecological changes). Other aspects of developmental ecology that were not captured in the ECLS-B data but that are promising for future research include resources outside the home but in children's proximal settings such as child care providers and neighborhoods, the physical features and health risks found in children's child care and neighborhood settings, children's structural opportunities to interact with different people, and repeated changes in all these factors. New developmental ecology domains are added with the start of formal schooling, and their interface with preexisting aspects would be useful to study. Other time-related dynamics of children's proximal environments should be studied besides the first step of measuring repeated change that this study accomplished. For example, aspects of children's developmental ecology may have different implications for school readiness depending on their developmental timing in the child's early life course. Alternatively, as researchers have found for poverty (Duncan, Brooks-Gunn and Klebanov 1994, NICHD Early Child Care Research Network 2005), the duration of exposure to aspects of developmental ecology may have important implications beyond their presence at any given time point. Studying developmental ecology longitudinally would advance our knowledge. Newer data and methods may facilitate these kinds of investigations in the future, making early childhood an exciting area for both theoretical development and empirical analysis.

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Table 1. Class-Conditional Response Probabilities from First-Order Latent Class Analyses (LCA) of Household Resources, Health Risks, and Ecological Changes

Wave 3 (Preschool) Variable	**1**	**2**	**3**	**4**	**5**	**6**
Resource classes	*Low Single*	*Highest*	*Mid 2-Parent*	*Low 2-Parent*	*Mid Single*	
Population share	17%	33%	22%	14%	13%	
Household income: In poverty	0.75	0.00	0.10	0.64	0.11	
Near poverty	0.24	0.02	0.50	0.35	0.34	
Not near poverty	0.01	0.98	0.40	0.01	0.54	
Own a car°	0.63	1.00	0.99	0.90	0.97	
Have investments°	0.02	0.87	0.29	0.02	0.37	
Have bank account°	0.31	1.00	0.84	0.35	0.91	
Own home°	0.09	0.95	0.65	0.33	0.39	
Food insecure°	0.35	0.00	0.08	0.26	0.07	
Child uninsured°	0.04	0.02	0.07	0.08	0.06	
Mother's education: < high school	0.35	0.00	0.10	0.51	0.05	
High school degree	0.42	0.09	0.34	0.36	0.33	
Some college	0.22	0.29	0.45	0.12	0.45	
College degree	0.01	0.62	0.11	0.02	0.16	
Father coresident°	0.13	0.98	0.96	0.93	0.19	
Coresident children: 0	0.19	0.14	0.11	0.10	0.48	
1	0.34	0.53	0.45	0.30	0.34	
≥2	0.47	0.33	0.44	0.60	0.18	
Coresident grandparent°	0.44	0.04	0.19	0.19	0.51	
Coresident other adult°	0.18	0.01	0.05	0.12	0.17	
HH member special needs°	0.18	0.08	0.13	0.13	0.09	
Mother not working°	0.30	0.32	0.38	0.62	0.11	
Mother not in school°	0.84	0.93	0.83	0.93	0.77	
Mother married°	0.09	0.99	0.95	0.74	0.17	
Child care: None	0.20	0.10	0.28	0.43	0.08	
Headstart	0.34	0.01	0.14	0.29	0.18	
Other center-based	0.30	0.83	0.42	0.18	0.58	
Kin-based	0.13	0.02	0.11	0.08	0.10	
Babysitter	0.04	0.04	0.04	0.02	0.06	
Health risk classes	*Consistently positive*	*Safety problems*	*Nutrition/ sleep problems*	*Food insecure/ violence/ smoke*	*Middle of road*	
Population share	40%	4%	23%	3%	30%	
Food insecure°	0.04	0.25	0.35	0.51	0.33	
Milk once/day°	0.89	0.84	0.85	0.90	0.80	
Sugary drink once/day°	0.11	0.31	0.65	0.48	0.27	
Fruit/vegetables five/day°	0.94	0.92	0.95	0.92	0.86	
Fast food once/day°	0.03	0.07	0.27	0.09	0.02	
Sweet snack once/day°	0.44	0.37	0.86	0.53	0.20	
Salty snack once/day°	0.20	0.28	0.79	0.34	0.06	
Smoking in house°	0.01	0.23	0.22	0.36	0.18	
Smoke detector in house°	0.98	0.33	0.83	0.87	0.88	
Wears helmet when needed°	0.60	0.36	0.39	0.47	0.39	
Car seat used at all times°	0.97	0.03	0.74	0.74	0.82	
In back seat of car at all times°	0.99	0.03	0.90	0.92	0.96	
Inadequate sleep°	0.29	0.42	0.49	0.33	0.48	
Bedtime after 10 p.m. °	0.00	0.05	0.07	0.01	0.07	
Unlocked gun in home°	0.07	0.09	0.06	0.04	0.07	
Witness of violent act°	0.02	0.12	0.04	0.99	0.04	
Victim of violent act°	0.00	0.02	0.00	0.49	0.01	

