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EdWorkingPaper No. 21-429

Racial and Socioeconomic Disparities in the Relationship Between Children's Early Literacy Skills and Third-Grade Outcomes: Lessons from a Kindergarten Readiness Assessment

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Third grade is oftentimes the first year standardized literacy assessments are mandated. In turn many policies aimed at improving literacy have focused on third-grade test scores as a key indicator. Yet literacy struggles begin well before third grade, as do racial and socioeconomic disparities in children's literacy skills. Kindergarten readiness assessments provide a unique opportunity to better understand the emergence of literacy disparities. We use unique kindergarten literacy data from nearly every school district in Virginia to document the relationship between children's early literacy skills and their later reading proficiency. Comparing children with similar literacy skills at kindergarten entry, we find significant racial and socioeconomic differences in the likelihood a child is proficient on their third-grade reading assessment.

VERSION: June 2021

Suggested citation: Herring, Walter, Daphna Bassok, Anita McGinty, Luke C. Miller, and James H. Wyckoff. (2021). Racial and Socioeconomic Disparities in the Relationship Between Children's Early Literacy Skills and Third-Grade Outcomes: Lessons from a Kindergarten Readiness Assessment. (EdWorkingPaper: 21-429). Retrieved from Annenberg Institute at Brown University: https://doi.org/10.26300/qay6-5224

Racial and Socioeconomic Disparities in the Relationship Between Children's Early Literacy Skills and Third-Grade Outcomes: Lessons from a Kindergarten Readiness Assessment

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Third-grade literacy is often framed as a watershed moment when children transition from "learning to read" to "reading to learn" (Annie E. Casey Foundation, 2010). Children who are not reading on grade level by third grade are four times more likely to drop out of high school than those who are reading on grade level. Adding to these concerns, Black, Hispanic, and low-income children are especially likely to be reading below grade level in third grade (Annie E. Casey Foundation, 2010). For these reasons, policymakers and practitioners have focused heavily on children's reading skills in third grade through initiatives like the federal "Reading First" program (Gamse et al., 2009) and state legislation like "Read by Grade Three" laws that have been enacted in 16 states plus the District of Columbia (National Conference of State Legislatures, 2019).

Of course, language and literacy skills, as well as systematic disparities in these skills based on race and socioeconomic status (SES), emerge much earlier than third grade (Fernald et al., 2013). However, Federal law mandates that schools administer standardized assessments in grades 3 through 8 and holds them accountable for students' academic performance in these middle grades. Because educational assessment and accountability policies tend to start with third grade, policymakers and policy researchers often focus there, rather than on the early elementary grades.

The lack of systemwide assessment data in the early elementary grades may also hamper stakeholders' ability to identify and address inequities in children's learning opportunities. The widespread availability of academic data in grades 3 through 8 enables policymakers to track the

development of test-score disparities at the state, district and even school levels (e.g., Reardon et al., 2019). Armed with such information, stakeholders can better identify which localities or campuses are in need of additional resources and work to address these inequities in the upper elementary and middle grades. Traditionally, however, policymakers have lacked the systemwide data necessary to inform decision making in the early elementary grades.

In an effort to better support learners in the early grades, policymakers in recent years have invested considerable resources in developing kindergarten readiness assessments (KRAs). Most notably, the Obama administration's Race to the Top Early Learning Challenge (RTT-ELC) identified implementing KRAs as a priority for applicants for federal aid (Administration for Children and Families, 2019). The majority of states now employ some form of KRA, and a growing number offer the same assessment to all entering kindergarteners (Education Commission of the States, 2018).

KRAs can be used in multiple ways (Regenstein et al., 2017). Practitioners, for example, can use them to screen children for specific supports and to inform their teaching in the early grades. Researchers and policymakers might also leverage data from KRAs to substantially expand our understanding of literacy development in the early grades: They can be used to track trends over time (e.g., are children arriving to school with stronger skills), to better understand disparities between groups (e.g., are there differences in children's skills between low- and high-income children), and to learn how children's skills at kindergarten entry relate to their future attainment on "high-stakes" assessments.

In this study, we highlight the utility of KRAs using novel data from Virginia, where all incoming kindergarteners in all but one school division take a literacy KRA [1]. Using these

data, we assess the extent to which literacy skills at kindergarten entry predict outcomes on third-grade state reading exams and whether this relationship varies by race and socioeconomic status.

This study is the first that we know of to link results from a statewide KRA to results on a high-stakes assessment and explore how this relationship varies by race and economically disadvantaged status. Consistent with prior research, we find that Black, Hispanic, and economically disadvantaged children enter kindergarten with fewer literacy skills on average than their peers and that kindergarten literacy skills are strong predictors of third-grade reading scores. Our key finding is that the link between literacy skills at kindergarten entry and third-grade reading proficiency differs substantially based on race and economically disadvantaged status. That is, irrespective of their literacy skills at kindergarten entry, White and more economically advantaged children are far more likely to be proficient readers by third grade than are Black, Hispanic, and economically disadvantaged children starting kindergarten with the same skills.

Background

Literacy Skills at Kindergarten Entry

Children enter kindergarten with widely divergent literacy skills. National datasets such as the Early Childhood Longitudinal Study (ECLS) show that Black, Hispanic, and economically disadvantaged children enter kindergarten with substantially lower reading skills than do their White and higher-income peers (Fryer & Levitt, 2004; Quinn, 2015; Reardon & Portilla, 2016; von Hippel & Hamrock, 2019). Using data from 2010, Reardon and Portilla (2016) estimate the Black-White reading readiness gap to be nearly one-third of a standard deviation. The Hispanic-White reading readiness gap is comparatively larger (0.56 standard deviations), though this figure likely masks considerable heterogeneity based on English language proficiency (Reardon

& Galindo, 2009). Along lines of SES, Reardon and Portilla (2016) estimate the disparity in reading test scores at kindergarten entry among children at the 90th percentile of income and those at the 50th percentile to be 0.58 standard deviations.

Kindergarten Skills and Future Outcomes

These disparities are important because children's skills at kindergarten entry predict their future outcomes. A metanalysis of more than 30 studies documented a moderately strong correlation between children's academic skills in kindergarten and their skills in first and second grade (r=0.48) (La Paro and Pianta, 2000). More recent work has corroborated these conclusions. For example, using KRA data from Ohio, Justice and colleagues (2019) find a very similar relationship between children's early skills and their later standardized test results (r=0.46). Some studies have also shown early literacy skills are correlated with much more distal adult outcomes: Chetty et al. (2011), for example, find a correlation between children's kindergarten test scores and their earnings at age 27.

Racial and socio-economic disparities in literacy skills observed at kindergarten entry also persist. For instance, data from the 1998 cohort of ECLS-K show that the Black-White disparity in average reading skills remains relatively stable during the early elementary grades and begins to expand more rapidly beginning around third grade (Reardon, 2011; Reardon et al., 2015). The same pattern holds for children in the top and bottom quintiles of the income distribution (Reardon et al., 2015).

Although a relatively large literature has documented disparities in children's literacy skills throughout the elementary grades, almost no studies have considered whether children who enter kindergarten with *the same literacy skills* have different early literacy trajectories depending on their race or SES. Claessens et al. (2009) is the only study we know of that uses

ECLS-K or similar data to examine differences in the relationship between early literacy skills and later-grade outcomes across subgroups, and that study did not find evidence of such differences. A recent analysis of ECLS-K data by Vinopal and Morrissey (2020) does find disparities in literacy growth rates in the early elementary grades along lines of neighborhood SES, but that study doesn't explore whether children with the same skills at kindergarten entry experience differential growth.

It is important to explore whether the relationship between early literacy skills and later reading outcomes varies by subgroup in order to determine how best to address racial and socio-economic test-score disparities in the early elementary grades. Systematic racial and socio-economic differences in third-grade reading scores even among children who start kindergarten with the same skills may point policymakers to inadequacies in interventions or inequities within and between schools.

The Utility of Kindergarten Readiness Assessments

To date, much of our understanding about differences in early learning trajectories across groups comes from large-scale datasets like the ECLS-K and similar datasets like the Measure of Academic Progress assessment data collected by NWEA. These data are useful for understanding overall trends, but tend to rely on relatively small samples at the state, school, or classroom levels.

For educators and state and local policy-makers, data that are representative of their own local context are more actionable and relevant. KRAs fill this need. The majority of states now require some form of readiness assessment in the early elementary years, with many states placing a particular focus on assessing children's literacy skills (Education Commission of the States, 2018). These assessments are intended to provide reliable data that can inform teachers'

classroom instruction and state and local policymakers' resource allocation (Regenstein et al., 2017).

KRA data also provide education stakeholders with an opportunity to better understand literacy disparities. Grodsky et al. (2017) highlighted the utility of statewide KRA data by documenting differences in kindergarten literacy skills across subgroups of children, schools, and districts in Wisconsin. Justice et al. (2019) used data from Ohio's KRA to explore the relationship between children's skills at kindergarten entry and their later academic outcomes, However, to date KRA have not been used to assess how racial and socioeconomic disparities in academic skills develop between kindergarten and third grade. This study aims to fill this gap.

