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**ACADEMIC OUTCOMES FOR ENGLISH LANGUAGE LEARNERS
IN ARKANSAS BETTER CHANCE PUBLIC PRE-K**

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EXECUTIVE SUMMARY

Analyses of large-scale public pre-Kindergarten programs in several U.S. states suggest that students with limited English proficiency differentially benefit from such pre-K programs, compared to their English-proficient peers. This analysis describes long-term outcomes of Arkansas public school students who participate in the Arkansas Better Chance (ABC) pre-K program. Specifically, we are interested in subgroup outcomes for students with limited English proficiency. We analyze three cohorts of students, those enrolling in Kindergarten in Arkansas public schools in the fall of 2011, 2012, and 2013. We identify whether students in each Kindergarten class attended ABC or not, and we follow their academic outcomes through fifth grade. We describe math and reading standardized test scores and incidence of exiting English Language Learner (ELL) programs, and we report the differences in outcomes between demographically similar students who attended ABC and those who did not. Our primary research questions and a brief summary of findings are reported below:

- 1. What are the enrollment trends of ELL students into Arkansas Better Chance (ABC) pre-K programs?**
 - Just over 10% of ABC enrollment in 2010-11 through 2012-13 was comprised of students with limited English proficiency.
 - ELL students were overrepresented in ABC pre-K enrollment, relative to their contribution to Kindergarten enrollment.
- 2. How do ELL program participants score on math and reading state-administered exams in 3rd, 4th, and 5th grades, relative to similar, non-participant peers?**
 - Overall, students who participated in ABC pre-K performed higher on math and reading standardized exams than demographically similar peers who were not ABC participants.
 - ELL students saw a differentially positive benefit from ABC in 3rd and 4th grade outcomes in the two most recent cohorts analyzed.
 - The negative association between initial ELL status and academic outcomes largely outweighed the observed program benefit, indicating that despite promise from this program, more work needs to be done to support academic success for this student subgroup.
- 3. How likely are ABC participants to exit the ELL program in 3rd, 4th, and 5th grades, relative to their non-participant peers?**
 - Students who enter Kindergarten with limited English proficiency are more likely to exit the ELL program in elementary school if they attend ABC pre-K.
 - By 5th grade, ABC participants were 1.5 percentage points less likely to be designated ELL than non-participant peers in the first cohort, 9.2 percentage points less likely in the second cohort, and 4 percentage points less likely in the third cohort.

I. INTRODUCTION

Students who have a first language other than English, often referred to as English Language Learners (ELL), face a unique set of challenges as they progress through their educational journey. Policymakers and district leaders are tasked with determining how to best serve this student population and help them achieve English proficiency as early as possible. According to the U.S. Department of Education (2020), the percentage of students in American public schools classified as ELL increased from 8.1% in 2000 to 10.1% in 2017, an almost 25% increase. In Arkansas, 8.3% of public school students were ELL as of fall 2017, up from 2.6% in 2000, an even more dramatic increase than seen nationally. Programs that can effectively serve this student population at-scale will be highly beneficial as the population of ELL students grows in Arkansas and nationally.

State supported pre-Kindergarten programs are growing in prevalence and political popularity, and they might be a promising intervention for this student group. In a nationally representative poll conducted by the First Five Years Fund, surveyors found that 82% of registered Republicans and 97% of registered Democrats were in support of making quality early childhood education more affordable and accessible (First Five Years Fund, 2017), indicating that there is momentum for such programs. The evidence of long-term pre-K outcomes is limited, and there is an indication that early benefits might fadeout in elementary school (Hill et al., 2015; Lipsey et al., 2018). However, pre-Kindergarten does show promise in its ability, at least in the short-term, to serve many student populations, particularly ELL students (Gormley, 2008; Markova, 2017; Peisner-Feinberg et al., 2013).

In the current study, we examine outcomes for ELL students in Arkansas who participate in the state-funded Arkansas Better Chance (ABC) public pre-K program. While our research

design prevents us from making causal claims of the program’s impact, we hope that our findings further our understanding of how well ELL students who attend ABC pre-K are performing relative to similar peers who do not attend. Findings from the analysis indicate that students with limited English proficiency who enroll in ABC pre-K programs achieve higher math and reading standardized test scores and are more likely to exit the ELL program, compared to similar peers who do not enroll in ABC before starting Kindergarten. These results are promising, but program benefits are almost always too limited to close achievement gaps between ELL and non-ELL students. Thus, policymakers and education leaders should consider both expansion of pre-K access as well as options for sustained support for this student group.

II. LITERATURE REVIEW

The Importance of Early English Proficiency

Students designated as English Language Learners (ELL) are academically at-risk in several ways, including but not limited to large gaps in standardized test score outcomes, disparities in identification for special opportunities such as Gifted/Talented (G/T) programs, and a label that can be stigmatizing for students. