

Psychological and Demographic Correlates of Early Academic Skill Development Among American Indian and Alaska Native Youth: A Growth Modeling Study

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Research regarding the development of early academic skills among American Indian and Alaska Native (AIAN) students has been very limited to date. Using a nationally representative sample of AIAN, Hispanic, African American, and White children at school entry, the authors used latent growth models to estimate the associations among poverty, low parental education, living in a rural location, as well as child attitudes toward learning and internalizing/externalizing behaviors, with mathematical and reading cognitive skill development across the 1st 4 years of school. Results indicate that AIAN children entered kindergarten with scores on both mathematical and reading cognitive tests that were comparable to their peers from other ethnic groups of color. Importantly, all children who entered kindergarten with lower cognitive skill scores also acquired skills more slowly over the next 4 years. Having a positive approach to learning at the start of kindergarten was associated with cognitive skill levels at school entry nearly 1 standard deviation above the population average. Results are discussed with reference to the shared early educational profiles observed between AIAN and other children of color. These findings provide a much-needed update regarding early academic development among AIAN children.

Keywords: American Indian, Alaska Native, academic skill, growth modeling, attitudes toward learning

The transition to school is a particularly important time in children's lives, marked by a period of growth in academic-related cognitive skill development that is predictive of later educational success (Alexander, Entwisle, & Horsey, 1997). As children build these early academic skills, positive social and psychological adjustment to school is essential to facilitate early academic success. For instance, characteristics of children's classroom behaviors and attitudes toward learning, as well as demographic indicators of developmental contexts such as poverty and parent education, can combine to promote or hinder children's transitions to school (Alexander et al., 1997; Duncan & Magnuson, 2005; Ferguson,

Horwood, & Ridder, 2005; Huffman, Mehlinger, & Kerivan, 2000). For American Indian and Alaska Native (AIAN)¹ children, who oftentimes have worse educational outcomes (Day & Jamieson, 2003; Germaine, 1996) and higher rates of mental health and behavioral problems than their White peers (Beiser & Atneave, 1982; Blum, Harmon, Harris, Bergeisen, & Resnick, 1992; LaFromboise, 1988; Manson, 1990), socioemotional readiness in kindergarten may be particularly important for a successful transition to elementary school. To date, researchers have yet to determine the extent to which classroom-based behavioral and school attitude characteristics are associated with early cognitive skills among AIAN children. These questions are of critical importance to understanding AIAN child cognitive development and to helping serve the growing subpopulation of AIAN students in the United States.

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Research of Early Educational and Cognitive Skill Development Among AIAN Children

The current state of research addressing early academic skill development among AIAN children is sparse. Extant school-related research with AIAN children most frequently has used ethnographic, case study, and small-scale descriptive designs, and there is a surprisingly small amount of research published on early AIAN childhood education after the 1980s (see review by Demmert, 2001). Nevertheless, several patterns of findings relevant to

¹ In this article the term American Indian and Alaska Native (AIAN) is used to describe children of American Indian and/or Alaska Native descent. Though past research cited in this report may have used the terms "Native American" or "American Indian," for consistency this article uses the term AIAN.

the study of early AIAN child academic skill development have emerged. In past qualitative research, AIAN children have been described as bringing unique learning styles into the classroom. These learning styles may include observational and visual learning styles as well as cooperative-based and experienced-based learning strategies (Deyhle & Swisher, 1997; Pewewardy, 2002). Such styles reflect a diversity of languages, spirituality, and communication styles (e.g., students make more peer eye contact, speak with a strong group orientation, and interrupt teachers more frequently; Greenbaum, 1985; Phillips, 1983). Importantly, AIAN learning styles are observed, interpreted, and responded to by teachers and may in turn affect students' attitudes and subsequent learning. Positive attitudes about education, academic motivation, and aspirations for academic achievement are among the most powerful facilitators of educational success for AIAN students (McInerney, Roche, McInerney, & Marsh, 1997; McInerney & Swisher, 1995). For example, in one cross-sectional study of third, seventh, and eleventh grade Asian American, Hispanic American, and AIAN students, positive attitude toward reading was an important correlate of reading cognitive performance and grades for all three groups of language minority students (Baratz-Snowden, 1988). However, though positive attitudes toward learning have been shown to facilitate academic performance among children of other ethnic groups across the developmental span (Anderman et al., 2001; Guimard, Florin, & Nocus, 2002; Gutman, Sameroff, & Eccles, 2002; Payne & Payne, 1991; Wigfield & Eccles, 2002), to our knowledge these associations have yet to be documented across the first years of school for AIAN children. As these early positive school attitudes may reflect an important adaptation to the school environment that in turn may facilitate subsequent learning and positive academic outcomes, characterizing the association between school attitudes and cognitive skills among AIAN children may be important to understanding early AIAN child academic outcomes.

In addition to attitudes toward learning, there is some evidence that behavioral problems among AIAN adolescents may partially explain academic achievement problems or dropout (e.g., Beauvais, Chavez, Oetting, Deffenbacher, & Cornell, 1996). Past research with children of other ethnic backgrounds has clearly demonstrated the importance of good classroom behavior (e.g., low externalizing and low internalizing) in elementary school (Huffman et al., 2000; Qi & Kaiser, 2003; Trout, Nordness, Pierce, & Epstein, 2003), and, as such, social and emotional readiness in kindergarten is increasingly recognized as important to children's early academic success. We therefore include in our current analysis measures of both internalizing and externalizing classroom behavior to determine the impact of children's school-based psychological characteristics on early academic skill development. To date it is unknown whether the associations observed in adolescence among classroom problem behaviors and poor grades and retention begin at school entry or develop later as AIAN children progress through school. Further, if AIAN children's early psychological characteristics are related to academic skill development, is this pattern unique to this ethnic group of children, or is this pattern part of a larger trend observed for all children in the United States?