Present Study

This study uses KRA data to explore the relationship between children's literacy skills at kindergarten entry and their future reading outcomes. We link nearly 70,000 children's scores on a statewide literacy readiness assessment to their later outcomes on a high-stakes reading assessment. All but one school division in Virginia administers the same literacy KRA to all entering kindergarten students. These rich data allow us to provide a nearly state-wide look at the relationship between children's literacy skills at kindergarten entry and their subsequent performance on a high-stakes reading assessment. As far as we know ours is the first study to use statewide data to examine whether there are systematic racial and socio-economic differences in the likelihood that children who enter kindergarten with comparable skills will reach proficiency by third grade. In doing so, we hope to highlight the utility of KRAs in informing policymaking in the early elementary grades.

Data

Virginia legislation requires that school divisions administer a state-approved literacy assessment to children during the fall of kindergarten. All but one of Virginia's 132 public school divisions administers the Phonological Awareness Literacy Screening (PALS) assessment, accounting for roughly 85% of kindergarteners in the state [2]. PALS measures children's knowledge of literacy fundamentals including phonological awareness, alphabet recognition, knowledge of letter sounds, and spelling. PALS is administered by the child's classroom teacher, usually in a one-on-one setting with the exception of several subtasks that are conducted in small groups of children. The assessment has been validated, with Cronbach's alpha coefficients ranging from 0.79 to 0.89 and inter-rater reliability correlations ranging from 0.96 to 0.99 (Invernizzi et al., 2017).

Kindergarten and Third-Grade Literacy Skills

Phonological Awareness Literacy Screening

Each record in our data contains a child's score on the PALS assessment in the fall of kindergarten. For the purposes of this analysis, we focus on children's overall score across the various subtasks of the assessment. Scores on the fall kindergarten assessment range from 0 to 102. We operationalize children's literacy skills at kindergarten entry three ways. First, in our main results, we divide children into quintiles based on their score on the PALS assessment. This quintile approach provides a crude but easy-to-interpret way to highlight patterns across different parts of the early literacy distribution.

However, dividing children into quintiles might mask important "within-quintile" differences in literacy skills across race and economically disadvantaged status. For instance, it may be that even among the lowest quintile of kindergarteners, high-income children

systematically score higher on the PALS than lower-income children. To address these concerns, we also report results from a second set of analyses where we consider children's continuous PALS score at K entry (shown in Appendices A and B). These results are consistent with the trends we identify using our quintile approach.

Finally, PALS provides a "benchmark" threshold that is designed to identify children who are relatively behind in their acquisition of these fundamentals and may benefit from academic intervention. In Virginia, all children who score below this benchmark are eligible for early intervention. For this reason, we also run a final set of analyses considering children whose PALS scores fall above and below the PALS benchmark. These results are reported in Appendix C and again are consistent with our main results.

Virginia Standards of Learning

We link children's PALS scores to their third-grade reading scale score on the Virginia Standards of Learning (SOL) assessment. The SOL, scored on a scale of 0 to 600, is Virginia's high-stakes student achievement assessment. We focus on whether a child reached proficiency or advanced status in third grade. Children scoring 400 or higher on the SOL are considered proficient and children scoring 500 or higher are classified as advanced. Children who score below proficient on the SOL assessment are required to attend some form of remediation program, usually taking place during the summer. Results from the SOL are also used to determine schools' accreditation status.

Student Covariates

Our data include child-level covariates provided by the Virginia Department of Education (VDOE), including an indicator for race (classified as White, Black, Hispanic, and Other Race), gender, English Learner (EL) status, and economically disadvantaged status [3]. The race,

gender, and EL indicators are recorded in the fall of kindergarten when the child takes the PALS assessment. We use the earliest indicator of children's economically disadvantaged status available in our data (usually collected annually between kindergarten and third grade).

Sample

Our dataset consists of nearly 80,000 children who entered kindergarten for the first time in the fall of 2013 [4]. We reduce the sample to exclude children who leave our sample before taking the SOL exam in third grade and children who score 0 on the SOL as VDOE considers this to be an invalid score. We also exclude children who take a modified version of the SOL assessment based on their language proficiency or disability status. These exclusions leave us with a final analytic sample of 67,164 children. Most of our sample entered third grade during the 2016-17 school year. We also include children who were once retained and took the third-grade reading exam in 2017-18 (n=4,476).

Attrition

Children for whom we do not have both a kindergarten PALS score and a third grade SOL differ from children with both scores. For example, the children in our analytic sample are 5.3 percentage points more likely to be disadvantaged and 3.2 percentage points more likely to be EL than the students excluded. A full summary of attrition can be found in Appendix D. Encouragingly, attrited children did not differ from our analytic sample with respect to PALS scores. Even so, this attrition should be kept in mind when interpreting the generalizability of the results we report below.

Descriptive Statistics

About half of children in our sample are White, about a quarter Black and 14 percent Hispanic. Half of all children are identified as economically disadvantaged. We divide the

Hispanic subgroup into Hispanic children who are identified as ELs and those who are not identified as ELs in the fall of kindergarten as we expect these two groups to have different literacy trajectories (Reardon & Galindo, 2009). Nearly 75% of children identified as EL in kindergarten in our sample are Hispanic [5]. Appendix E contains a table showing descriptive statistics for our sample, both overall and for each quintile of the PALS distribution.

Methodology

We assess the probability that a given child will meet proficiency or advanced standards on their third-grade SOL exam conditional on their literacy skills at kindergarten entry. We use the following base model to quantify the probability that child *i* will be proficient (or advanced) on their SOL exam in third grade conditional on their PALS quintile and their race or disadvantaged status:

$$(1)\ SOL_i = \theta' \sum_q \sum_g \left(Quintile_i^q * Group_i^g\right) + \varepsilon_i$$

Where SOL_i indicates whether or not child *i* was proficient (or advanced) on their third-grade reading SOL exam, $Quintile_i^q$ represents a vector of indicator variables for each quintile, *q*, of the kindergarten PALS distribution, and $Group_i^g$ indicates the racial or economically disadvantaged group, *g*, of child *i.* We estimate separate models for race/ethnicity and disadvantaged status.

Results

Consistent with prior studies we find substantial racial and socioeconomic disparities in kindergarten literacy skills. Table F1 in Appendix F shows standardized disparities in PALS scores along lines of race and SES for children in our sample. White and economically advantaged children in our sample enter kindergarten with higher literacy skills, on average, than their Black, Hispanic, and economically disadvantaged peers.

Also consistent with earlier work we find that children's kindergarten literacy scores predict their third-grade outcomes. The Pearson's correlation between children's PALS sum score and their score on the third-grade SOL reading assessment is 0.47. The positive relationship between early skills and later reading outcomes is echoed in Figure 1, which displays the proportion of children in each PALS quintile that reach proficiency standards on their third-grade reading assessment. Less than half (47%) of children who entered kindergarten with literacy skills in the lowest quintile reached proficiency standards on their third-grade reading assessment, compared to 94% of children who entered kindergarten in the highest quintile.

-FIGURE 1 ABOUT HERE-

The central question of this analysis is whether the relationship between children's kindergarten skills and third-grade reading outcomes differs by race and disadvantaged status. We find large differences in the probability of passing the third-grade reading SOL among children whose PALS scores at kindergarten entry were in the same quintile (Figure 2).

For instance, 55% of White children who started kindergarten with literacy scores in the lowest quintile ultimately were proficient on the third-grade SOL. In contrast, this was only true for 35% of Black children. As another illustrative example, 72% of Black children who entered kindergarten with literacy skills in the fourth quintile (well above the median skill level) met the proficiency standard. This was the same rate as White children whose kindergarten PALS score was in the second quintile (well below the median). While the Black-White disparities displayed in Figure 2 are quite large, the disparities between Hispanic (non-EL) children and White Children are comparatively small.

- FIGURE 2 ABOUT HERE -

There are also substantial differences in third-grade outcomes between economically disadvantaged children and their more-advantaged counterparts (Figure 3). Among children who start kindergarten in the lowest quintile of literacy skills, economically disadvantaged children are 17 percentage points less likely to meet proficiency standards in third grade than their peers who are not economically disadvantaged. Though we treat race and economically disadvantaged status separately in Figures 1 and 2, the patterns discussed are largely unchanged when we account for both simultaneously (Appendix B).

