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Does Minority Status Increase the Effect of Disability Status on Elementary Schoolchildren's Academic Achievement?

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Abstract

We investigated whether children's reading and mathematics growth trajectories from kindergarten to fifth grade inter-related, and to what extent disability and minority status interacted to predict their achievement trajectories. We conducted secondary data analysis based on a nationally representative sample of 6,446 U.S. schoolchildren from the Early Childhood Longitudinal Study-Kindergarten Cohort. Results indicated that children's reading and mathematics achievement highly correlated in both initial status and growth. Being disabled or a racial/ethnic minority independently predicted lower academic achievement. However, and contrary to what might be expected from prior research on minority children's special education experiences, disability status was associated with similar academic disadvantages for minority students and White students from kindergarten to fifth grade. Growth mixture models identified a group of children with lower and lagging achievement in both reading and mathematics from kindergarten until fifth grade.

Keywords

Academic achievement; reading; mathematics; individualized education plan; disability; minority

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Having a disability or being a racial/ethnic minority each increase children's risk for lower reading and mathematics achievement (Fuchs & Fuchs, 2002; Judge & Watson, 2011). For example, scores on the National Assessment of Educational Progress indicate significant achievement gaps between those with and without disabilities in both 4th and 8th grade and in both reading and mathematics (National Council on Disability, 2011). These academic achievement gaps begin occurring at an early age and persist or even increase over time (Morgan, Farkas, & Maczuga, 2011; Nelson, Benner, Lane, & Smith, 2004). Children who are racial/ethnic minorities are more likely to display both an initially lower level of reading or mathematics achievement and lower growth rates over time (McCelland, 2006). Many possible explanations for these achievement gaps have hypothesized. Examples include economic factors relating to poverty and inter-generational racism (Lorsen & Orfeld, 2002) and having less access to higher-quality childcare and schools (Burchinal et al., 2011), as well as non-economic factors such as home language use (Kreisman, 2012), teacher perceptions of academic potential (Wildhagen, 2012), student's perceived social stereotypes

(Cohen, Garcia, Apfel, & Master, 2006), and variation in parenting involvement (Jeynes, 2003). For example, Lee & Bowen (2006) reported that European American parents had more frequent parent-child discussions and more frequent participation of parents at school activities than both Hispanic and Black parents.

Some researchers also report that minorities are disproportionately over-identified as having disabilities (Sullivan & Bal, 2013), in that the proportion of minority students in special education programs exceeds their proportions in the general population. For example, students who are Black have been reported to be 2.4 times more likely to be identified as intellectually disabled, 1.1 times more likely to be labeled as learning disabled, and 1.7 times more likely to be labeled as having emotional or behavioral disorders (Klingner et al., 2005). Such disproportionality has been hypothesized to possibly result from economic factors (Hosp & Reschly, 2004), bias in teacher ratings (Cullinan & Kauffman, 2005), measurement bias (Skiba, Knesting, & Bush, 2002), as well as educational processes that are predisposed to favor majority language and culture (Harry, Klinger, & Hart, 2005). However, other researchers have hypothesized that disproportionate representation often attributed to racial/ethnic minority status may instead be explained by other, confounding factors (MacMillian & Reschly, 1998). Examples include minority children's greater likelihood of being born with low birth weight, being exposed to lead, and experiencing other biological and environmental risk factors (Donnovan & Cross, 2002). The limited research that has extensively controlled for confounding factors repeatedly finds that minority students are instead *under*-represented in special education (e.g., Hibel, Farkas, & Morgan, 2010; Mann, McCartney, & Park, 2007).

Being placed in special education has also been hypothesized to result in lower-quality experiences for racial/ethnic minorities than for White students. For example, racial/ethnic minorities have been reported to be more likely to receive lower quality educational experiences than White students following identification as disabled (Artiles, Kozleski, Trent, Osher, & Ortiz, 2010), to be more likely to be placed in more segregated settings (Cartledge, Singh, & Gibson, 2008), and to attend economically disadvantaged schools than disabled children who were White (Parrish, 2002). These experiences may further compound the lower attainment of minority children with disabilities.

Although existing studies have examined how disability and minority status independently influence academic achievement, whether and to what extent children who are both disabled *and* minorities display comparatively lower academic achievement over time has yet to be empirically investigated. From a methodological perspective, several possibly empirical tests might be conducted to evaluate whether racial/ethnic and disability status interact. For example, if racial/ethnic minorities are inappropriately placed in special education, one observable consequence should be that, at the time of placement, the achievement gap between those with and without disabilities would be smaller for Blacks than for Whites. That is, a significant statistical interaction would occur between the variables indexing race/ethnicity and disability in their effects on the intercept of an estimated growth curve model. Here, effect of disability on the starting value of achievement at placement would be smaller for minorities than for Whites. This is because some minority students, as a consequence of being inappropriately placed in special education, would not be experiencing disabilities that were negatively impacting their academic achievement. If no such interaction were observed, this may constitute indirect evidence that minority and White students are selected for disability status using similar criteria, *or* possible misplacement was not itself related to academic achievement. In addition, if minorities placed into special education receive fewer or inferior services, an interaction between minority and disability status should be observed, such that the effect of disability on growth rates is more negative for minorities than for Whites. This is because minority students would be receiving less effective compensatory services for their disabilities than Whites. Conversely, a non-significant interaction would indicate either comparable service was being delivered across the minority and non-minority groups of students with disabilities, *or* that any variation in service quality was again not related to academic achievement.