Table 1, continued.

Ecological change classes	*Stable, mid work/care*	*Unstable union/house*	*Consistently stable*	*Unstable lateral HH*	*Consistently unstable*	*Unstable work/care*
Population share	24%	14%	25%	10%	14%	14%
Mother's partner transitions: 0	0.94	0.30	0.96	0.69	0.48	0.75
1	0.06	0.47	0.04	0.23	0.31	0.18
2-3	0.00	0.24	0.00	0.08	0.20	0.07
1-3 grandparent transitions°	0.03	0.21	0.03	0.10	0.30	0.07
1-3 other adult transitions°	0.07	0.05	0.00	0.57	0.85	0.03
Coresident child transitions: 0	0.47	0.62	0.67	0.08	0.04	0.50
1	0.44	0.37	0.31	0.53	0.36	0.43
2-3	0.09	0.00	0.02	0.39	0.60	0.07
Residential moves: 0	0.46	0.07	0.53	0.19	0.10	0.31
1-2	0.15	0.45	0.04	0.32	0.51	0.22
≥3	0.10	0.43	0.50	0.13	0.17	0.52
Mother's work transitions: 0	0.48	0.24	0.54	0.48	0.24	0.21
1	0.30	0.37	0.29	0.32	0.30	0.47
2-3	0.01	0.06	0.04	0.00	0.29	0.75
Child care hours transitions: 0-1	0.00	0.46	0.78	0.92	0.17	0.04
2	0.98	0.48	0.19	0.08	0.54	0.21
3	0.02	0.06	0.04	0.00	0.29	0.75
Child care type transitions: 0-1	0.00	0.35	0.55	0.74	0.09	0.00
2	0.93	0.48	0.33	0.20	0.52	0.20
3	0.07	0.17	0.12	0.06	0.38	0.80

Source: Early Childhood Longitudinal Study-Birth Cohort, 2001-2007. ° 1 = yes.

Table 2. Class-Conditional Response Probabilities of Four-Class Model from Second-Order Latent Class Analysis (LCA) of Developmental Ecology, and Weighted Means for Latent Class Indicators