- FIGURE 3 ABOUT HERE -

It could be the case that there are differences in the distribution of PALS scores across subgroups within each quintile. For example, Black children may enter kindergarten with relatively lower scores than White children on average within a given PALS quintile. Chi-squared analyses shown in Appendix A confirm there are racial and socioeconomic differences in scores within PALS quintile. These differences could explain any racial and socioeconomic differences in third grade outcomes we observe in Figures 2 and 3. To address this possibility, we present results from a model that accounts for children's continuous PALS score within each quintile in Appendix A. Results are largely similar to those we report based on Equation 1 with two notable exceptions: for children in the first quintile, holding PALS scores constant within quintile decreases the Hispanic (EL) and White disparity by 46 percent and the disadvantaged and non-disadvantaged disparity by 35%. In Appendix B, we also present results from models that control for children's continuous PALS score and allow the relationship to vary for each racial subgroup of children. We again find these results to be consistent with those we report in the main body of the paper.

Virginia provides intervention funding for children who enter kindergarten with a score below 28 on the PALS. This benchmark score falls roughly in the middle of the first quintile of the kindergarten PALS distribution. In Appendix C we document that, among children who are identified for this intervention, Black, Hispanic EL, and economically disadvantaged children remain considerably less likely to recover from early reading struggles than their White and more advantaged peers.

Although we document racial and socioeconomic disparities within every PALS quintile, the magnitude of these disparities diminishes in the higher quintiles. This pattern may be the result of a "ceiling" effect: Nearly all children in the top quintile of PALS (94%) are proficient in reading in third grade (Figure 1). To address this possibility, we also look at the likelihood of reaching advanced proficiency on the third-grade reading SOL (i.e., a score of 500 or greater) conditional on children's kindergarten literacy quintile and their race or disadvantaged status. Figures 4 and 5 demonstrate significant disparities along lines of both race and disadvantaged status in reaching advanced proficiency on the SOL.

- FIGURE 4 ABOUT HERE -

- FIGURE 5 ABOUT HERE -

Among children entering kindergarten with literacy skills in the top quintile, White children are more than twice as likely to meet advanced standards by the end of third grade relative to their Black peers (43% vs. 20% respectively), a pattern that holds in every quintile of the PALS performance distribution. Appendix B documents that racial disparities in the likelihood of reaching advanced status increase considerably for children that enter kindergarten with relatively higher literacy skills.

Discussion

Though the early elementary grades are a critical period in young children's literacy development, until recently, few states collected state-wide assessment data in the early grades. The lack of systemwide academic information in the early elementary grades has hampered our ability to understand how achievement disparities along lines of race and SES develop prior to third grade, especially at the state and local levels. School readiness assessments, which are becoming common nationwide, create an opportunity to address this gap. In this paper we used KRA data from Virginia to explore how the relationship between children's literacy skills at kindergarten entry and their future reading outcomes varies across racial and socioeconomic subgroups.

Consistent with prior literature, we document significant disparities in literacy skills at kindergarten entry along lines of race and SES. Like prior studies using the ECLS-K, we find that Black, Hispanic, and economically disadvantaged children enter kindergarten with fewer literacy skills on average than their White and economically more advantaged peers. Our estimate of the relationship between children's skills at kindergarten entry and their future reading outcomes in third grade is also consistent with prior studies. The correlation we report between kindergarten skills and third-grade scores is almost identical to the correlations that La Paro and Pianta (2000) and Justice et al. (2019) find in their examinations of the relationship between children's early academic skills and their later outcomes.

Our key contribution is providing evidence of heterogeneity in this relationship across race and SES. We find that Black, Hispanic EL, and economically disadvantaged children are substantially less likely to reach proficiency standards on their third-grade reading assessment relative to their White and more-advantaged peers who enter kindergarten *with similar literacy*

skills. We document similar disparities in the likelihood children reach advanced status on their third-grade standardized reading assessment across subgroups. These disparities were strikingly large for Black children and economically disadvantaged children. Children in these subgroups that enter kindergarten with literacy skills in the lowest quintile are roughly twenty percentage points less likely to reach reading proficiency in third grade than White children and more economically advantaged children who enter kindergarten with skills in the same quintile. By contrast, we find much smaller disparities among non-EL Hispanic children and White children

From a policy perspective, it is notable that these trends hold for children that are identified as in need of intensive reading intervention at kindergarten entry (Appendix C). The differences along lines of race and economically disadvantaged status in the likelihood of recovering from early reading struggles suggest that evaluating Virginia's targeted intervention strategy might provide important insight into how the state could improve outcomes for Black, Hispanic, and economically disadvantaged children who enter kindergarten with low literacy skills.

These findings are based on the relationship between a specific measure of early literacy and children's future reading outcomes. It may be that the results we report here would be different if we employed other measures of children's skills at kindergarten entry. For example, economically disadvantaged and non-disadvantaged children that enter kindergarten with the same score on the PALS assessments may systematically differ in their skill levels in other domains (e.g., mathematics or social-emotional skills). These underlying differences, in turn, might explain economically disadvantaged children's lower proficiency rates on their third-grade reading assessment. In this vein, Virginia has rolled out the Virginia Kindergarten Readiness Program (VKRP), a new readiness assessment designed to measure children's mathematics and

social-emotional skills at kindergarten entry in addition to their literacy skills. Linking VKRP results to children's future academic outcomes offers an opportunity to observe whether the trends we document here are consistent across other cognitive and non-cognitive domains in both kindergarten and third grade.

Implications

This study aimed to highlight the promise of KRA data for helping policymakers and practitioners better understand literacy development in the early grades, and particularly racial and socio-economic differences in children's early literacy development. Although earlier studies have shown racial and socioeconomic gaps in literacy skills at school entry, as well as links between these early skills and later outcomes of interest, our work is the first to use statewide data to documents large differences by race and SES in the likelihood children who start school *with the same literacy skills* achieve reading proficiency in third grade,

While the overarching state-level finding is striking, KRAs are also powerful because policymakers and practitioners can use these data to identify localities or even specific schools in which such disparities are most stark in order to provide additional resources or supports to address these inequities. KRAs could thus be used to significantly enhance targeted literacy investments in the early grades. Using data from KRAs in this manner will prove especially important as states begin to address the fallout of the COVID-19 pandemic: Early assessment data gives policymakers an opportunity to address children's post-COVID needs early in their academic careers when interventions have the greatest impact (Cunha & Heckman, 2007). The same data could also be used to evaluate the success of intervention efforts in ameliorating these disparities.

Of course, successfully addressing the inequities documented in the current paper requires identifying their source. Here, we document three plausible explanations. First, it could be the case that the disparities we observe here are driven by differences in instructional quality or resource availability *between* the schools that children attend. For example, White and economically advantaged children are more likely to attend schools that are better funded or have more experienced and effective teachers (Goldhaber et al., 2015; Hanushek & Rivkin, 2006). Such inequitable experiences among different groups of children across schools could explain why White and economically advantaged children are more likely to reach proficiency standards on their third-grade reading exam.

Second, it could also be the case that the disparities are driven by differential experiences that children have *within* schools. There are a number of within-school considerations that might contribute to differential student learning across subgroups attending the same school, including academic tracking (e.g., Lucas & Berends, 2007), placement into gifted programs (e.g., Grissom & Redding, 2016), differences in teachers' expectations (Papageorge et al., 2019), disparities in special education placement (e.g., Morgan et al., 2015), and ability grouping (Lleras & Rangel, 2009). Such inequities in children's opportunities within the same schools might contribute to the patterns we document in this paper.

Lastly, outside-of-school factors could also be responsible for the disparities. As Merolla and Jackson (2019) convincingly argue, the within- and between-school factors highlighted above cannot fully account for disparities in children's academic outcomes. Rather these school-based inequities are only symptoms of the deeper societal issues of structural racism and economic bias. These structural inequalities influence many facets of society beyond education, including housing, criminal justice, and finance. As such, Merolla and Jackson (2019) posit that

it is difficult, if not impossible, to address educational inequities like we highlight here without reducing socio-economic disparities along lines of race and income more broadly.

While the current analyses leverage KRA to describe differences in the link between school entry skills and later outcomes, the same data, and KRA data from other states, provide the type of system-wide information needed to better understand how within-school, between-school, and outside-of-school factors influence the racial and socioeconomic inequities we document here.

Endnotes:

[1] While most states refer to public education entities over which a school board has jurisdiction as "school districts," these entities are referred to as "school divisions" in Virginia.

[2] Fairfax County is the lone division in the state that uses a different literacy readiness assessment.

[3] The Virginia Department of Education identifies students as economically disadvantaged if they either (1) are eligible for Free/Reduced Meals, (2) receive TANF, (3) are eligible for Medicaid, or (4) are identified as migrant or experiencing homelessness.

[4] These data do not include a subset of children with disabilities whose Individualized Education Plans specifically require them to take a modified version of the PALS assessment. A relatively small number of children in this sample are missing data on the economically disadvantaged indicator but are included in all analyses not involving disadvantaged status (275 observations).

[5] We do not divide other racial subgroups into similar EL and non-EL groups because ELs make up a very small proportion of other racial subgroups in our data.