To empirically evaluate these aforementioned possibilities, and so to better inform educational policy, research, and practice regarding the educational experiences of minorities students identified for and receiving special education services in the U.S., we investigated whether and to what extent elementary schoolchildren's status as racial/ethnic minorities and as disabled interact to help explain their lower reading and mathematics achievement, both regarding their starting values in kindergarten and their growth rates from kindergarten to fifth grade. First, we simultaneously modeled reading and mathematics achievement of a population-based sample of U.S. elementary schoolchildren. We used parallel processes growth models to estimate the initial and over time inter-relation between reading and mathematics achievement, from kindergarten to fifth grade. Second, we estimated the predicted effects of race/ethnicity and disability status, and their interaction, on the intercept and slope of children's reading and mathematics achievement trajectories, controlling for potentially confounding socio-demographic characteristics and additional educationally relevant factors. Third, we identified distinct growth trajectory classes, with a particular interest in identifying an at-risk group with lagging achievement and whether being both disabled and minorities would further increase the likelihood of being in this at-risk group. These analyses were designed to evaluate whether and to what extent minority status functioned to intensify the negative impact of disabilities on academic achievement as children aged throughout elementary schools in the U.S.

Method

Study's Database and Analytical Sample

We analyzed data from the Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K). The ECLS-K involved a multistage probability sample design to draw a nationally representative sample of children who entered kindergarten classrooms in the fall of 1998. For most children, the ECLS-K survey waves corresponded to the fall and spring of kindergarten, the fall and spring of first grade, and the spring of third and fifth grade. We analyzed scores from fall kindergarten through spring of fifth grade except for spring of first grade where only a subsample was available. The study's full sample consisted of 9,796 children having a non-zero longitudinal sampling weight. We performed listwise deletion on the covariates to ensure that all analyses were based on the same sample. Missing data in reading and mathematics scores across the five time points was treated with Full Information

Maximum Likelihood method (FIML) in Mplus 6.12 (Muthén & Muthén, 2010). FIML utilizes all available data and produces less biased results (Enders, 2001). Our final analytical sample included 6,446 children who had complete information on the predictors, and at least one reading and one mathematics scores. About 70% of the missing was due to a missing disability status at kindergarten. Table 1 indicates that the final analytical sample was largely similar to the full sample in terms of gender composition, kindergarten retention, public school status, and Individual Education Program (IEP) status. We note, however, that the study's analytical sample had 5% more Whites and 4% fewer Hispanics, and slightly older and higher-SES students.

Measures

Reading and Mathematics Achievement—We used scores from the ECLS-K Reading and Mathematics Tests to estimate children's reading and mathematics achievement. The Reading Test is designed to measure a range of age- and grade-appropriate reading skills (e.g., print familiarity, letter recognition, beginning and ending sounds, creating rhyming words, "sight" word recognition, words in context, phonemic awareness, single word decoding, receptive vocabulary, listening comprehension, and passage comprehension). The Mathematics Test is designed to measure a range of age- and grade-appropriate mathematics skills (e.g., identify numbers and shapes, sequence, add or subtract or multiply or divide, use rates and measurements, use fractions, and calculate area and volume).

A multi-step panel review process was used to construct both measures (National Center for Education Statistics [NCES], 2005). A wide range of grade-level test items were used. NCES used Item Response Theory (IRT, Hambleton & Swaminathan, 1985) methods to generate adaptive tests that were administered one-to-one to each child in an un-timed format. Children first took a brief routing test. Based on their scores from the routing test, they then completed a second test of lower-, middle-, or higher-difficulty items. IRT assumes that an underlying trait determines the probability of correct responses to test items; the IRT scores are estimates of such trait. NCES considers use of the IRT scores as the most appropriate metric for growth modeling, as these scores are comparable across different test form administrations and different grades (NCES, 2005). Reliabilities of the Reading IRT scaled scores ranged from .91 to .96 across all time points; those of the Mathematics IRT scaled scores ranged from .89 to .94 (NCES, 2005). High correlations between the ECLS-K Reading and Mathematics IRT scaled scores and scores from the Woodcock-McGrew-Werder Mini-Battery of Achievement (Woodcock, McGrew, & Werder, 1994) indicated concurrent validity.

Disability Status, Race/Ethnicity—We considered children as having an identified disability if they had an IEP on record at school in kindergarten. School administrative records are often used to identify children's disability status (e.g., Hosp & Reschly, 2002). A set of dummy variables indicated whether the child was parent-identified as White, non-Hispanic; or Black/African-American, non-Hispanic; or Hispanic; or other.

Learning-related Behaviors—We evaluated the effect of learning-related behaviors (i.e., attention, task persistence, organization, eagerness to learn, learning independence, flexibility in changes to routine). Learning-related behaviors are distinct from socio-emotional- or interpersonal-type behaviors (McClelland & Morrison, 2003) and are strong predictors of children's subsequent achievement (Morgan, Farkas, & Wu, 2009). We measured these behaviors using the kindergarten teacher ratings from the ECLS-K modified version of the Social Skills Rating System (Gresham & Elliott, 1990), Approaches to Learning subscale. The fall of kindergarten split half reliability for the subscale was .89 (NCES, 2005).

Retention and Public or Private School Status—We evaluated the effects of two additional educationally relevant variables: a binary variable indicating whether the child repeated kindergarten, and another binary variable from the school administrator questionnaire indicating whether the kindergarten was a public or private school.

Socioeconomic Status, Age, Gender—The socioeconomic status (SES) variable measured household SES by the spring of kindergarten. NCES calculates SES using information about father's (or male guardian's) and mother's (or female guardian's) education, occupation, and household income. The SES variable ranged from -4.75 to 2.75. The continuous age variable indicated children's age in months at the start of fall kindergarten (i.e., September of 1998). Interviewed parents reported children's gender.

Analytical Methods

Parallel Processes Growth Modeling—Parallel processes growth models estimate two sets of longitudinal outcomes (e.g., reading and mathematics achievement) simultaneously (Muthén, 2004). The model consists of two (or more) traditional growth curve models, each for one set of outcome. The growth factors (i.e., initial status and growth rates) are allowed to correlate across domains, and in order to test for the effect of one domain on the other (e.g., the effect of reading initial status on the growth of mathematics), we may also allow the growth rate of one domain to load on the initial status of the other domain. Note that we can also impose an alternative configuration of model by replacing the path coefficients from *I1* to *S2* and from *I2* to *S1* with correlated errors. We chose the model specification we presented in Figure 1 because we believe there might be a causal link from the initial status of reading to the growth rate of mathematics, and likewise from mathematics initial status to reading growth rate.

Growth Mixture Modeling (GMM)—GMM combined growth curve model and latent class models, and allows the growth trajectories to vary across different classes and is thus capable of modeling distinct groups of growth trajectories. We used GMM to identify heterogeneity in children's reading and mathematics achievement trajectories. Other investigators (e.g., Boscardin, Muthén, Francis, & Baker, 2008) have reported that children's achievement growth trajectories display substantial heterogeneity.

Procedures

We carried out our analyses in three steps. Step 1 involved modeling the parallel processes growth models. In Step 2, we added a set of covariates and estimated their effects on the intercepts and slopes of reading and mathematics trajectories. We were particularly interested in the effects of disability and race/ethnicity status. In Step 3, we superimposed GMM on the unconditional model from Step 1 to extract distinct classes of growth trajectories. We conducted all analyses using Mplus 6.12. Mplus is capable of handling complex stratified cluster sampling designs to obtain unbiased parameter estimates and proper standard error estimates.

The intercept *I*s and slope *S*s factors in Figure 1 were defined as follows. Factor loadings of the observed variables to the corresponding intercept factors (i.e., *I1* and *I2*) were all fixed to one to define intercepts. Factor loadings of *R1* to *S1* and *M1* to *S2* were fixed to zero so that the first time point defined initial status. Factor loadings of *R5* to *S1* and *M5* to *S2* were fixed to one to define the slopes as the change from fall kindergarten to spring fifth grade. That is, the mean slope was the mean difference between fall kindergarten and spring fifth grade. Loadings of the remaining time points to their corresponding slope factors were freely estimated. We allowed errors of adjacent time points to be correlated with each other (i.e., lag one autocorrelations) at first, and then fixed the non-significant ones to zero. Error covariances between mathematics and reading scores at the corresponding time points were also estimated to reflect the uniqueness at each time point. Goodness-of-fit was evaluated based on the chi-square statistic as well as Comparative Fit Index (CFI), Tucker-Lewis Index (TLI) and Root Mean Square Error of Approximation (RMSEA). Recommended cutoff values are close to .95 for TLI, CFI, and close to .06 for RMSEA; adequate fit of a model is supported by CFI and TLI greater than the cutoff and RMSEA lower than the cutoff (Hu & Bentler, 1999). When attempting to identify distinct classes of growth trajectories, we allowed the means and covariances of the slopes and the loadings from observed variables on the slopes to differ across classes. Doing so allowed the growth curves from each class to differ in general shapes and in their means and variability. In order to determine the optimal number of latent classes, we fitted the models with two to five classes and then compared their values on Bayesian information criterion (BIC). We used a less conservative p value of .10 to establish statistical significance because of the study's attempt to establish risk status, including among relatively small subpopulations (e.g., racial/ethnic minorities identified with disabilities in kindergarten) and the exploratory nature of our modeling of the aforementioned development processes.

Results

Are Children's Reading and Mathematics Achievement Inter-Related?

We fitted a parallel processes growth model with Reading and Mathematics Test scores from five time points. Residual variances of the observed variables were freely estimated at first, but we fixed the residual variances of the fall kindergarten reading scores to zero because its initial estimate was negative. The fit of this model was acceptable with χ^2 = 429.26, df = 27, p < .0001, CFI = .96, TLI = .93, RMSEA = .05.