First-Order Latent Class or Indicator	1 Privileged	2 Vulnerable	3 Traditional	4 Nontraditional
Population Share	43%	22%	20%	15%
Resource Classes				
1 (Low single)	0.00	0.69	0.00	0.07
2 (Highest)	0.84	0.00	0.00	0.05
3 (Mid two parent)	0.16	0.01	0.49	0.28
4 (Low two parent)	0.00	0.22	0.46	0.00
5 (Mid single)	0.00	0.08	0.05	0.59
Health Risk Classes				
1 (Consistently positive)	0.74	0.14	0.28	0.45
2 (Safety problems)	0.03	0.05	0.05	0.06
3 (Nutrition/sleep problems)	0.10	0.38	0.32	0.16
4 (Food insecure/violence/smoking)	0.01	0.07	0.02	0.02
5 (Middle of the road)	0.12	0.35	0.33	0.31
Ecological Change Classes				
1 (Stable, mid work/care)	0.41	0.15	0.40	0.03
2 (Unstable partner/housing)	0.04	0.20	0.03	0.32
3 (Consistently stable)	0.36	0.11	0.24	0.13
4 (Unstable lateral household)	0.03	0.11	0.15	0.09
5 (Consistently unstable)	0.02	0.29	0.10	0.24
6 (Unstable work/care)	0.14	0.14	0.09	0.18
Wave 3 Resources				
Household income (poor=1, near poor=2, neither=3)	2.90	1.25	1.84	2.43
Own a car°	0.99	0.62	0.96	0.99
Have investments°	0.78	0.02	0.15	0.36
Have bank account°	0.97	0.29	0.59	0.92
Own home°	0.91	0.12	0.54	0.37
Food insecure°	0.00	0.37	0.19	0.08
Child uninsured°	0.03	0.04	0.10	0.08
Mother's education (< high school=1, high school=2, some college=3, college degree=4)	3.40	1.88	2.11	2.75
Father coresident°	0.99	0.25	0.95	0.33
Coresident children (0=1, 1=2, ≥2=3)	2.21	2.31	2.47	1.88
Coresident grandparent°	0.05	0.38	0.17	0.45
Coresident other adult°	0.01	0.17	0.08	0.15
HH member special needs°	0.07	0.15	0.12	0.07
Mother not working°	0.34	0.28	0.50	0.15
Mother not in school°	0.92	0.84	0.89	0.77
Mother married°	0.99	0.17	0.84	0.37
Preschool child care: None	0.11	0.26	0.48	0.11
Headstart	0.02	0.22	0.07	0.16
Other center-based	0.78	0.13	0.34	0.58
Kin-based	0.05	0.15	0.08	0.09
Babysitter	0.04	0.04	0.03	0.06
Wave 3 Health Risks				
Food insecure°	0.00	0.37	0.19	0.08
Milk once/day°	0.85	0.86	0.85	0.84
Soda once/day°	0.16	0.49	0.43	0.33
Fruit/vegetables five/day°	0.93	0.94	0.91	0.91
Fast food once/day°	0.04	0.17	0.10	0.06
Sweet snack once/day°	0.50	0.48	0.43	0.40
Salty snack once/day°	0.25	0.41	0.36	0.25

Smoking in house°	0.07	0.58	0.42	0.40
Smoke detector in house°	0.94	0.79	0.84	0.87
Wears helmet when needed°	0.56	0.43	0.38	0.45
Car seat used at all times°	0.91	0.70	0.82	0.81
In back seat of car at all times°	0.96	0.88	0.88	0.87
Inadequate sleep°	0.32	0.51	0.45	0.51
Bedtime after 10 p.m. °	0.01	0.07	0.06	0.06
Unlocked gun in home °				
Witness of violent act°	0.02	0.13	0.05	0.09
Victim of violent act°	0.00	0.04	0.01	0.02
Ecological Changes				
Mother's partner transitions (0=1, 1=2, 2-3=3)	1.07	1.73	1.17	1.87
1-3 grandparent transitions°	0.02	0.18	0.06	0.21
1-3 other adult transitions°	0.03	0.39	0.21	0.32
Coresident child transitions (0=1, 1=2, 2-3=3)	1.57	1.93	1.75	1.71
Residential moves (0=1, 1-2=2, ≥3=3)	1.61	2.35	1.88	2.26
Mother's work transitions (0=1, 1=2, 2-3=3)	1.74	2.19	1.79	2.15
Child care hours transitions (0-1=1, 2=2, 3=3)	1.76	1.82	1.62	1.77
Child care type transitions (0-1=1, 2=2, 3=3)	1.96	2.01	1.69	1.87

Source: Early Childhood Longitudinal Study-Birth Cohort, 2001-2007. N≈6450 for weighted means on indicators.
° 1 = yes. Shaded cells indicate highest values across the four latent classes.

Table 3. Weighted Means for Analysis Variables, Overall and by Developmental Ecology Class

	All	Class 1: Privileged	Class 2: Vulnerable	Class 3: Traditional	Class 4: Nontraditional
Developmental ecology class					
1 (privileged)	0.43				
2 (vulnerable)	0.22				
3 (traditional)	0.20				
4 (nontraditional)	0.15				
Child age at assessment (months)	68.13	68.32	68.09	67.83 *	68.06
Child is male°	0.51	0.50	0.51	0.51	0.51
Child race/ethnicity (White)	0.54	0.78	0.25 *	0.42 *	0.41 *
Black	0.14	0.04	0.35 *	0.09 *	0.21 *
Hispanic	0.25	0.11	0.34 *	0.42 *	0.30 *
Other/multiracial	0.07	0.07	0.06 *	0.07	0.08
Born to a teen parent°	0.12	0.01	0.32 *	0.09 *	0.19 *
Mother had late or no prenatal care°	0.08	0.03	0.17 *	0.09 *	0.11 *
Birth weight (≥2500g)					
Moderately low (1500-2499g)	0.06	0.05	0.09 *	0.06 *	0.07 *
Very low (<1500g)	0.01	0.01	0.02 *	0.01	0.02 *
Mother drank during pregnancy°	0.01	0.02	0.01	0.00 *	0.01
Mother smoked during pregnancy°	0.10	0.04	0.18 *	0.14 *	0.13 *
Mother was foreign-born°	0.20	0.13	0.20 *	0.37 *	0.16 *
Mother grew up with 2 parents°	0.60	0.72	0.43 *	0.58 *	0.49 *
Mother born to teen mother°	0.15	0.08	0.24 *	0.20 *	0.17 *
Mother repeated a grade in school°	0.15	0.06	0.31 *	0.20 *	0.14 *
Mother received welfare as child°	0.11	0.05	0.23 *	0.11 *	0.12 *
Wave 1 age at assessment (months)	10.46	10.35	10.42	10.49 *	10.78 *
Wave 1 cognitive score	0.20	0.20	0.11 *	0.17	0.31 *
Wave 1 positive behavior score	0.10	0.13	0.05 *	0.04 *	0.18
Wave 1 very good/excellent health°	0.89	0.93	0.85 *	0.84 *	0.89 *
Kindergarten outcomes					
Early reading score	-0.01	0.35	-0.50 *	-0.26 *	-0.05 *
Early math score	0.03	0.43	-0.50 *	-0.25 *	-0.02 *
Positive behavior score (parent)	0.09	0.25	-0.14 *	-0.04 *	0.11 *
Positive behavior score (teacher)	0.05	0.26	-0.30 *	0.07 *	-0.11 *
Very good/excellent health°	0.87	0.93	0.82 *	0.80 *	0.87 *
Asthma diagnosis°	0.17	0.12	0.27 *	0.16 *	0.21 *

Source: Early Childhood Longitudinal Study-Birth Cohort, 2001-2007. N≈6450.
Notes: Analyses account for sample design effects. Reference categories are in parentheses. ° 1 = yes.
* p<.05; two-tailed tests comparing children in each latent class with "privileged."