Figures

Figure 1: Probability of Proficiency on Third-Grade SOL by Kindergarten PALS Quintile (All Children)

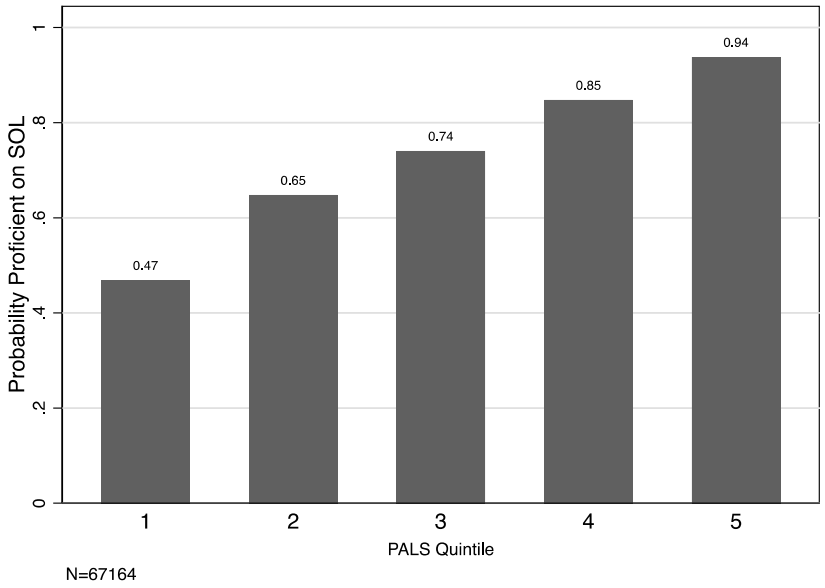


Figure 2: Probability of SOL Proficiency by Quintile and Race/Ethnicity

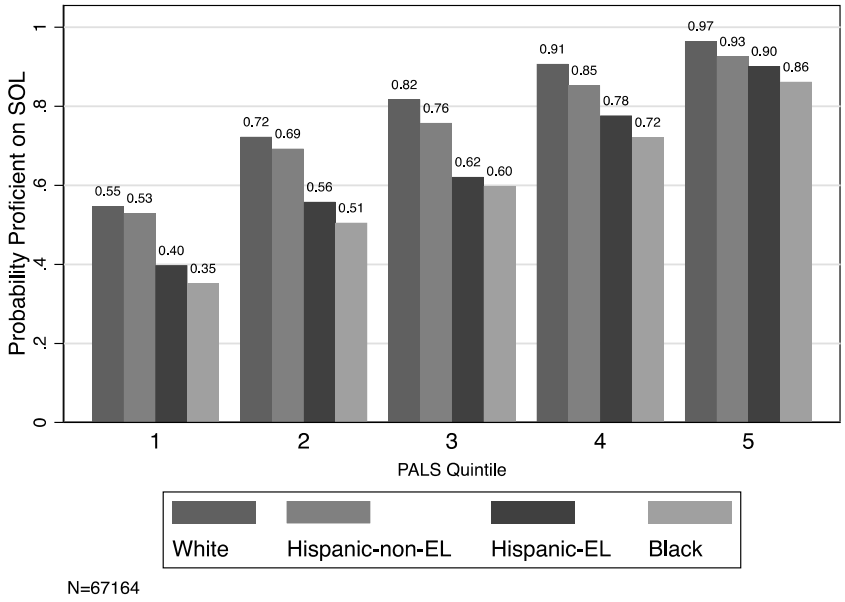


Figure 3: Probability of SOL Proficiency by Quintile and Disadvantaged Status

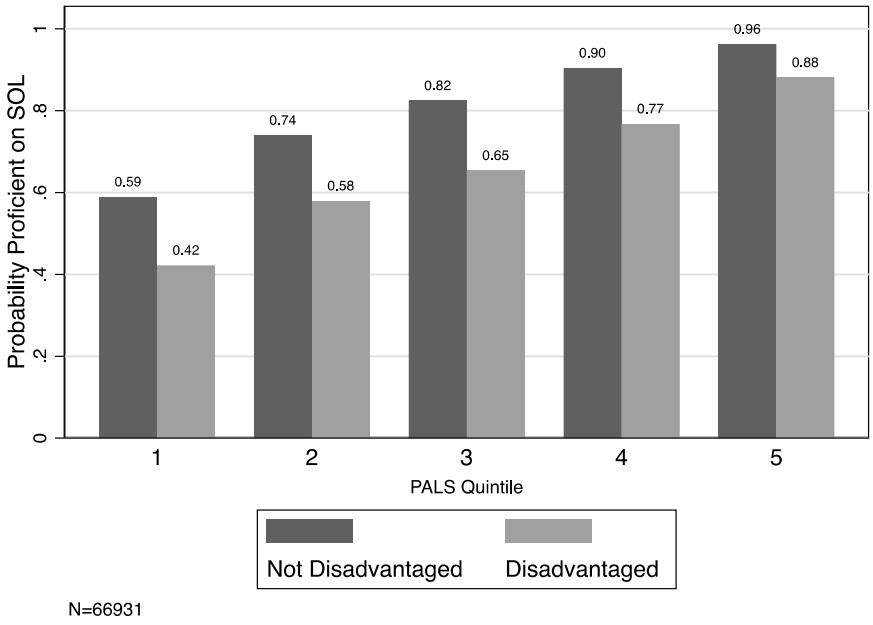


Figure 4: Probability of SOL Advanced Proficiency by Quintile and Race/Ethnicity

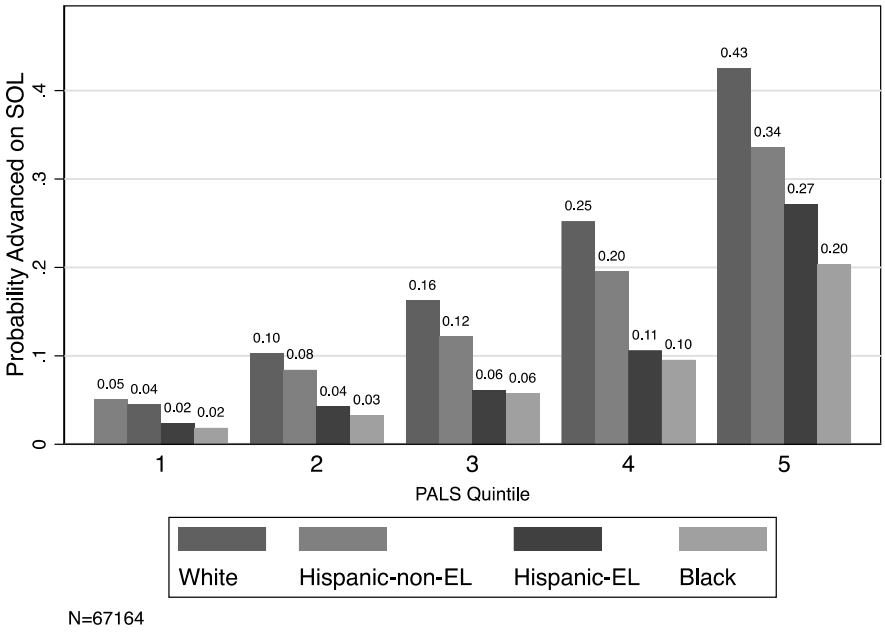
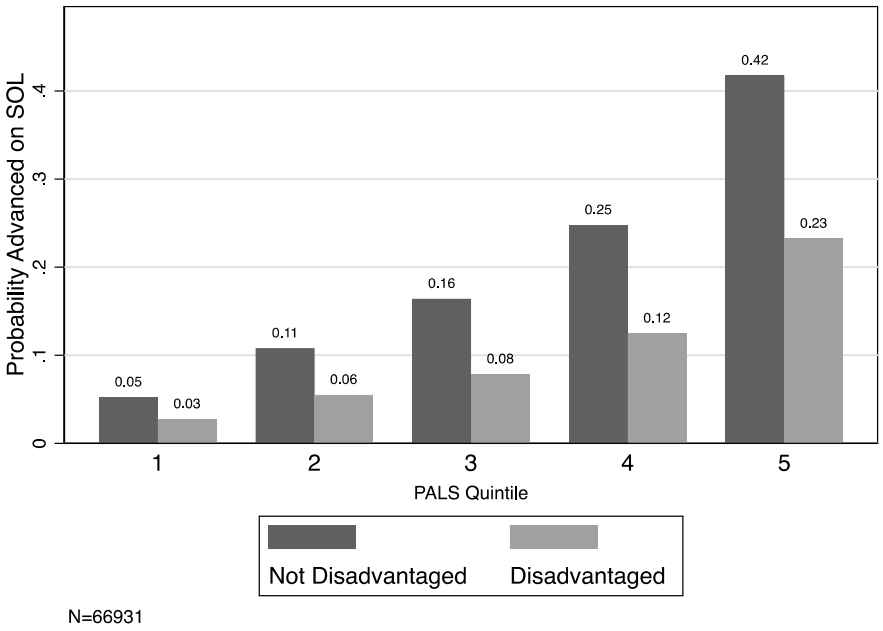


Figure 5: Probability of SOL Advanced Proficiency by Quintile and Disadvantaged Status



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Appendix A: Predicted Probability of Passing SOL by Quintile Compared to Uncontrolled Means

To determine whether the gaps observed in Figures 2 through 5 are an artifact of the distribution of scores by subgroup within quintile, we conduct a within-quintile chi-squared analysis. We first divide each quintile of the kindergarten PALS score distribution into five subquintiles with equal numbers of children in each. We then conduct a chi-squared analyses for each quintile along lines of both race and disadvantage status across these subquintiles.