Figure 1 shows the loadings and standardized path coefficients of the estimated model. Initial status scores of reading and mathematics achievement were highly correlated (r = .74, p < .001), as were their growth rates (r = .64, p < .001). Thus, kindergarten children displaying low initial levels of reading achievement also tended to display low initial mathematics achievement. Likewise, those making slow progress in reading achievement also tended to make slow progress in mathematics. The standardized path coefficient from reading initial status to mathematics slope was .28 ($p < .001$), and that from mathematics to reading was .38 ($p < .001$). Correlation between the intercept and the slope was statistically significant and negative for reading ($r = -.13$, $p < .001$), controlling for mathematics initial status scores, suggesting a slowly closing gap in reading achievement. The corresponding correlation for mathematics was statistically significant and positive ($r = .15$, $p < .001$), suggesting a slowly increasing gap in mathematics achievement. Altogether, this set of analyses indicated that reading and mathematics achievement were highly correlated both initially and over time; higher achievement in one domain in kindergarten had a statistically significant and positive effect on the subsequent growth in the other till at least fifth grade.

Do Disability and Racial/ethnic Status Predict Children's Initial and Over Time Growth in Reading and Mathematics Achievement?

All the study's predictors were added to the previous parallel processes growth model and their effects on the four growth factors were estimated. The fit of this model was good, with $\chi^2 = 700.823$, $df = 106$, $p < .001$, CFI = .96, TLI = .94, and RMSEA = .03. The interactions between disability status and race/ethnic categories consistently showed non-significant effects on either intercepts or slopes (Table 2), indicating that the predictive utility of children's disability status was similar across race/ethnic categories. Regardless of race/ethnicity, children with disabilities tended to start lower and grow slower in both reading and mathematics. They were .18 ($p < .10$) and .30 *SD*s ($p < .01$) behind children without disabilities at kindergarten entry in reading and mathematics respectively. Their growth until the spring of fifth grade was .40 ($p < .01$) and .45 ($p < .001$) *SD*s slower than children without disabilities.

Children who were racial/ethnic minorities also averaged lower intercepts and slopes than children who were White. Children who were Hispanic averaged a third of an *SD* lower in their initial reading and mathematics achievement (both *p*s < .001) than White children but had similar growth rates. In contrast, children who were Black appeared to be lagging increasingly behind. Their growth rates were .39 and .66 *SD* (both *p*s < .001) lower in reading and mathematics, respectively. Children of other races were comparable to their White peers in reading, but they were worse off in mathematics.

Learning-related behaviors and family SES showed positive effects on both the initial status and growth rates of reading and mathematics. Children who were older or repeated kindergarten initially displayed higher achievement, but they had slower growth. Children from public schools averaged lower initial status than matched peers attending private schools, but they averaged greater growth in mathematics.

Do Disability and Race/ethnicity Status Predict Latent Class Membership?

When we compared the fit indices across models with 2 to 5 latent classes, BIC kept decreasing (lower BIC indicates better fit) as number of latent classes increased (BICs= 466966, 464444, 463391, 462519). However, the 5-class model began to show difficulty in convergence, and a closer examination of the 5-class solution revealed that two of the five extracted classes were very similar. Therefore, we proceeded with the 4-class model for further analysis and interpretation. Table 3 (top panel) displays class- specific mean intercepts and slopes for the extracted classes. Class 1 (*n* = 2,014) consisted of 31% of the studied sample. We considered Class 1 as “doubly disadvantaged” in both reading and mathematics due to their lowest intercepts and lowest slopes. Class 2 (*n* = 2,421) consisted of 38% of the studied sample, characterized by average slopes in both reading and mathematics. We considered this class as (relative to the other classes) displaying “typical growth”. Class 3 (*n* = 1,581) consisted of 25% of the studied sample, characterized by the fastest growth rates and relatively high intercepts. We considered them to be a relatively “fast growth” class. Class 4 (*n* = 430) consisted of 7% of the studied sample. They were characterized by the highest intercepts and higher than average growth rates. We considered this group as constituting a “strong start” class. The lower panel of Table 3 displays descriptive statistics of the observed scores at each time point, which was consistent with the estimated achievement trajectories.

Figure 2 displays the estimated growth curves of reading (upper panel of the figure) and mathematics (lower panel of the figure) for Classes 1 to 4. The patterns were consistent with our interpretation based on the estimated intercepts and slopes. Note that the doubly disadvantaged and typical growth classes were not very different initially in reading, but the former fell increasingly behind over time. By the end of fifth grade, the doubly disadvantaged group's scores were .46 and .43 *SD*s lower in reading and mathematics, respectively, than those for the typical growth class.