Table 4. Odds Ratios from Multinomial Logistic Regression Models Predicting Developmental Ecology Latent Class Membership, Compared to Class 1 ("Privileged")

Variable	Class 2: Vulnerable		Class 3: Traditional		Class 4: Nontraditional	
Child age at assessment (months)	1.01		0.99		1.00	
Child is male°	1.04		1.02		1.02	
Child race/ethnicity (White)						
Black	28.58	***	3.50	***	9.17	***
Hispanic	11.29	***	4.94	***	6.58	***
Other/multiracial	3.82	***	1.49	*	2.78	***
Born to a teen parent°	41.50	***	9.19	***	19.57	***
Mother had late or no prenatal care°	4.63	***	2.54	**	3.20	***
Birth weight (≥2500g)						
Moderately low (1500-2499g)	1.24		1.00		1.19	
Very low (<1500g)	1.10		0.86		1.13	
Mother drank during pregnancy°	0.43		0.16	**	0.74	
Mother smoked during pregnancy°	11.72	***	6.16	***	5.17	***
Mother was foreign-born°	1.21		2.19	***	0.64	**
Mother grew up with 2 parents°	0.72	*	0.76	*	0.63	***
Mother born to teen mother°	2.36	***	2.17	***	1.68	**
Mother repeated a grade in school°	4.14	***	2.57	***	1.69	**
Mother received welfare as child°	2.44	***	1.68	*	1.17	
Constant	0.02	***	0.35		0.18	
Model F test	102.28	***				

Source: Early Childhood Longitudinal Study-Birth Cohort, 2001-2007. N≈6450.
Notes: Analyses account for sample design effects. Reference categories are in parentheses. ° 1 = yes.
* p<.05 ** p<.01 *** p<.001

Table 5. Unstandardized Coefficients from OLS Regressions (Reading, Math, Behavior) and Odds Ratios from Binary Logistic Regressions (Health, Asthma) Predicting Kindergarten Outcomes

Variable	Early reading 1	Early reading 2	Early math 1	Early math 2	Behavior (teacher) 1	Behavior (teacher) 2	Very good health 1	Very good health 2	Asthma diagnosis 1	Asthma diagnosis 2
Developmental ecology class (1: privileged)										
2 (vulnerable)	-0.85 ***	-0.65 ***	-0.92 ***	-0.60 ***	-0.57 ***	-0.46 ***	0.35 ***	0.59 **	2.85 ***	1.82 ***
3 (traditional)	-0.61 ***	-0.44 ***	-0.67 ***	-0.44 ***	-0.20 ***	-0.31 **	0.31 ***	0.49 ***	1.45 **	1.25
4 (nontraditional)	-0.40 ***	-0.28 ***	-0.44 ***	-0.24 ***	-0.38 ***	-0.15 ***	0.52 ***	0.71	2.06 ***	1.58 **
Child age at assessment (mos)		0.06 ***		0.07 ***		0.02 ***		0.99		1.00
Child is male°		-0.13 ***		-0.03		-0.47 ***		1.13		1.43 **
Child race/ethnicity (White)										
Black		0.02		-0.21 ***		0.00		0.68 *		1.96 ***
Hispanic		-0.18 **		-0.31 ***		0.01		0.63 **		1.13
Other/multiracial		0.14 *		0.00		-0.04		0.91		1.30
Born to a teen parent°		-0.10		-0.10 *		-0.03		0.86		1.07
Late/no prenatal care°		-0.14 *		-0.16 **		-0.04		1.03		1.07
Birth weight (≥2500g)										
Moderately low (1500-2499g)		-0.02		-0.10 *		-0.01		0.76		1.39 *
Very low (<1500g)		-0.15 *		-0.32 ***		-0.13		0.77		2.47 ***
Drank during pregnancy°		-0.10		-0.03		-0.19		3.95 *		0.56
Smoked during pregnancy°		-0.07		-0.04		-0.15		1.18		0.98
Mother was foreign-born°		-0.02		0.01		0.09		0.59 **		0.70 *
Mother grew up with 2 parents°		0.02		0.05		0.12 *		0.96		0.89
Mother born to teen mom°		-0.02		-0.02		0.01		0.94		1.20
Mother repeated grade°		-0.15 **		-0.20 ***		-0.07		0.70 *		1.01
Mother received welfare°		-0.07		-0.08		-0.02		0.89		1.32
Child age at Wave 1 assessment		-0.05 **		-0.07 ***		-0.07 ***		0.91		1.01
Wave 1 cognitive score		0.13 ***		0.18 ***		0.18 ***		1.23 *		1.02
Wave 1 behavior score		-0.02		-0.01		0.02		0.91		1.00
Wave 1 very good health°		0.17 **		0.17 ***		0.05		2.46 ***		0.46 ***
Constant	0.35 ***	-3.55 ***	0.43 ***	-3.45 ***	0.27 ***	-0.17	12.8 ***	29.7 **	0.13 ***	0.25
Model F test	151 ***	58 ***	221 ***	82 ***	50 ***	22 ***	21 ***	10 ***	31 ***	17 ***
R-squared	0.14	0.26	0.16	0.32	0.06	0.15				
Pairwise comparisons of classes										
Vulnerable-Traditional	*	*	*	*	*	*			*	*
Vulnerable-Nontraditional	*	*	*	*	*	*	*		*	
Traditional-Nontraditional	*	*	*	*	*	*	*	*	*	