These within-quintile chi-squared analyses reveal statistically significant differences in the distribution of Black and White children in the bottom and top quintile, differences for Hispanic-non-EL and White children in the bottom quintile, and differences for Hispanic-EL and White children in all but the third quintile. We also find differences in the distribution by disadvantaged status in all quintiles. The p-values associated with each chi-squared analyses are displayed in Table A1 below:

Table A1: P-Values for Within-Quintile Chi Squared Analyses

	Black-White		Hispanic (non-EL) - White		Hispanic (EL) - White		Disadvantaged-Not Disadvantaged	
Quintile 1	0.000	***	0.000	**	0.000	***	0.000	***
Quintile 2	0.922		0.466		0.004	***	0.000	***
Quintile 3	0.460		0.989		0.383		0.000	***
Quintile 4	0.065	*	0.175		0.000	***	0.000	***
Quintile 5	0.048	**	0.645		0.000	***	0.000	***

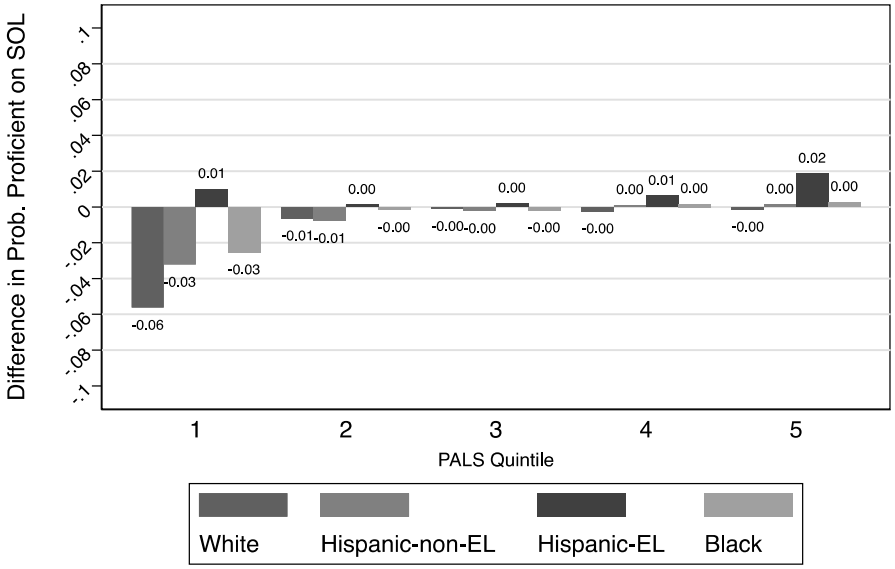
*** p<0.01, ** p<0.05, * p<0.1

To assess whether the disparities we observe in the likelihood of meeting proficiency are an artifact of these subgroup differences in the distributions of scores within quintile, we conduct additional analyses that control for children's PALS score within each quintile. Using equation A1 (an adaptation of equation 1), we estimate a given child's probability of reaching proficiency standards (or advantaged proficiency standards) on the third-grade SOL as a function of that child's quintile, race, and continuous PALS exam score (0 to 102):

$$(A1)\ SOL_i = \theta' \sum_q \sum_g \left(Quintile_i^q * Group_i^g * PALS\ Score_i\right) + \varepsilon_i$$

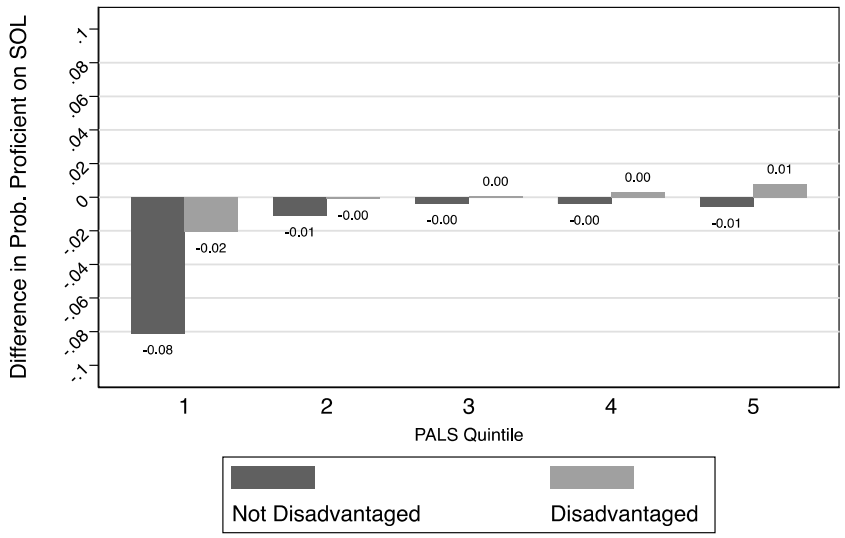
If the results from equation 1 are an artifact of within-quintile differences in the distribution of children across race or disadvantaged status groups, the estimated θ-coefficients would be different. We display the differences between the two equations in Figures A1 through A4, holding constant the PALS score for all children within a given quintile at that quintile's mean. The comparisons show that the predicted probabilities of meeting proficiency or advanced proficiency standards change very little (2 percentage point or less) for all subgroups in the all quintiles with four exceptions. All exceptions concern children in the lowest PALS quintile. Holding PALS scores constant within quintile decreases the predicted probability of meeting third-grade proficiency standards for White children in the lowest quintile by 6 percentage points, for Hispanic-non-EL children and Black children by 3 percentage points, and for non-economically disadvantaged children by 8 percentage points (see Figures A1 and A2) compared to the results in Figure 2. In terms of percentage change, holding PALS scores constant within quintile, decreases the Black-White gap by 15 percent, the Hispanic (EL)-White gap by 46 percent, and eliminates the already narrow Hispanic (non-EL)-White gap among children in the lowest quintile of PALS performance. Holding PALS scores constant also decreases the disparity in future proficiency between disadvantaged and non-disadvantaged children by 35%.

Figure A1: Differences in the Predicted Probability of Meeting Proficiency Standards (Equation A1 minus Equation 1) by Race/Ethnicity



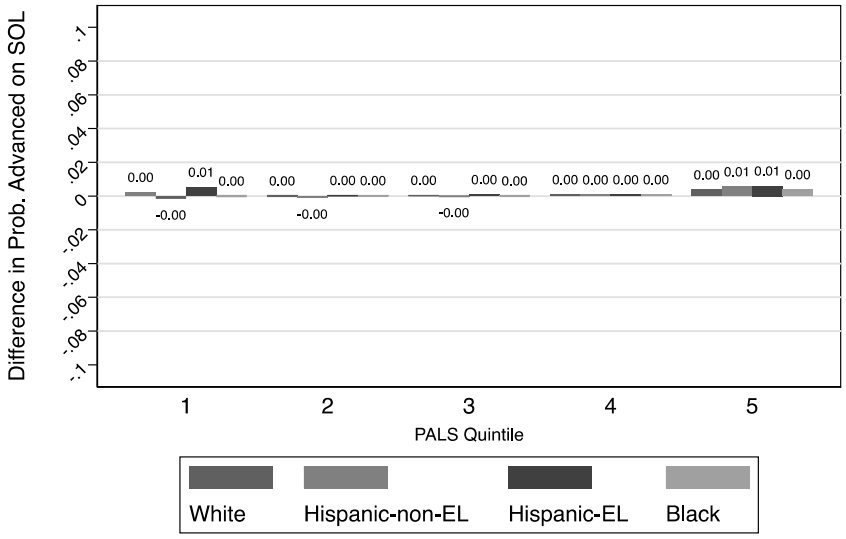
For equation E1, we hold PALS scores constant by assigning all students mean PALS score within each quintile.
N=67164

Figure A2: Differences in the Predicted Probability of Meeting Proficiency Standards (Equation A1 minus Equation 1) by Economically Disadvantaged Status