Table 4 displays the effects of the study's predictors on the odds of being in a specific latent class versus the typical growth class (i.e., Class 2). Similar to Table 2, the interaction between children's disability status and race/ethnicity did not achieve statistical significance. Children with disabilities were 2.30 times (p = .067) as likely as children without disabilities to be in the doubly disadvantaged versus typical growth class. (This effect was significant at the p<.05 level in the main effects model without interactions.) Children who were minorities were more likely than white children to be in the doubly disadvantaged versus typical growth class. In addition, children who more frequently displayed learning-related behaviors were less likely to be in the doubly disadvantaged class. The last two columns of Table 4 display the effects of covariates on the likelihood of being in the fast growth or strong start classes versus the typical growth class. Children who more frequently engaged in learning-related behaviors, who were being raised in higher SES families, or who entered kindergarten at an older age were more likely to be in the fast growth or strong start classes versus the typical growth class.

Discussion

Researchers have reported or hypothesized that racial/ethnic minority children (a) are more likely to be placed into special education than otherwise identical White students and (b) when minorities are so placed, they receive lower quality special education services than Whites (Artiles et al., 2010). The current study indirectly evaluated these hypotheses by focusing on achievement scores as possible consequences of misplacement and differentiating educational experiences. We do so by examining whether there are significant interactions between children's minority status and disability status on the intercepts and slopes of their elementary school growth trajectories in both reading and mathematics achievement. Consistent with prior work (McCelland, 2006; National Council on Disability, 2011), we observed that disability and minority status independently predict lower reading and mathematics achievement. However, and unlike as has been hypothesized (e.g., Artiles et al., 2010), our results provided no empirical evidence of an interaction between these two risk factors. Instead, our results indicated that having a disability was associated with the same degree of academic disadvantage in reading and mathematics achievement regardless of children's minority status. We observed this to be the case both in initial level of reading and mathematics achievement at the start of kindergarten, and in over time achievement growth until the fifth grade.

Our investigation of children's initial and over time academic achievement informs two distinct but important issues in special education. For children who are identified as disabled during kindergarten, having a disability was observed to be associated with the same degree of academic disadvantage in reading and mathematics around the time of disability identification regardless of their minority status. Additionally, and contrary to what might be expected if minorities with disabilities were receiving lower quality special education services, receipt of these services as early as kindergarten was observed to have relatively uniform predicted effects on children's reading and mathematics achievement throughout elementary school years for whether they were White or of other race/ethnicity.

While disproportionate representation often describes a phenomenon of minority students being inappropriately placed into special education programs (Blanchett, 2006; Klingner et al., 2005), our findings suggest that being identified as disabled was associated with similar degrees of lagging achievement in reading and mathematics for both White and minority students from kindergarten to fifth grade. This might be explained by previous findings that racial/ethnic inequality occurs very early in children's life-course (e.g., Magnuson, & Waldfogel, 2005). By school entry, there may be established differences among those groups that may not be addressed by changing practices in identification. For example, Cheadle (2008) argues that family educational investment, as manifested by whether parents engage in purposeful cognitively stimulating activities, almost completely explains the White-Black achievement gaps upon school entry. Similarly, Freyer and Levit (2004) reported that the Black-White achievement gap was largely explained by a small number of covariates at school entry, and that lower school quality explained subsequent differences in these groups of children's achievement trajectories. This highlights the importance of early identification and intervention and access to quality schooling to reduce disproportionate representation, as has been recommended by other researchers (e.g., O'Shaughnessy, Lane, Gresham, & Beebe-Frankenberger, 2003). Early intervention may be more effective than remedial services because of the compounding problems associated with early school failure (Morgan et al., 2009). Furthermore, the sometimes-observed overrepresentation of minority students in special education may be partially attributable to differences in family and school-level resources (e.g., Hibel et al., 2010). Studies that account for these and other confounds instead find that minorities are under-represented in special education (Hibel et al., 2010). Therefore, early interventions designed to ameliorate the negative impact of lower quality home and school environments that are disproportionately experienced by racial/ethnic minority children may help reduce any observed overrepresentation of minority students in special education services (Conyers & Reynolds, 2003; Donovan & Cross, 2002).

From a research perspective, the current study also clarifies the interplay between reading and mathematics achievement over the elementary school years. The positive and statistically significant path coefficients from the intercept of one domain to the growth rate of the other suggest that early competencies in reading/mathematics may accelerate ability growth in mathematics/reading. This interplay is consistent with prior work reporting (a) a positive effect of early reading achievement on later mathematics achievement (Jordan et al., 2002), and (b) a positive effect of early mathematics achievement on later reading achievement (Duncan et al., 2007). That early competency in mathematics may be even more important to later growth in reading achievement than even early reading achievement is consistent with this prior work as well (Duncan et al., 2007).

By modeling reading and mathematics achievement trajectories simultaneously, we identified four distinct latent classes characterizing children's achievement growth from the beginning to the end of elementary school. We identified one group as being doubly disadvantaged in both reading and mathematics, as indicated by their relatively lower initial achievement and slower growth in both domains. The average reading and mathematics initial status and growth rates of this class were at least half a *SD* below the overall average. Identification of this group based on GMM provides evidence for the existence of a comorbid group previously identified through specified cutoff scores in other research (Jordan et al., 2002). The size of this group (30% of the sample) appears to be larger in our analysis than in previous studies. A possible explanation for the smaller share of this group from previous studies is that previous studies have utilized percentage breakdowns or absolute cutoff scores to define comorbidity. The advantage of such usage is the possible clinical implications, but the associated disadvantage is the potential lack of validation given the arbitrary nature of the chosen percentage or cutoff scores.