Source: Early Childhood Longitudinal Study-Birth Cohort, 2001-2007. N≈6450.
Notes: Analyses account for sample design effects. Reference categories are in parentheses. Significance in last 3 rows shows classes are different. ° 1 = yes. * p<.05 ** p<.01 *** p<.001

Figure 1. Conceptual Model of Developmental Ecology and Early Childhood Development

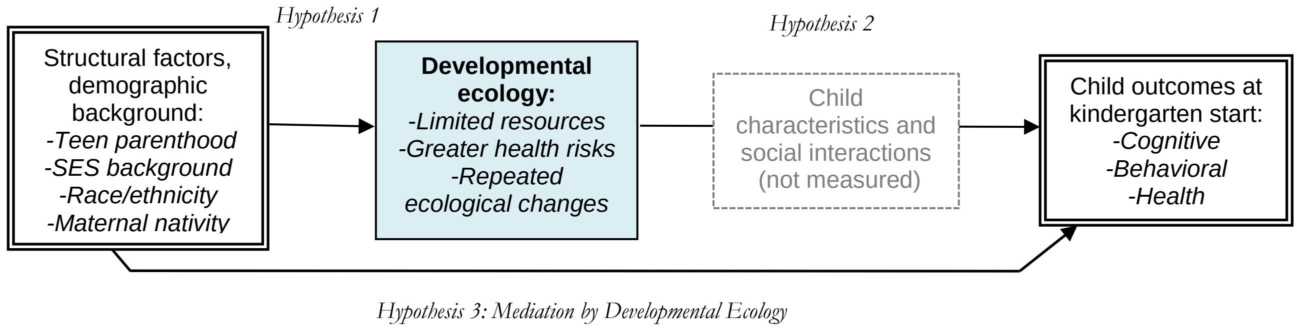


Figure 2a. Predicted Cognitive and Behavior Scores by Developmental Ecology Latent Class