Past research also has addressed several aspects of early AIAN child language and literacy development, though as with the learning style research noted above, we have found no studies docu-

menting language, literacy, or mathematical skill development over time in the early school years. Instead, research typically has used cross-sectional designs to investigate the role of parenting practices and involvement in education that may promote child literacy. Such research has noted many challenges facing AIAN parents in managing competing cultural demands of home and school (Deyhle, 1991; Guilment, 1979; Leveque, 1994), characterized cultural practices or interventions designed to understand achievement gaps between AIAN and Caucasian children in early language development (Guilment, 1983; Long & Christiansen, 1998; Prince, Grace, Linebarger, Atkinson, & Huffman, 2002), and provided supporting evidence for bilingual and traditional language practice in developing effective early AIAN child math, language, and literacy skills (Reyhner, 1990; Watahomigie & Yamamoto, 1987). Therefore, to address the gap in early childhood AIAN education research, we wished to document the extent to which AIAN child socioemotional readiness and demographic factors are associated with early academic skill development for both quantitative mathematical and reading skills across the first 4 years of school.

As indicated above, there is relatively little developmental research available that documents normative child developmental processes among AIAN children. A recent review of published, unpublished, thesis, and other professional reports addressing AIAN child development noted that most existing research typically uses small samples with no reference or comparison groups (E. L. Marks, Moyer, Roche, & Graham, 2003). In other words, though past research has yielded some important, detailed accounts of AIAN child development, many studies are limited in their ability to generalize well across AIAN tribes. Thus, one of the most-needed additions to the base of research with AIAN children is longitudinal, large-scale (i.e., population based) studies using comparison samples of non-AIAN children to facilitate the interpretation and potential generalizability of existing smaller-scale (i.e., small sample size, tribal-specific) research. The current study therefore uses one of the largest available nationally representative samples of AIAN children across tribes in order to advance research practice and theory related to normative AIAN child development.

Theoretical Framework

To address these questions, we use an integrative theoretical model of child development formulated specifically for understanding development among children of color (García Coll et al., 1996). According to this model, among ethnic minority children, developmental outcomes such as academic cognitive skill must be understood in terms of demographic contexts such as poverty and geographic location (e.g., living in a rural area) that influence and interact with the child and the family. In this framework, it is important to consider these contexts of development for children of color, as they reflect social stratification (based upon race, ethnicity, gender, and social class) that impacts developmental outcomes such as educational success. The effects of this stratification create common social and psychological processes among children of color, regardless of ethnic or tribal background, in which children and families form an *adaptive culture* that creates goals, attitudes, and behaviors that set them apart from the dominant culture. Therefore, our analysis of early cognitive skill development for AIAN children includes a nationally representative

sample of AIAN children across many tribal groups, who as a function of shared ethnic background and social stratification may also share common adaptive behaviors regardless of tribal culture in response to their promoting and/or inhibiting contexts to facilitate positive educational outcomes. For AIAN children entering kindergarten, these adaptations may be seen by teachers in the classroom as positive attitudes toward learning or increased externalizing behavior and may be influenced by the promoting (e.g., having a parent with a college education) or inhibiting (e.g., living below the poverty level) contexts in which the child is living. We also include in our analysis reference groups of White children as well as African American and Hispanic children of color whose early psychological correlates of academic skill development may share commonalities with AIAN children based on their shared experiences as children of ethnic minority groups. Such analyses further facilitate our understanding of whether the associations among early academic skills, promoting and inhibiting contexts, and psychological processes are unique to AIAN children or are shared among all children entering kindergarten in the United States. Finally, as research with ethnic minority youth has historically taken a comparative, deficit-model approach to understanding child development by focusing on problems of development as the research outcome, we present estimates of normative cognitive skill growth, including the potential benefits of positive psychological characteristics (i.e., approaches to learning), in addition to more commonly studied psychological difficulties (i.e., internalizing and externalizing behavior).

The Current Study

The current study models academic-related mathematical and reading skill development across the first 4 years of school for a nationally representative sample of AIAN kindergarteners. In keeping with our theoretical model, we present a within-ethnic group analysis and interpretation by modeling growth trajectories of cognitive skill development separately for each of four ethnic groups (AIAN, Hispanic, African American, and White). In doing so, we create our population estimates of cognitive skill growth based on variability between and within individuals separately for each ethnic group. This within-group estimation stems from recognition that comparative studies in which White children serve directly as the reference group for analysis perpetuate a deficit-based approach to understanding child development in children of color (see Cooper, Jackson, Azmitia, & Lopez, 1998; McLoyd, 1991). In our study, subsequent modeling of associations among child psychological characteristics, demographic factors, and cognitive skill growth were then examined within ethnic group, allowing unique patterns of associations among variables to emerge within each group. This type of research design falls into the parallel research paradigms described by Cooper et al. (1998), which provide a framework for understanding similarities and differences in child development across cultural groups. According to this model of study design, parallel research (in this population study, conducting comparable analyses separately for each ethnic group) may help researchers to prevent the interpretation of differences among cultural groups as deficits with respect to one another while allowing the researcher to discuss both common and unique correlates of development across different cultural groups.

As children's academic skill development across the elementary school years is predictive of later educational outcomes, the dynamic influences of demographic and child psychological characteristics on early educational skill development are extremely important to document, particularly among groups of children facing socioeconomic hardship (Alexander et al., 1997; Duncan, Brooks-Gunn, Yeung, & Smith, 1998; Ferguson et al., 2005; McLoyd, 1998). The present study characterizes the rate of academic-related cognitive skill development in both mathematics and reading among AIAN youth across the first 4 years of formal schooling using the Early Childhood Longitudinal Study–Kindergarten Cohort (ECLS-K) database (*User's manual for the ECLS-K*, 2004). Both mathematical and reading skills are modeled, as they represent multiple dimensions (quantitative and language-based) of foundational cognitive skills important for future academic skill development and achievement (see Rock & Stenner, 2005, for details on the predictability and importance of multidimensional cognitive assessments used in the ECLS-K). Also in keeping with past research, this study characterizes the effects of demographic factors (poverty and parent education), demographic location (rural locality), and child psychological characteristics (externalizing and internalizing behavior and approaches to learning) on early academic skill growth. As demographic and psychological characteristics are often interrelated, (Alexander et al., 1997; Beiser & Gotowiec, 2000; Beiser, Sack, & Dion, 1998), we include both demographic factors and child psychological characteristics in our study, allowing them to compete in our growth models to explain both baseline kindergarten skills and growth in academic skills.