We identified factors predictive of children's likelihood of belonging to the doubly disadvantaged group. Both disability status and minority race/ethnicity were associated with increased likelihood of membership in this class. However, there was no evidence of an interaction. Our study did not identify a class of children displaying learning difficulties in only one domain. This may be because the sample size of such a group was too small for GMM to reliably identify.

In addition to disability status and minority status, we also found consistent effects of SES and approaches to learning on reading and mathematics achievements (Duncan et al., 2007). Higher SES and more frequent engagement in approaches to learning behaviors were associated with higher initial status in both reading and mathematics, and more rapid growth in both domains. Further, those with more frequent approaches to learning behaviors also showed higher likelihood of being in the fast growth and strong start class, and lower likelihood of being in the doubly disadvantage class.

Limitations

Failing to observe a significant interaction between minority status and disability status on either the intercept or slopes of minority and non-minority children's academic growth trajectories does have inherent limitations. For example, such empirical tests are influenced by statistical power, which itself partially depended on sample size. Even in a large, population-based sample, being both disabled and a minority constitute an interacting condition that has low prevalence. In addition, an interaction may occur in other indicators of school functioning than reading and mathematics achievement. For instance, and although the misplacement or differentiating services may not exert an effect on reading or mathematics achievement, it may result in an interaction on non-achievement indicators such as social-emotional development. Due to the nature of secondary data analysis, our sample is also limited to students whose disabilities can be accommodated by the ECLS-K settings (NCES, 2006). We were unable to test for interactions between minority status and non-surveyed disabilities (e.g., blindness, deafness).

The current study has additional limitations. We did not distinguish among specific subtypes of disabilities. The ECLS-K did not oversample students with disabilities and so statistical power would have been low in analyses of each specific disability subtype. Although we expect certain degrees of variation among the experiences of students with different disabilities, collectively those experiences tend to be negative when compared with their non-disabled age-mates. The current study focused on individual level characteristics. However, we acknowledge the importance of geographic variations in minority representation of different disability subtypes (Zhang & Katsiyannis, 2002). We were unable to test for geographic variation as doing so would have greatly reduced statistical power. However, we note that, unlike studies reporting on geographic variation in regards to disproportionate representation, our analyses accounted for individual-level confounders that may also explain disproportionality attributable to individual student's race/ethnicity. Contextual factors such as school and home environment also plays important roles in children's development and they may interact with child-level characteristics such as disability and minority status (Lindsay, Dockrell, & Strand, 2007; Reschly & Christenson, 2007). The study's fit indices from GMM did not provide a clear solution to the number of latent classes. However, because clear divergences between any pair of latent trajectory classes were observed, we considered the 4-class solution to be both justifiable and consistent with the exploratory purpose of the study.

Study's Contributions and Implications

Our findings of a lack of interaction between children's status as disabled and as a minority on their initial and over time growth in reading and mathematics has several implications for policy and practice. First, our results indicate that having a disability is associated with a negative but fairly uniform effect across racial/ethnic groups on children's reading and mathematics achievement around the time of special education placement during kindergarten. This suggests that efforts to reduce disproportionate representation likely need to occur prior to school entry. After this time period, achievement gaps become quite stable (Reardon, 2011). Second, we find no evidence that minority children with disabilities benefit less from special education in reading and mathematics growth over time. We caution that such a conclusion is based on an aggregate level, and we would discourage any attempt to make individual decisions based on such a conclusion. However, our results are not consistent with prior hypotheses that minority students with disabilities receive lower quality educational experiences than similarly disabled White students.

In sum, children's reading and mathematics achievement highly correlate across elementary school, both in their initial status and over time growth. Although being disabled and being a racial/ethnic minority independently predicts lower achievement in both reading and mathematics initially and over time, these predicted effects are likely additive—not multiplicative.

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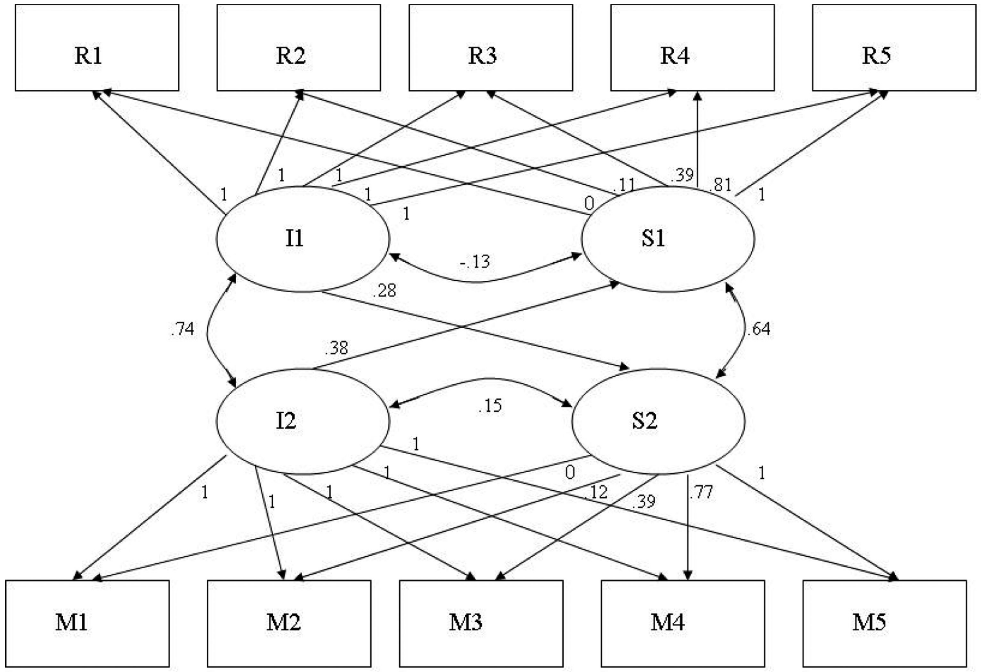