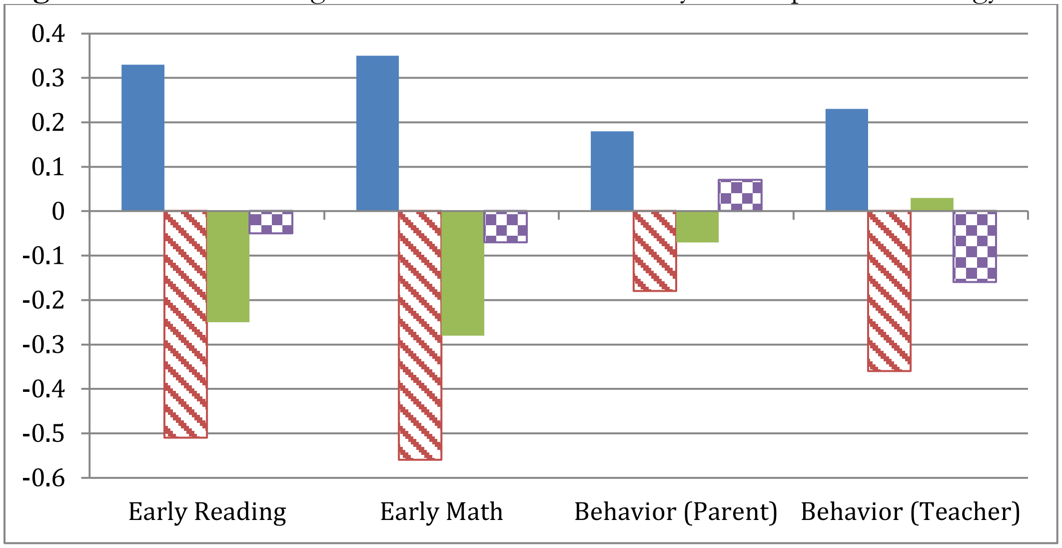
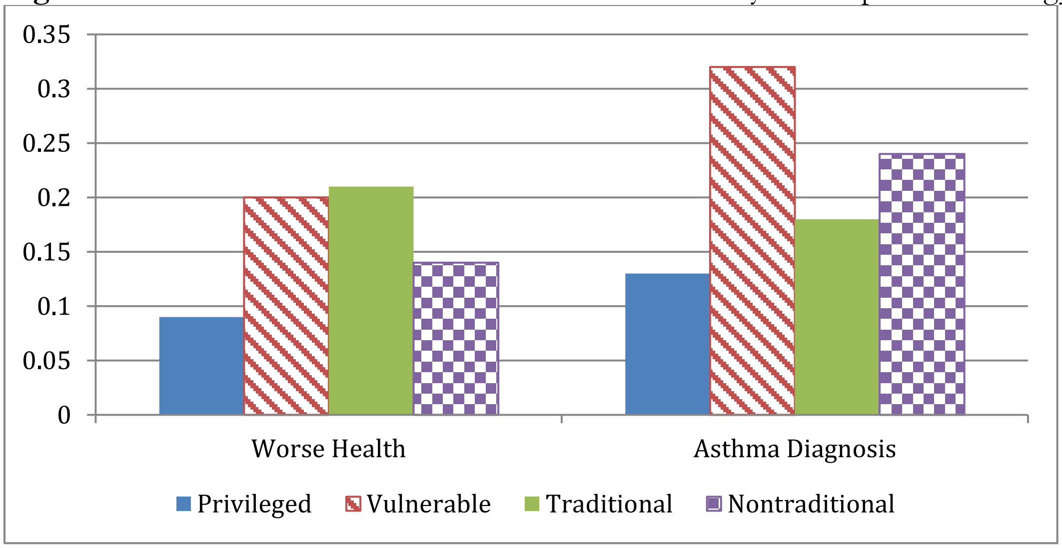
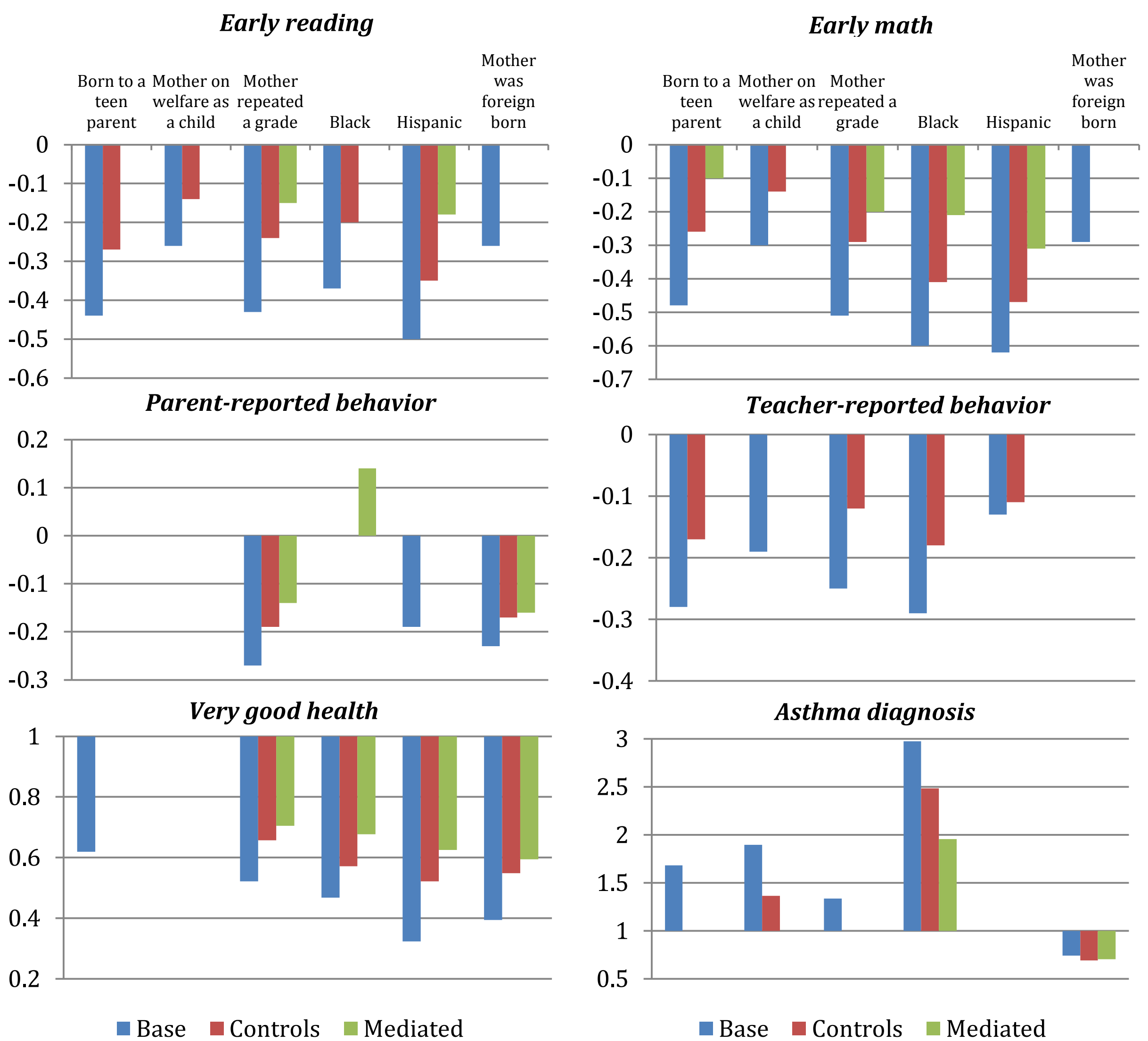


Figure 2b. Predicted Probabilities for Health and Asthma by Developmental Ecology Latent Class



Source: Early Childhood Longitudinal Study-Birth Cohort, 2001-2007. N≈6450.
Notes: Analyses account for sample design effects. Predictions based on Table 5, Model 2 for each outcome, with all variables except latent class set to sample mean.

Figure 3. Does Developmental Ecology Mediate Demographic Influences? Significant OLS Regression Coefficients (Reading, Math, and Behavior) and Binary Logistic Regression Odds Ratios (Health and Asthma) Predicting Kindergarten Outcomes



Source: Early Childhood Longitudinal Study-Birth Cohort, 2001-2007. N≈6450.
Notes: Analyses account for sample design effects. Only significant coefficients at p<.05 are shown. Base model includes only variable(s) named (separate models conducted for teen parent; welfare and repeated grade; child race/ethnicity; and nativity); controls model adds controls from Table 5, Model 2; mediated model adds developmental ecology classes.