In sum, latent growth modeling is used to capture both baseline level and growth in cognitive skills, considering variability within and between individuals in each of the four ethnic groups. Based on past research, we anticipated that (a) AIAN students (as well as their ethnic minority peers) would have lower baseline levels and growth in both math and reading skills than their White peers, (b) positive aspects of child psychological characteristics such as low externalizing behavior, low internalizing behavior, and positive approaches to learning would be associated with both baseline level and growth in math and reading skills across the first 4 years of school, regardless of ethnicity, and (c) living in poverty, living in a rural location, and lower parent educational attainment would be negatively associated with both baseline levels and growth in math and reading skills for all ethnic groups, though the negative association between living in a rural location and academic skill development would be strongest for the AIAN group, given the geographic isolation of many rural AIAN communities.

Method

Data for this study were obtained from the ECLS-K, a National Center for Educational Statistics (NCES) study. The ECLS-K's procedures for recruitment of participants, extensive study design, and procedures are depicted in detail in a publicly available NCES manual (*User's manual for the ECLS-K*, 2004). As the scope of the ECLS-K, which began active data collection in 1998, was broad and aimed to measure many developmental outcomes and predictors among a nationally representative sample of U.S. kindergarteners, only the portions of the study used in the current research

project are reported here (see the ECLS-K website for detailed information, <http://www.nces.ed.gov/ECLS/>).

Participants and Procedures

Children, parents, and teachers were recruited to participate in the ECLS-K using U.S. Census methods for selecting a representative sample of children entering kindergarten in 1998. One hundred primary sampling units (comprising counties or groups of counties) were selected across the United States, with both public and private school frames then identified within primary sampling units. Approximately 23 students participated from each school, to comprise a nationally representative sample of about 22,000 kindergarteners. This methodology not only allows researchers to test broad theories concerning typical U.S. child development but also provides framework for interpreting findings about subgroups of students within the overall study population.

Starting in September of 1998, participants were assessed in the fall of kindergarten, spring of kindergarten, and spring of first and third grades. All participants identified by parents as AIAN, Hispanic, African American, and White were included in the present analyses. As AIAN ethnicity is racially and culturally diverse, including children of "mixed" ethnicities, all children identified by the participating parent as being AIAN with at least one AIAN parent were included in the AIAN ethnic group for this study. A similar procedure was used to identify African American and Hispanic participants. The final study sample ($N = 15,533$) therefore included AIAN students ($n = 437$), Hispanic students ($n = 2,892$), African American students ($n = 2,441$), and White students ($n = 9,763$). This sample is smaller than the overall 22,000 sample size because it includes only the above four ethnic groups and only those participants available beginning in the kindergarten longitudinal sample (not those added during the 2nd year of the study). Across the 4 years of study, over 90% of the sample in all four groups continued participation. All teachers and parents gave fully informed consent for their own (and their child's) participation in the study; children, parents, and teachers were allowed to decline participation at any point throughout the study.

Measures

Professional field research staff conducted all child cognitive assessments and parent interviews and coordinated the collection of survey measures from teachers. Field staff was recruited locally from participating communities across the United States and were trained centrally at NCES. With the exception of the copyright-protected child behavior measure completed by parents and teachers, details of the following measures are available from NCES (Rock, Pollack, & Hausken, 2002; *User's manual for the ECLS-K*, 2004).

Child cognitive assessments. The cognitive assessment was administered individually to each child without time constraint at each of the four longitudinal time points (fall of kindergarten and spring of kindergarten, first grade, and third grade) by trained field staff. The mathematical thinking portion of the cognitive battery was developed from the National Assessment of Educational Progress in 1996 and includes two sets of problems: a routing set (to determine where along a vertical developmental scale of mathematical knowledge the child should be tested) and approximately

35 test problems (depending on occasion of assessment). The problems of the mathematical thinking assessment vary in difficulty, from simple conceptual and procedural knowledge in kindergarten (such as number sense, properties, and operations) to complex problem solving abilities in third grade (i.e., geometric and algebraic manipulations, probability understanding, and complex word problems). The reliability of the routing and test scales was satisfactory (routing, $\alpha = .78-.83$, and test, $\alpha = .80-.83$, depending on the child's vertical scaling placement).²

The reading portion of the cognitive battery was also developed from the National Assessment of Educational Progress in 1996 and was designed to measure basic skills in language and literacy. These skills span from letter recognition, print familiarity, beginning and ending sounds, and rhyming in the first year of school to reading comprehension and interpretation skills in the third grade. All children passed an English language proficiency test before they were administered the reading cognitive test. If the child was not able to pass the proficiency examination, a translated version of the cognitive battery was available in Spanish only, for which the participant was required to pass a preliminary Spanish examination. For the purposes of this study, children were included if they were able to take either the English or the Spanish test. No children were therefore excluded based on the student's most proficient language. The reliability of routing and test items was satisfactory (routing, $\alpha = .86-.88$, and test, $\alpha = .69-.93$, depending on the child's vertical scaling placement).

Finally, item response theory (IRT) estimation methods were used to create the final scaled scores for both the mathematical thinking and reading assessments (Rock et al., 2002). These IRT scaled scores were used in all growth modeling analyses. In IRT scaling, item characteristics are estimated (i.e., the probability that a child with a certain level of mathematical abilities will answer a particular math test item correctly) across the entire population for each item; these estimations are recalculated after each new cognitive assessment. The IRT scaling was an essential component for modeling change in cognitive skill over time as it allowed equitable scoring with identical scale meaning at each time point.

Parent interviews. Parent interviews were conducted at the start of kindergarten. Extensive family demographic information, educational and health history information, as well as parents' reports of child behavior were collected. For the purposes of this study, the parents' own history of education (i.e., having at least one parent with a college-level degree), family income, location of residence (urban vs. rural), and family ethnic background data were used.