Figure 1.

Estimates from parallel processes growth curve analyses of reading and mathematics from kindergarten to fifth grade.

Notes. R1-R5: reading IRT scaled scores at five time points; *M1-M5*: mathematics IRT scaled scores at five time points. *I1*/*I2*: intercepts for reading/mathematics growth trajectories; *S1*/*S2*: slopes for reading/mathematics growth trajectories. Estimates are standardized except for factor loadings.

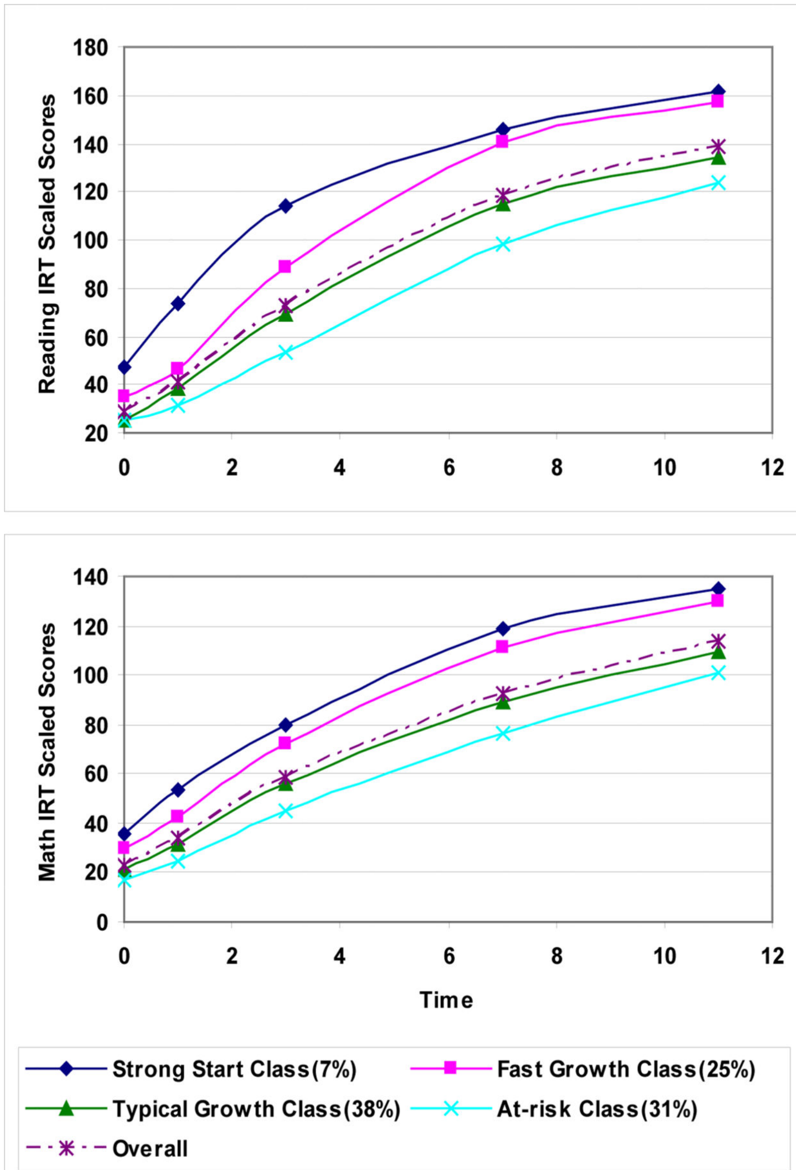

Figure 2.
Estimated reading and mathematics growth trajectories for the four latent classes.

Table 1

Descriptive Statistics of the ECLS-K Longitudinal Sample and Analytical Samples

Key Covariates	Full Sample *n* = 9,796	Analytical Sample *n* = 6,446	*p*-value[1]
Gender			.43
Male	51%	52%	
Female	49%	48%	
Race/Ethnicity			<.01
White	58%	63%	
Black	16%	15%	
Hispanic	19%	15%	
Other	7%	7%	
SES	−.03 (.80)	.01 (.81)	<.01
Age at K. entry (in months)	65.54 (4.17)	65.78 (4.17)	<.01
Repeat K.	4%	4%	.09
Public School	85%	85%	.50
IEP	8%	8%	.36

Notes. Estimates were weighted by the longitudinal sampling weights C1_6FC0. Numbers within the parentheses are *SD*s for the continuous variables.