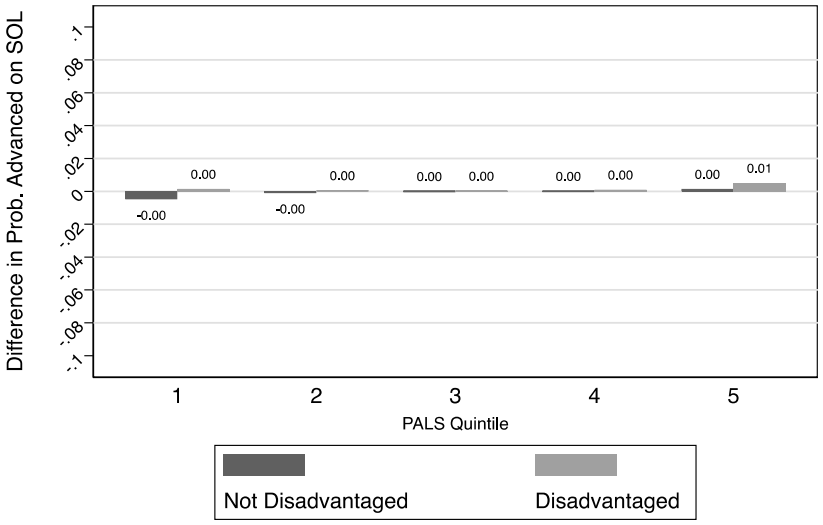
For equation E1, we hold PALS scores constant by assigning all students mean PALS score within each quintile.
N=66931

Figure A3: Difference in the Predicted Probability of Meeting Advanced Proficiency Standards (Equation A1 minus Equation 1) by Race/Ethnicity



For equation E1, we hold PALS scores constant by assigning all students mean PALS score within each quintile.
N=67164

Figure A4: Difference in the Predicted Probability of Meeting Advanced Proficiency Standards (Equation A1 minus Equation 1) by Economically Disadvantaged Status



For equation E1, we hold PALS scores constant by assigning all students mean PALS score within each quintile.
N=66931

Appendix B: Continuous Score Robustness Check

To provide evidence that the disparities in the likelihood of reaching proficiency standards in third grade along lines of race and SES are robust to models that allow for the relationship between early skills and later outcomes to vary by race and economically disadvantaged status, we run a similar analysis as equation (1) in the main body of this paper using a child's continuous score on the PALS assessment at kindergarten entry rather than their quintile:

$$(B1)\ \ln\left(\frac{p_i}{1-p_i}\right) = \alpha + \beta PALS_i + \gamma Disadvantaged_i + \sum_g \delta_g\ Race_i + \sum_g \theta_g\ (Race_i * PALS_i) + \sum_g \mu_g\ (Race_i * Disadvantaged_i) + \varepsilon_i$$

Where p_i represents the probability that child *i* reaches proficiency or advanced standards on their third grade SOL, $PALS_i$ represents the child's sum score on the PALS assessment at kindergarten entry, $Disadvantaged_i$ represents the child's economically disadvantaged status, and $Race_i$ represents the racial group (g) with which child *i* identifies. Here we allow the relationship between continuous PALS score and third grade outcome to vary across each racial subgroup, g, by including an interaction term. We similarly allow the relationship to vary within race across economically disadvantaged status.

Based on the results from equation (B1), we can predict the probability that a child of each racial or socioeconomic subgroup will reach proficiency or advanced standards on their third-grade reading assessment conditional on their continuous PALS score. The results of this analysis are reported in figures B1 through B6 below.

Figure B1: Disparities in Probability of Third-Grade Proficiency
Black and White Children

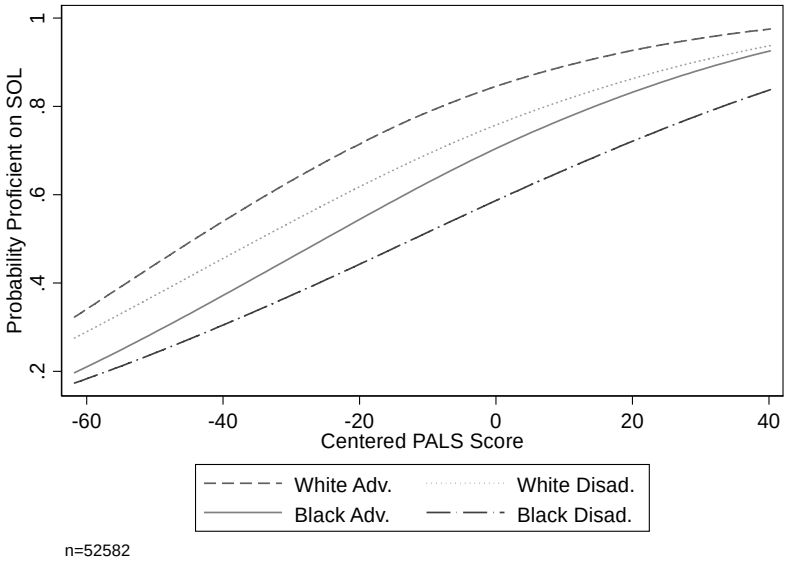


Figure B2: Disparities in Probability of Third-Grade Proficiency Hispanic (non-EL) and White Children

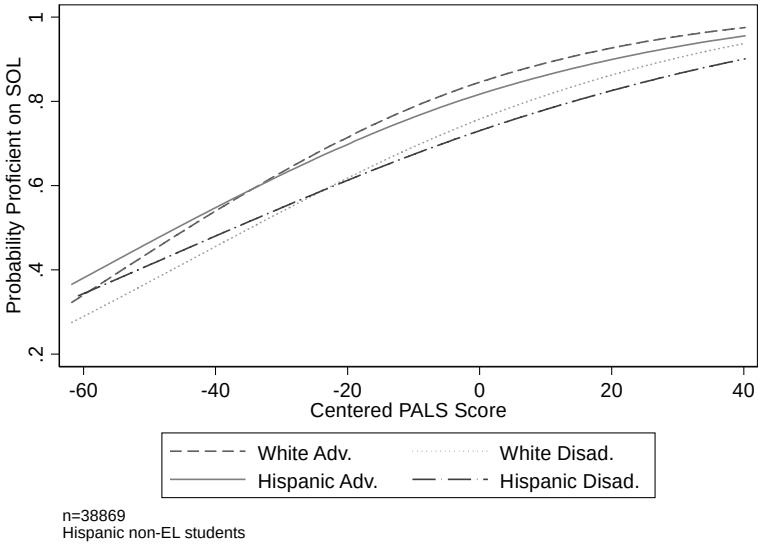


Figure B3: Disparities in Probability of Third-Grade Proficiency Hispanic (EL) and White Children

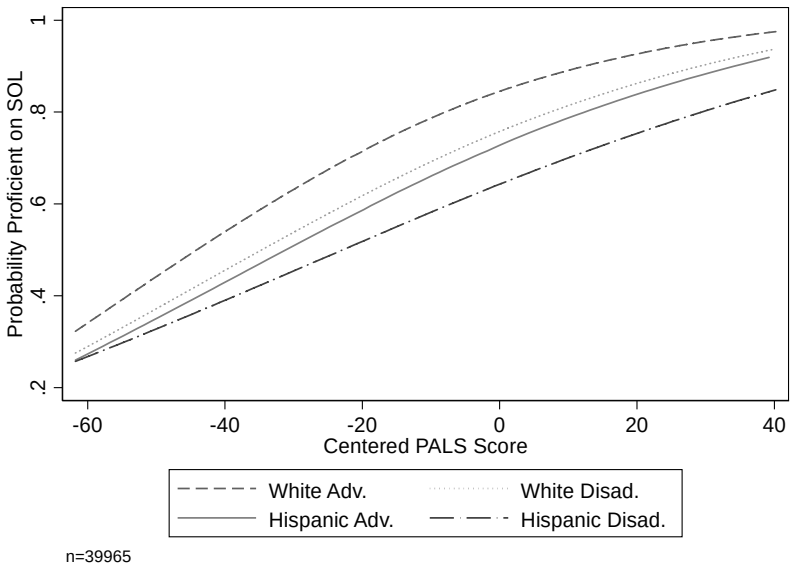


Figure B4: Disparities in Probability of Third-Grade Advanced Black and White Children

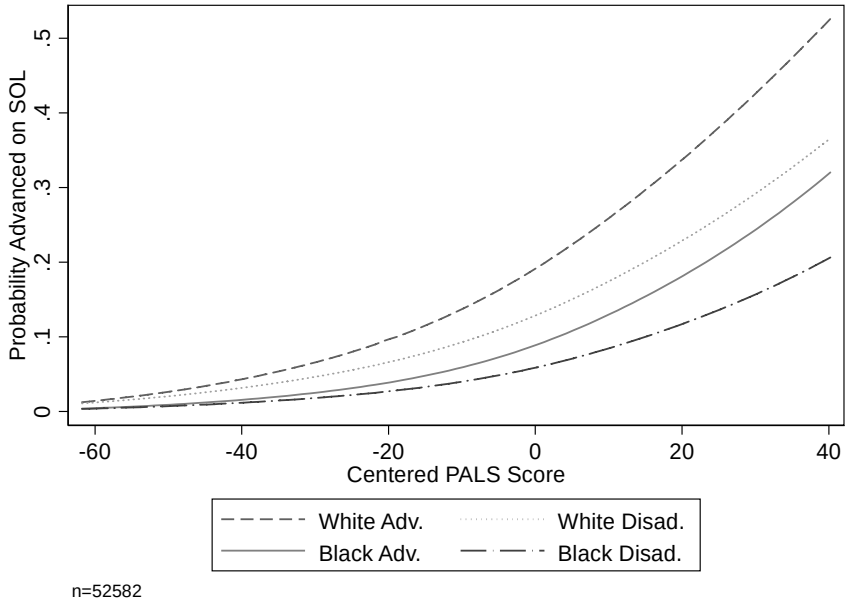


Figure B5: Disparities in Probability of Third-Grade Advanced Hispanic (non-EL) and White Children