Teacher questionnaire. The student's current teacher completed a booklet of questionnaires within approximately 1 month of each child cognitive assessment. A portion of the booklet was comprised of items from previously established and highly used research measures of child psychological behaviors. The 24-item scale used in this article was derived from the Social Skills Rating System (see Gresham & Elliott, 1990). The base-year kindergarten teacher scales are used in the current analysis. Three parameters of child psychological functioning used in this study include Internalizing Behavior (e.g., appearance of worry, loneliness, or sad-

² No differential item functioning information has been made available considering AIAN versus White youth responses.

ness), Externalizing Behavior (e.g., fights with others, controls temper), and Approaches to Learning (e.g., accepts new ideas well, willingness to try, frustration while learning, adherence to classroom rules). Teachers reported the frequency of the observed behavior of the child on a scale of 1 to 4 (*never to very often*); for Internalizing and Externalizing Behavior, a higher score represents more of the problem behavior, and for Approaches to Learning, a higher score indicates a more positive attribute. Scale reliability for these three scales was satisfactory ($\alpha = .76-.91$ across all four time points), and both exploratory and confirmatory factor analyses were used previously to confirm scale construction (Rock et al., 2002).

Statistical Analyses

Preliminary analysis. All variables were examined (to understand their distributions, growth over time, and basic relations with other variables) using descriptive statistics and Pearson correlations. In order to maintain the nationally representative nature of the study to all U.S. kindergarteners, population weights and residual adjustments (the jackknife method) were used in all mean-based analyses and in estimating error.

Prior to growth modeling, several methodological issues were considered. Preliminary analyses confirmed normality of distribution for all continuous variables. Over 200 individual growth plots were examined to determine the shape of the growth curve (at least 50 individuals were selected from each of the four ethnic study groups), and data sets were split and tested for cross-validation of main effects (cross-validation of factor estimates was very high for each ethnic group, $r_s > .95$). All growth modeling estimates were obtained using AMOS 4.0 structural equation modeling software, and a covariance structure analytic approach was used to estimate the multilevel modeling parameters and error variances; this approach has been described, reviewed, and validated in detail elsewhere, and our sample sizes were adequate for this type of analysis (Willett & Sayer, 1994).

Latent growth modeling. Latent growth modeling is a multilevel approach to modeling change over time. A broad overview of the concepts behind the multilevel model is presented below (see Singer & Willett, 2003, for an excellent presentation of the methodology used here). All modeling analyses were conducted separately for the four ethnic groups (AIAN, Hispanic, African American, and White), and missing data were imputed using maximum likelihood estimation in growth models.

In the first stage of latent growth analysis, two questions were addressed: "Do children (individually) differ in their baseline level of mathematical or reading skill at kindergarten?" and "Do children grow differently in their mathematical or reading skill over time?" To answer these questions, data were fit to an unconditional linear-change growth model such that a student i on occasion j can be represented by,

$$Y_{ij} = \pi_{0i} + \pi_{1i}\text{TIME}_j + \text{error}_{ij},$$

where Y represents growth in mathematical or reading knowledge, and TIME_j takes on the values 0, 0.75, 1.75, and 3.75 for the length of time (in years) since the initial kindergarten cognitive assessments (equation from Singer & Willett, 2003, p. 144). In addition, the fixed effects π_0 and π_1 represent true

values (determined by full maximum likelihood estimation) of the intercept (i.e., baseline mathematical or reading knowledge at entry to kindergarten) and slope (i.e., annual rate of linear growth in mathematical or reading skill from kindergarten through third grade), respectively. In addition to fixed effects, variance components were also examined to answer questions such as, "Do all AIAN children begin with similar levels of mathematical or reading skill? Do individual children grow in mathematical or reading skill differently from one another?" In this case, a non-zero error variance (against the null hypothesis) would indicate that children do differ in their baseline and rate of growth in mathematical or reading knowledge. A non-zero error variance therefore indicates there is variance to be predicted by adding contributors to the model, providing a basis for the second stage of growth modeling described below.

In the second stage of growth modeling analysis, child psychological characteristics and demographic factors were entered into the model specified above to investigate contributions to baseline knowledge (intercept) and rate of growth (slope). To estimate these main effects, the intercept and slope variables in the model become endogenous (i.e., dependent variables) and are estimated in the presence of a new independent variable. Examples of the second stage questions answered include, "Does a child's approach to learning correlate positively with baseline mathematical or reading knowledge at entry to kindergarten?" and "Does a child's approach to learning correlate positively with the rate of mathematical or reading skill growth?"

Once the main effect of a contributor (i.e., approaches to learning) is determined on the intercept and slope of mathematical thinking or reading skills, the presence of a competing contributor may be entered into the model. To build the final multiple predictor models for each ethnic group, those demographic variables making a significant contribution were then entered into a final model along with all three psychological factors. Because past research has demonstrated gender effects among older children on both mathematical and reading skill (Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Lepola, Vaurus, & Maeki, 2000), and because these effects are replicated in the present study, child gender was included as a covariate in all multiple models. Finally, commonly used structural equation modeling fit statistics such as the comparative fit index (values $> .90$ for adequate fit) and root-mean-square residual (values $< .06$ for adequate fit) were checked and met to ensure stability of parameter estimation.

Results

Descriptive Analyses: Demographic Factors and Child Psychological Characteristics

Sample demographic characteristics are presented in Table 1. As anticipated by study design, no child age or gender differences were observed across the four study groups. The AIAN group had the greatest proportion of families living below the poverty line ($\chi^2 = 1,997.2$, $df = 3$, $p < .001$) and living in a rural location ($\chi^2 = 1,022.3$, $df = 3$, $p < .001$). In addition, there was a minority status effect on family education: Only 10% of AIAN, Hispanic, and African American families had at least one parent who had earned a college degree, compared to about 30% of White families ($\chi^2 = 817.1$, $df = 3$, $p < .001$).