* $p < .05$

** $p < .01$

*** $p < .001$

[1] *p* value reflected whether missing in the analytical sample was statistically associated with each key variable.

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Table 2

Standardized Coefficients of Covariates on Reading and Mathematics Achievement Growth Factors

Covariates	Reading		Mathematics	
	Intercept	Slope	Intercept	Slope
IEP	−.18†	−.40**	−.30**	−.45***
Approaches to learning	.26***	.15***	.33***	.24***
Public School	−.20*	.05	−.23**	.16**
Repeat Kindergarten	.62***	−.79***	.66***	−.64**
SES	.32***	.14**	.33***	.21***
Age	.17***	−.10***	.26***	−.14***
Gender (Female)	.06	−.02	−.16***	−.46***
Race[1]				
Black	−.07	−.39***	−.32***	−.66***
Hispanic	−.35***	−.03	−.40***	−.08
Other	−.12	−.08	−.24**	−.19[1]
Black*IEP	.07	.10	.22	.06
Hispanic*IEP	.13	−.13	.11	.17
Other*IEP	−.06	−.36	−.05	−.34
R^2	.32	.27	.45	.32

Notes. The reported standardized coefficients indicate amount of *SD* change in the growth factors associated with either a one *SD* change in continuous predictors, or a change from 0 to 1 in dichotomous predictors.

[1] Reference category was students who were white.

† $p < .10$

* $p < .05$

** $p < .01$

*** $p < .001$

Table 3

Descriptive Statistics of the Growth Trajectories, Observed Scores and Demographics of the Four Latent Classes

Variables	Class 1: Doubly Disadvantaged (31%)	Class 2: Typical Growth (38%)	Class 3: Fast Growth (25%)	Class 4: Strong Start (7%)	Overall
Reading Growth Trajectories					
intercept	24.90(5.18)	25.65 (4.49)	35.12(7.27)	47.19(19.75)	29.19(9.89)
slope	99.18(21.76)	109.02(17.0)	122.44(11.23)	114.17(18.28)	109.94(19.94)
Mathematics Growth Trajectories					
intercept	17.29(3.54)	20.94(3.85)	30.01(7.35)	35.93(11.70)	23.08(8.75)
slope	83.89(18.98)	88.24(15.43)	99.62(9.79)	98.97(9.37)	90.38(16.87)
Reading Scores					
Fall-K	25.09(7.04)	25.58(5.67)	35.73(8.25)	47.64(24.43)	29.53(12.95)
Spring K	31.61(8.67)	38.43(8.37)	46.82(8.93)	74.28(23.94)	40.92(17.47)
Sprig 1st	53.20(17.43)	69.51(17.76)	89.29(17.87)	113.90(23.95)	72.36(29.24)
Spring 3rd	98.12(29.10)	115.94(23.09)	141.85(15.42)	145.69(21.71)	118.93(32.74)
Spring 5th	123.93(33.14)	135.23(23.72)	158.50(13.89)	161.57(15.69)	139.25(30.61)
Mathematics Scores					
Fall-K	17.09(6.33)	20.97(6.19)	30.50(9.25)	36.12(15.88)	23.12(11.53)
Spring K	24.10(7.93)	32.O9(8.76)	42.80(11.12)	53.03(18.28)	33.63(15.29)
Sprig 1st	44.10(14.14)	57.14(14.12)	72.91(15.80)	78.82(21.50)	58.38(21.92)
Spring 3rd	75.39(24.14)	89.76(20.62)	112.02(15.07)	118.73(14.72)	92.70(28.31)
Spring 5th	100.73(29.87)	109.77(24.05)	130.39(13.43)	134.90(12.35)	113.73(28.18)

Notes. Estimates were weighted by the longitudinal sampling weights C1_6FC0. Numbers within the parentheses are *SD*s for the continuous variables.

Table 4

Effects of Covariates on Latent Class Membership Using the Typical Growth (Class 2) as the Reference Category (Odds Ratios)

Covariates	Class 1 (Doubly Disadvantaged)	Class 3 (Fast Growth)	Class 4 (Strong Start)
IEP	2.30†	.83	1.89
Approaches to learning	.56**	2.41***	2.87***
Repeat K.	1.42	1.17	.31
Public School	.91	.69	.81
SES	1.09	4.28***	4.31***
Age	1.02*	.97***	.96**
Gender (Female)	1.12	.82	.71
Race[1]			
Black	1.61*	.37**	.44
Hispanic	2.28**	.58	.89
Other	1.40	.56*	.82
Black * IEP	3.23	2.47	7.72
Hispanic * IEP	.42	.19	.34
Other * IEP	1.93	1.39	.92

Notes. IEP = Individualized Education Plan; SES = Socio-economic status. Class 2 (Typical Growth class) was used as the reference group.

[1]Reference category was students who were white.

$^{\dagger}p < .10$

$^{*}p < .05$

$^{**}p < .01$

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