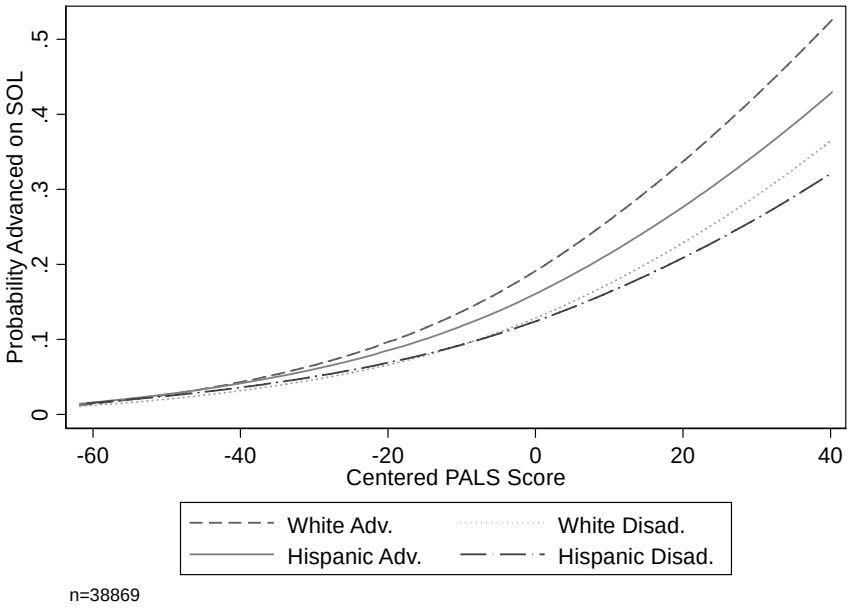
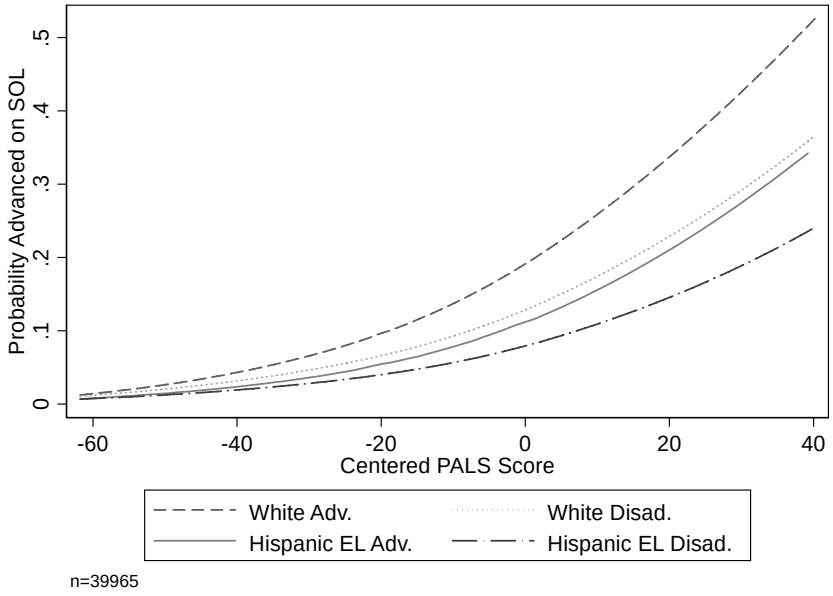


Figure B6: Disparities in Probability of Third-Grade Advanced Hispanic (EL) and White Children



Appendix C: Probability of Meeting Proficiency Standards in Third Grade by PALS Benchmark

Figure C1: Probability of Meeting Proficiency Standards on the Third-Grade SOL by Kindergarten PALS Benchmark (All Children)

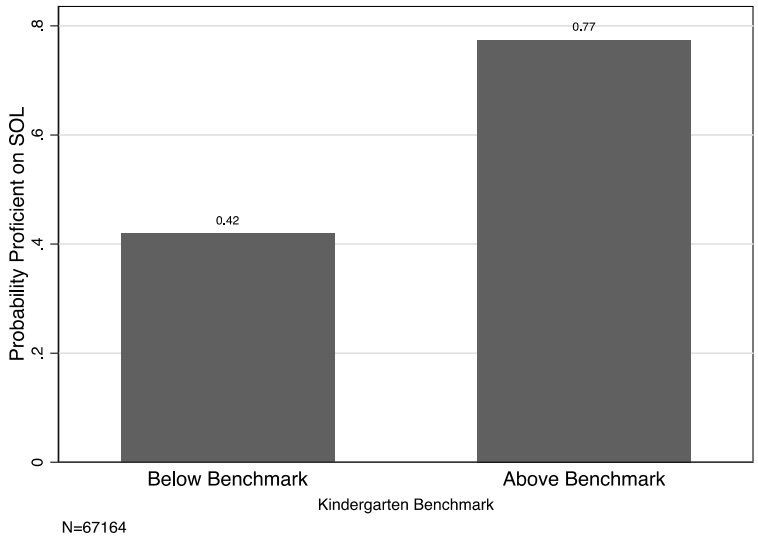


Figure C2: Probability of Meeting Proficiency Standards on the Third-Grade SOL by Kindergarten PALS Benchmark and Race/Ethnicity

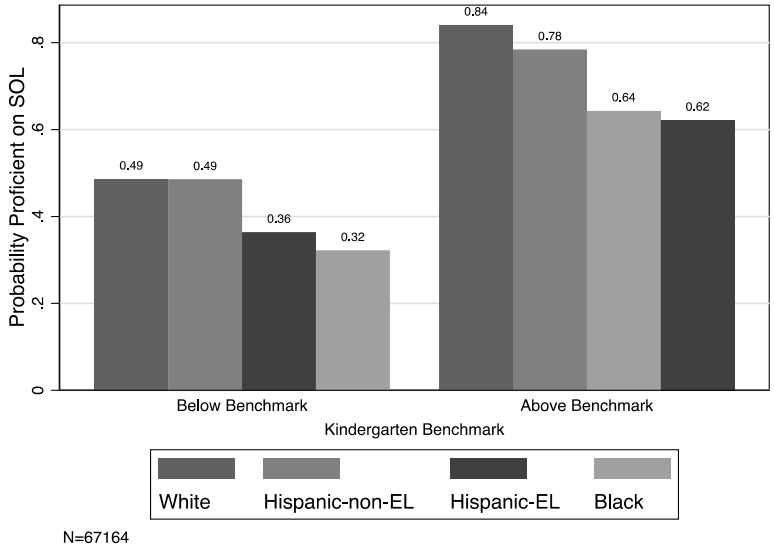


Figure C3: Probability of Meeting Proficiency Standards on the Third-Grade SOL by Kindergarten PALS Benchmark and Economically Disadvantaged Status

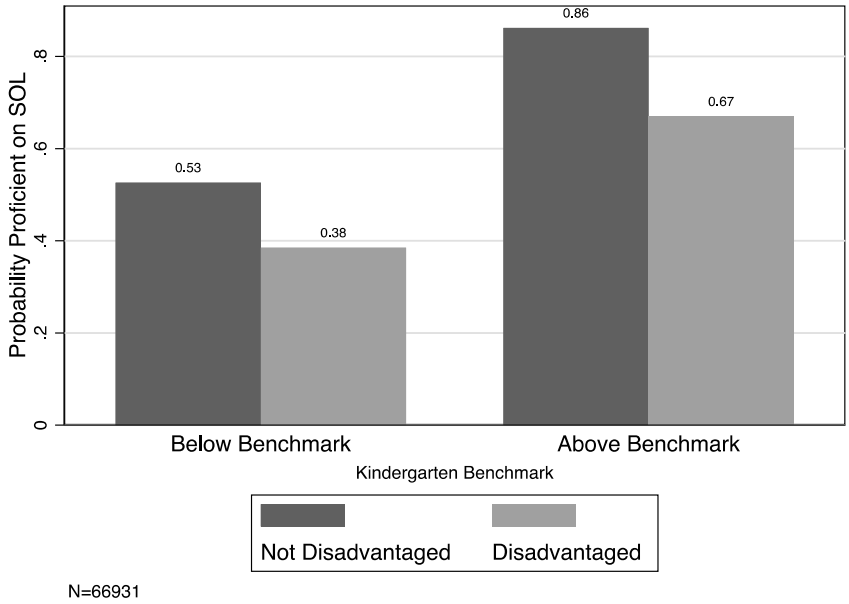


Figure C4: Probability of Meeting Advanced Standards on the Third Grade SOL by Kindergarten PALS Benchmark and Race/Ethnicity