Table 1
Participant Demographic Characteristics at School Entry in Kindergarten, by Ethnic Group

Characteristic	AIAN (<i>n</i> = 437)	Hispanic (<i>n</i> = 2,892)	African American (<i>n</i> = 2,441)	White (<i>n</i> = 9,763)
Child age (years) <i>M</i> (<i>SD</i>)	5.71 (.36)	5.65 (.36)	5.68 (.36)	5.72 (.36)
Child gender: % female	51.0	48.6	49.4	48.7
Parental education: % college degree ^a	10.6	9.7	10.7	30.7
Poverty level: % of families below ^a	44.9	34.2	42.6	9.1
Rural location: % of families in rural ^a	57.7	6.9	12.0	27.6

Note. AIAN = American Indian and Alaska Native.

^a Distributions are significantly different across the four ethnic groups ($p < .001$).

For the population estimates of teacher-rated child psychological characteristics, AIAN children were most comparable to their White peers in internalizing behavior, and displayed levels of externalizing behavior similar to that of their African American peers (see Table 2). For teachers' impressions of approaches to learning, AIAN children were rated most similarly to their African American peers. Correlations between child psychological characteristics and parent demographic variables were low ($r_s < .15$).

Baseline Levels and Growth in Mathematical Thinking and Reading Skills by Ethnic Group

Table 2 also presents the ethnic group averages for both mathematical thinking and reading cognitive skill scores at school entry in kindergarten and in the third grade. AIAN children began kindergarten with reading and math skills at comparable levels to those of their Hispanic and African American peers. At the end of the third grade, the average AIAN score for reading was 19.6 points (approximately 1 standard deviation) lower than the White group, and the average AIAN score for mathematical thinking was 14.4 points (nearly 1 standard deviation) lower than the White group, suggesting different population rates of cognitive skill growth between these two groups.

The first stage of latent growth modeling confirmed significant growth (i.e., slopes were not flat and showed significant

and increasing trajectories) for each of the four study groups, as well as variability in both baseline levels and growth in cognitive skills between individuals. Further, correlations were calculated from the covariance and variance estimates of the slope and intercept terms to quantify the degree to which baseline skills correlated with academic skill gains in mathematical thinking and reading skills, and Fisher z transformations were used to compare the difference between correlations observed between the four study groups. In the AIAN group, baseline skills were highly correlated with gains in mathematical thinking skills ($r = .89$) and reading skills ($r = .69$), such that children who came into kindergarten with a greater knowledge of mathematics or literacy were more likely to grow at a more rapid pace in their skill development than children entering kindergarten with less mathematical or literacy knowledge. In the White group, baseline knowledge and rate of growth also were positively correlated ($r = .69$ for mathematical thinking, $r = .56$ for reading), though this association was not as strong as the association for the AIAN group ($z = 11.40$ for mathematical thinking, $z = 4.39$ for reading), or as high as the correlations observed for the other two ethnic minority groups (math: Hispanic, $r = .86$, African American, $r = .87$, and reading: Hispanic, $r = .83$, African American, $r = .74$).

In a second stage of latent growth analysis, we confirmed that all demographic and psychological variables had significant modeling

Table 2
Child Psychological Characteristics, Mathematical Thinking Skills, and Reading Skills, by Ethnic Group

Variable	AIAN (<i>n</i> = 437)	Hispanic (<i>n</i> = 2,892)	African American (<i>n</i> = 2,441)	White (<i>n</i> = 9,763)
Psychological characteristics in kindergarten: <i>M</i> (<i>SD</i>)				
Internalizing behavior ^a	1.64 (.55)	1.57 (.55)	1.55 (.55)	1.52 (.51)
Externalizing behavior ^b	1.81 (.66)	1.56 (.61)	1.79 (.68)	1.60 (.62)
Attitude toward learning ^c	2.76 (.67)	2.93 (.67)	2.78 (.70)	3.04 (.67)
Academic skills at school entry in kindergarten				
Mathematical thinking: <i>M</i> (<i>SD</i>) ^d	17.1 (7.9)	17.0 (7.2)	18.0 (6.2)	23.2 (9.2)
Reading: <i>M</i> (<i>SD</i>) ^e	22.1 (7.5)	24.0 (8.2)	24.5 (7.7)	28.5 (10.2)
Academic skills in spring of third grade				
Mathematical thinking: <i>M</i> (<i>SD</i>) ^f	73.8 (17.4)	78.4 (17.8)	72.8 (18.2)	88.2 (17.1)
Reading: <i>M</i> (<i>SD</i>) ^g	92.2 (22.3)	99.3 (20.4)	97.1 (19.9)	111.8 (19.1)

Note. Analysis of variance of unweighted averages showed significant mean differences by ethnic group for all psychological characteristics and cognitive skill scores. AIAN = American Indian and Alaska Native.

^a $F(3, 13721) = 6.98, p < .001$. ^b $F(3, 13879) = 63.04, p < .001$. ^c $F(3, 14058) = 108.54, p < .001$. ^d $F(3, 13106) = 520.25, p < .001$. ^e $F(3, 13175) = 201.50, p < .001$. ^f $F(3, 12544) = 609.54, p < .001$. ^g $F(3, 14558) = 325.92, p < .001$.

main effects on mathematical thinking and reading skill levels and growth in all four ethnic groups.

Combined Effects of Psychological and Demographic Contributors to Child Mathematical Thinking and Reading Skills and Gains

Tables 3, 4, 5, and 6 present the final growth models with combined demographic and psychological contributors to child baseline levels and growth in mathematical thinking and reading skills for each of the four study groups. To assist in the interpretation of the findings for the AIAN group, the effects of having a positive approach to learning, having a parent with a college degree, and living in poverty were graphed along with a reference line from the initial growth model (see Figures 1 and 2). Child gender was included in all multiple-conditional models as a covariate.

For AIAN children, living in a household below the poverty level was associated with lower mathematical thinking and reading baseline skills at school entry. In addition, living in a rural location was associated with lower growth in both mathematical thinking and reading skills across the next 4 years of school. In the presence of these demographic factors and internalizing and externalizing behavior, only approaches to learning had a significant, positive association with growth in mathematical thinking and reading skills. Remarkably, having a more positive approach to learning (by 1 teacher rating point) was associated with baseline cognitive skills about 6 points higher at school entry (nearly 1 standard deviation).

Several commonalities and differences were observed across the four ethnic groups' final models in academic skill growth. For example, the magnitude of the effect of poverty observed at school entry on mathematical thinking and reading baseline skills for AIAN children was similar for Hispanic and White children. For African American children, living in poverty was significantly associated with a slower rate of growth in reading skills. Though poverty had a strong negative association with children's early academic skills regardless of ethnicity, these differences in specific results demonstrate the importance of calculating population estimates separately for each ethnic group.

Notably, having a positive approach to learning was very important to promoting child academic baseline skills and growth not only for AIAN children, but also for Hispanic, African American, and White children. Internalizing and externalizing behavior, on the other hand, was less important to explaining baseline or growth in educational skills for AIAN children. Only externalizing behavior was associated with higher mathematical thinking skills by approximately 1 point at school entry. This was in most contrast to African American and White children, for whom externalizing behavior was associated with both mathematical thinking and reading skill levels at baseline by approximately 1 point. Further, internalizing behavior was negatively associated with baseline mathematical thinking and reading skills for African American children and was negatively associated with both baseline and growth in mathematical thinking and reading skills for White children.

Discussion

This study documents growth in mathematical and reading skills across the first 4 years of school for a nationally representative sample of AIAN kindergarteners. In this study, growth modeling analyses not only examined the variability and rate of mathematical and reading skill attainment but also investigated the associations among demographic factors and child psychological characteristics with academic knowledge and skill. In general, there were numerous similarities observed among early demographic and psychological correlates of academic skill growth by ethnic group. Perhaps most striking, students' positive approaches to learning were strongly associated with higher baseline levels and growth in mathematical and reading skills, promoting positive academic skill development for all children. In all ethnic groups, children rated by their teachers as having a more positive attitude (by just 1 point) entered kindergarten with a mathematical ability score almost 1 standard deviation higher than their peers with a slightly less positive approach to learning. Remarkably, having a positive approach to learning was as strong a contributor to academic skill development as having at least one parent with a college education. In addition, these students gained, on average, about 1.5 more points per year in mathematical and reading skill

Table 3
AIAN Multiple Growth Model (n = 437): Combined Effects of Psychological and Demographic Correlates of Mathematical Thinking and Reading Skills

Variable	Mathematical thinking		Reading	
	Baseline	Growth	Baseline	Growth
Demographic characteristics				
Parent education: College degree	3.44 (1.19)**	0.96 (0.68)	4.00 (1.38)**	2.25 (0.93)*
Household below poverty level	-2.49 (0.73)***	-0.97 (0.41)*	-4.18 (0.85)***	-1.27 (0.57)*
Living in rural location	-1.18 (0.72)	-1.85 (0.41)***	-1.94 (0.84)*	-2.60 (0.57)***
Psychological characteristics				
Internalizing behavior	0.63 (0.60)	0.51 (0.34)	-1.24 (0.69)	0.36 (0.47)
Externalizing behavior	1.16 (0.68)*	-0.42 (0.32)	1.27 (0.66)	-0.29 (0.45)
Approaches to learning	5.55 (0.52)***	1.40 (0.30)***	6.44 (0.60)***	2.03 (0.41)***

Note. Standard error follows the estimate in parentheses. AIAN = American Indian and Alaska Native.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4

Hispanic Multiple Growth Model (n = 2,892): Combined Effects of Psychological and Demographic Correlates of Mathematical Thinking and Reading Skills

Variable	Mathematical thinking		Reading	
	Baseline	Growth	Baseline	Growth
Demographic characteristics				
Parent education: College degree	5.25 (0.71)***	2.17 (0.37)***	5.34 (0.51)***	0.87 (0.30)**
Household below poverty level	-4.032 (0.44)***	-2.53 (0.23)***	-3.39 (0.31)***	-1.09 (0.19)***
Living in rural location ^a	0.41 (0.58)	-0.56 (0.34)	0.94 (0.81)	0.72 (0.42)
Psychological characteristics				
Internalizing behavior	-0.33 (0.35)	0.21 (0.19)	-0.40 (0.26)	0.043 (0.16)
Externalizing behavior	0.26 (0.35)	0.012 (0.19)	0.93 (0.25)***	-0.19 (0.15)
Approaches to learning	5.16 (0.32)***	1.34 (0.16)***	5.14 (0.22)***	1.63 (0.14)***

Note. Standard error follows the estimate in parentheses.

^a This variable was dropped during preliminary model building analyses; it was not a significant contributor to the outcome in the presence of the other demographic variables.

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

scores than their peers. These relations between teachers' ratings of students' attitudes and basic academic cognitive skill levels and growth were observed for all ethnic groups in the final growth models after accounting for salient demographic variables and controlling for child gender.

By conducting analyses separately by ethnic group, we also observed several differences in patterns and strength of associations among psychological characteristics and early math and reading cognitive skills across ethnic groups. For example, higher levels of internalizing behavior were associated with lower math and reading skills at school entry for African American and White students only. Further, externalizing behavior appeared to be mildly associated with early academic skills differently, depending on ethnic group. Among White children, higher externalizing behavior was associated with mildly higher cognitive scores at kindergarten entry in both math and reading. Among AIAN children, externalizing behavior was associated only with higher math baseline scores. By conducting modeling analyses separately by ethnic group, we are able to observe—not assume—similarities and differences in patterns and strength of associations. Though there are numerous possible explanations for the observed variability within ethnic groups among psychological characteristics

and academic skill development, we interpret these differences in part with respect to variations in cultural, community, school, and family contexts in which children live (see García Coll et al., 1996). Future studies are needed to examine, for example, the specific characteristics of schools in particular geographic localities (e.g., urban, suburban, rural) that may promote externalizing and internalizing classroom behavior among African American and White children at school entry. New studies also are needed to characterize the specific aspects of rural community contexts that are associated with slower growth in early academic skills, particularly among AIAN and African American children for whom this association is strongest.

The notable strength of association observed between early approaches to learning and growth in academic skills across the early elementary years are interesting in light of other research with AIAN children. Several past studies have indicated the importance of having a positive attitude toward learning in facilitating AIAN children's early academic skill development (e.g., McInerney et al., 1997; McInerney & Swisher, 1995). Moreover, it has been suggested that many problems in academic achievement (such as lower grades and greater teacher–student conflict) observed among AIAN children from a variety of tribes may stem

Table 5

African American Multiple Growth Model (n = 2,441): Combined Effects of Psychological and Demographic Correlates of Mathematical Thinking and Reading Skills

Variable	Mathematical thinking		Reading	
	Baseline	Growth	Baseline	Growth
Demographic characteristics				
Parent education: College degree	3.34 (0.48)***	1.30 (0.32)***	5.17 (0.62)***	1.82 (0.39)***
Household below poverty level	-1.78 (0.30)***	-0.67 (0.19)**	-1.18 (0.24)***	-3.23 (0.38)***
Living in rural location	-1.60 (0.45)***	-1.38 (0.29)***	-0.86 (0.57)	-1.28 (0.36)***
Psychological characteristics				
Internalizing behavior	-0.65 (0.24)**	0.054 (0.16)	-0.89 (0.30)**	-0.041 (0.19)
Externalizing behavior	1.21 (0.22)***	0.027 (0.14)	1.15 (0.28)***	-0.13 (0.17)
Approaches to learning	5.71 (0.31)***	1.75 (0.14)***	6.48 (0.27)***	1.86 (0.17)***

Note. Standard error follows the estimate in parentheses.

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

Table 6
White Multiple Growth Model (n = 9,763): Combined Effects of Psychological and Demographic Correlates of Mathematical Thinking and Reading Skills

Variable	Mathematical thinking		Reading	
	Baseline	Growth	Baseline	Growth
Demographic characteristics				
Parent education: College degree	4.56 (0.21)***	0.87 (0.09)***	4.94 (0.26)***	1.22 (0.12)***
Household below poverty level	-2.57 (0.33)***	-0.91 (0.14)***	-3.18 (0.42)***	-1.38 (0.19)***
Living in rural location	-1.16 (0.21)***	-0.44 (0.10)***	-1.98 (0.27)***	-0.27 (0.12)*
Psychological characteristics				
Internalizing behavior	-1.62 (0.16)***	-0.35 (0.07)***	-1.48 (0.20)***	-0.18 (0.091)*
Externalizing behavior	0.61 (0.16)***	0.018 (0.072)	1.079 (0.20)***	-0.14 (0.09)
Approaches to learning	7.67 (0.15)***	1.22 (0.067)***	7.46 (0.19)***	1.45 (0.083)***

Note. Standard error follows the estimate in parentheses.

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

from a cultural mismatch between the students' home life and school demands. For example, in one study of 20 Hupa children, Bachtold (1982) suggests that parents' childrearing emphasis on social interdependence may present parents with a challenge in developing the child's cultural identity alongside the need for children to be increasingly independent in the classroom. Other authors have described similar situations in which AIAN parents are essentially caught between their cultural values and promoting their children's education (Deyhle, 1991; Deyhle & LeCompte, 1994), creating a situation in which parents are pressured to assimilate into the mainstream culture (Leveque, 1994). Given the strong associations between teacher-perceived positive attitudes toward learning and cognitive skill development demonstrated in the current study's nationally representative sample of AIAN kindergarteners, future studies aimed at understanding which aspects of home-school communication and children's bicultural socialization (including children's ethnic identity development) may work to promote children's positive attitudes toward school are sorely needed.

As there are many aspects of early child education that can impact approaches to learning (e.g., teacher attitudes and beliefs, parent educational values, peer attitudes and relationships, school

and classroom environment), designing interventions that foster positive attitudes about school in kindergarten may be a promising way to enhance early AIAN child academic skill development. In particular regard to AIAN youth, careful attention should be given to fostering positive attitudes toward school and learning that are in keeping with family and tribal daily routines and values that do not emphasize assimilation; this can be done with close cooperation and partnerships fostered between educators and AIAN community members (for examples, see recommendations made by LaFromboise, 1988). Though approaches to learning and motivation continue to emerge in relational models of achievement and cognitive development (including the current study), the actual mechanisms linking achievement to developing academic attitudes still are not completely understood and await further investigation. For example, it may be that the relationship between having a positive attitude toward learning and academic success is a mutually-reinforcing one in which children who exhibit positive classroom attitudes are encouraged more by teachers, achieve greater success in school, and in turn continue to have positive attitudes. Parents' involvement in shaping their children's early educational attitudes and behaviors may also promote the relationship between positive learning approaches and early academic skill

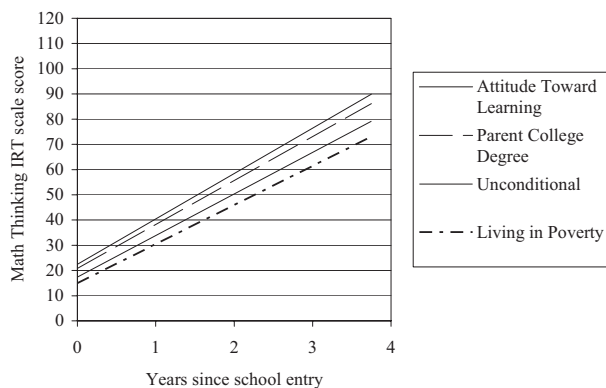


Figure 1. Conditional linear growth model for mathematical thinking in American Indian and Alaska Native youth: Modeling effects of a positive approach to learning, parent education, and poverty. IRT = item response theory.