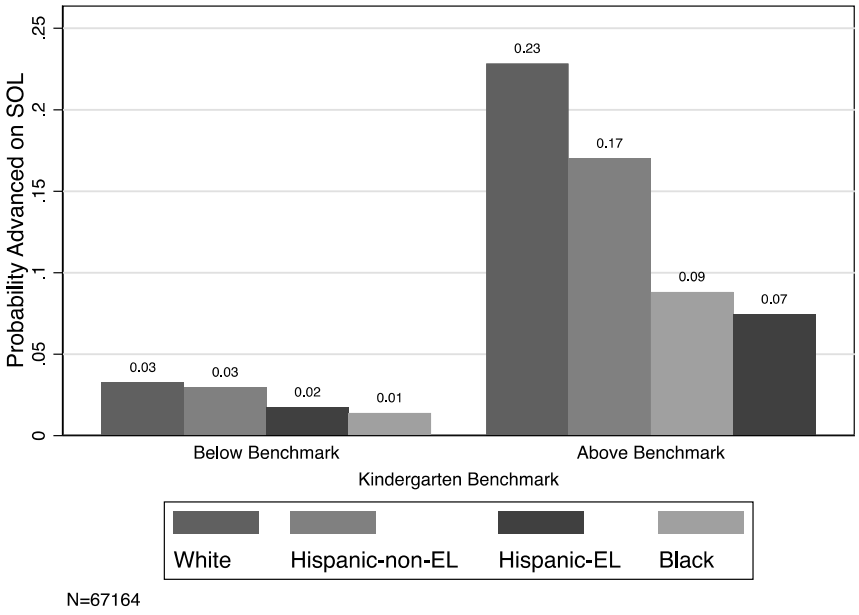
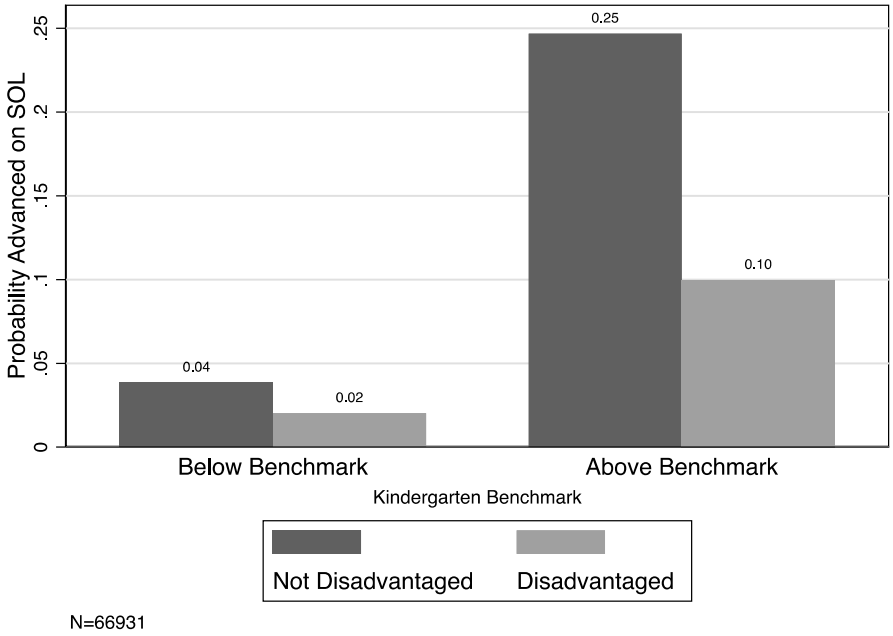


Figure C5: Probability of Meeting Advanced Standards on the Third-Grade SOL by Kindergarten PALS Benchmark and Economically Disadvantaged Status


Probability Advanced on SOL
0
.05
.1
.15
.2
.25
0.04
0.02
0.25
0.10
Below Benchmark
Above Benchmark
Kindergarten Benchmark
Not Disadvantaged
Disadvantaged
N=66931

Appendix D: Attrition Summary

Table D1: Attrition Summary

	Analytic Sample	Attrited Sample	Difference (Robust Std. Error)
White	0.522	0.532	0.010 (0.007)
Black	0.261	0.241	-0.020*** (0.006)
Hispanic-non-EL	0.057	0.088	0.031*** (0.003)
Hispanic-EL	0.073	0.040	-0.033*** (0.004)
Other Race	0.087	0.098	0.012*** (0.004)
Disadvantaged	0.492	0.438	-0.053*** (0.007)
EL (All)	0.100	0.067	-0.032*** (0.004)
PALS Score (Fall K)	61.777	61.932	0.115 (0.316)
Below Benchmark (Fall K)	0.120	0.132	0.012*** (0.004)
N	67,164	10,714	

*** p<0.01, ** p<0.05, * p<0.1

Appendix E: Descriptive Statistics

Table E1: Descriptive Statistics

	Mean	Std. Deviation
White	0.52	-
Black	0.26	-
Hispanic-non-EL	0.06	-
Hispanic-EL	0.07	-
Other Race	0.09	-
Economically Disadvantaged (ED)	0.49	-
EL (All)	0.10	-
Below Benchmark (Fall K)	0.12	-
Proficient on Third-Grade SOL	0.73	-
PALS Score (Fall K)	61.78	24.5
SOL Score (Third Grade)	431.59	72.8

N = 67164

Table E2: Descriptive Statistics by PALS Quintile

	Quintile 1	**Quintile 2**	**Quintile 3**
White	44%	51%	53%
Black	26%	27%	28%
Hispanic (Non-EL)	7%	6%	6%
Hispanic (EL)	17%	8%	6%
Other Race	6%	7%	8%
Disadvantaged	72%	57%	49%
EL (All)	19%	11%	9%
PALS Score (Fall K)	24	49	64
SOL Score (3rd Grade)	383	412	429
Proficient on Reading SOL (3rd Grade)	47%	65%	74%
N	13320	13099	13009

Note: Different N in each quintile reflects need for quintiles to contain exclusive PALS score ranges.

Table E2: Descriptive Statistics by PALS Quintile (cont'd)

	Quintile 4	**Quintile 5**
White	55%	57%
Black	26%	23%

Hispanic (Non-EL)	6%	5%
Hispanic (EL)	4%	2%
Other Race	9%	13%
Disadvantaged	41%	29%
EL (All)	7%	4%
PALS Score (Fall K)	77	93
SOL Score (3rd Grade)	451	481
Proficient on Reading SOL (3rd Grade)	85%	94%
N	14055	13681

Note: Different N in each quintile reflects need for quintiles to contain exclusive PALS score ranges.

Appendix F: Disparities in Literacy Skills at K Entry

The disparities in children's literacy skills at kindergarten entry in our sample are displayed in Table F1 below. Like Reardon and Portilla (2016), we estimate the Hispanic-White gap (including children who are identified as EL) to be 0.55 standard deviations (SD). This said, our estimate of the Black-White gap is much smaller than that computed by these authors (0.13 SD here compared to 0.32 SD in Reardon and Portilla). There are a number of reasons why the estimates we report here are smaller than those reported in prior studies which use the ECLS-K data. First, the reading assessment used in the ECLS-K study measured different literacy skills than the PALS assessment used in this paper. While PALS measures only children's basic skills like letter recognition and sound awareness, the ECLS-K reading assessment also includes higher-level questions measuring children's reading comprehension. Our findings, then, reflect only differences along the more fundamental literacy skills, while the disparities reported using ECLS reflect differences along higher-level literacy skills.

Second, our results may reflect differences between the sample we employ here and the national sample used in the ECLS-K. For example, Black children make up a greater share of the population in Virginia than nationally and Black families are less likely to fall below the poverty line in Virginia than nationally (Kaiser Family Foundation, 2018). If we expect our sample to have a greater proportion of non-disadvantaged Black children than the ECLS's nationally representative sample, we might also anticipate that the Black-White disparity in literacy skills at kindergarten entry to be comparatively smaller in our sample.

Table F1: Standardized Differences in PALS Scores at Kindergarten Entry

	Present Study Difference
Black-White Disparity	-0.127

	(0.018)
Hispanic-White Disparity	-0.545
	(0.025)
Hispanic (non-EL)-White Disparity	-0.181
	(0.024)
Hispanic (EL)-White Disparity	-0.828
	(0.029)
Disadvantaged-Advantaged Disparity	-0.601
	(0.015)

Note: Units in standard deviations on the PALS assessment.