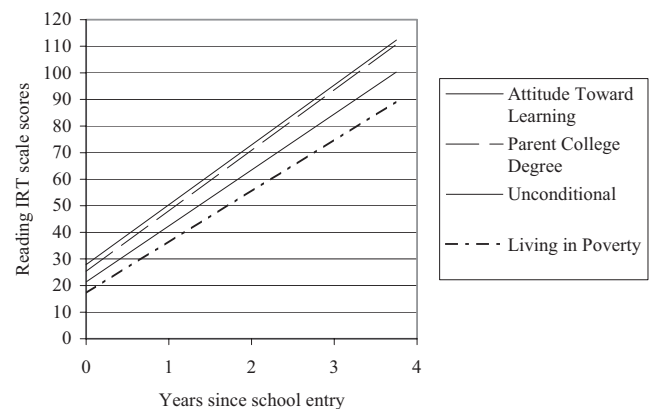


Figure 2. Conditional linear growth model for reading in American Indian and Alaska Native youth: Modeling effects of a positive approach to learning, parent education, and poverty. IRT = item response theory.

development among AIAN children, and this should be considered in future studies.

Among the demographic factors examined, poverty and parent educational attainment were the most salient contributors to mathematical and reading skill development for the AIAN group; in addition, the negative impact of living in a rural location had a stronger effect in the AIAN group than in the other three study groups. Our findings suggest that the combination of geographic isolation and poverty that characterizes many AIAN children's environments may be unusually severe. New studies are needed to understand the characteristics of the rural context (independent from and alongside the effects of poverty) that may particularly hinder (or enhance) AIAN education. Such studies may consider the benefits of community education-related resources such as gathering places for art and dance, libraries, and after-school initiatives that may promote early education. They may also consider markers of negative community characteristics such as crime and alcoholism rates that have been shown to directly and indirectly raise AIAN children's risk for a variety of poor behavioral and health outcomes early in life (A. K. Marks, 2005). To date, these associations among developmental contexts and AIAN early childhood behavior, health, and education outcomes remain largely unexamined.

As was revealed in the growth modeling analyses, the gap between AIAN students' mathematical and reading skills and the skills of their White peers grew wider across the first 4 years of school, such that AIAN students were scoring, on average, approximately 1 standard deviation lower on tests of both mathematical and reading skills than their White peers. These striking differences between population estimates of cognitive skill performance between AIAN (as well as other ethnic minority) and White children—as early as the first 4 years of school—call for future research attention and community intervention to improve these early gaps in academic skill development. Because AIAN education has evolved by a unique history and doctrine to assimilate AIAN children into the U.S. educational system, intervention requires novel solutions and approaches (see review by Deyhle & Swisher, 1997). It is of utmost importance that early education intervention efforts be informed, designed, and carried out by the AIAN community members whose lives are to be shaped by them. For example, in the Cherokee tradition, characteristic teaching exchanges between instructors and students are based on mutual respect and trust. The specific tenets of an early education intervention, one that may be designed to increase students' positive attitudes toward learning (as the current study demonstrates is an important correlate of early academic skill development), should therefore grow from the cultural traditions and values of education specific to the tribal community. In this example of a Cherokee community, an intervention should be built with guidance from tribal community members and may target new ways to promote trust and equality among teachers, parents, and students to foster and support positive attitudes toward education.

Further, the strength of the correlation between entry scores and rate of growth for both domains of academic skill development were strongest among the ethnic minority groups. For AIAN children entering kindergarten, the correlation between their baseline cognitive ability and growth in mathematics was .89, whereas for the White children this correlation, though still positive, was significantly lower at .69; Hispanic children and African American

children had high positive correlations between their baseline entry scores and academic skill growth rates, similarly to the AIAN group. In other words, AIAN, Hispanic, or African American children who entered kindergarten with greater mathematical knowledge were much more likely to grow academically at a faster rate thereafter. In turn, children entering with lower math skills were likelier to experience slower academic skill growth over time. Though the same type of association between school entry skills and academic skill growth was true for White children, the magnitude of this effect was considerably smaller. This finding is extremely important in the context of early intervention planning as the paths of academic growth for children of ethnic minority backgrounds and lower income communities appear to be less changeable over time than those of their middle-class counterparts. As such, it may be very important to intervene prior to kindergarten entry in order to close these early academic skill gaps (see discussion by Pellegrini & Stanic, 1993).

Limitations and Final Considerations

The current study must be interpreted in light of its limitations. First, the findings presented here are correlational, documenting bi-directional relations between psychological characteristics and cognitive skills, not causal relations. Secondly, the AIAN, Hispanic, African American, and White students comprising the targeted study groups represent a very heterogeneous mixture of cultural and heritage backgrounds. As the findings presented here are population-level observations, they should not be interpreted as wholly characteristic of any particular culture. Third, the present study employs teacher ratings of child psychological characteristics. Though past research has demonstrated teacher behavioral ratings are closely tied to student academic outcomes (e.g., Keane & Calkins, 2004), teacher ratings are only moderately externally valid. Though teachers are sometimes considered better judges of normative child behavior than parents (Scourfield, Bethan, Martin, & McGuffin, 2004), this may not be the case with AIAN children (see discussion by Fisher, Bacon, & Storck, 1998); it is becoming increasingly recognized that teachers on tribal reservations or in rural areas are often less educated and less sensitive to student psychological attributes than urban or upper socioeconomic community teachers. Follow-up analyses from the current project could include an examination of how teacher characteristics may vary by rural location, ethnic group, or socioeconomic level and how these differences may impact both teacher ratings of children's attitudes and child mathematical and reading skill gains. In the current report, it is therefore important to interpret the psychological findings not as true measures of child psychological characteristics but as teacher perceptions of child psychological functioning. As such, these ratings may be in part an impression of child likeability or compliance to classroom rules. Despite these weaknesses and considerations, several aspects of the current study offer notable strengths, including the nationally representative nature of the AIAN sample, the use of a well-established developmental measure of mathematical and reading cognitive abilities, and the use of latent growth analyses to characterize child academic skill development in this understudied population. Demmert (2005) articulates well the need for and importance of establishing a base of information, such as the findings provided in part by this study, describing educational skill development among AIAN children in

order to empower leaders and researchers to make much-needed improvements in serving AIAN students in the U.S. educational system. Such future research, as Demmert writes, should include new dynamic, culturally appropriate cognitive assessments for better understanding how AIAN children learn.

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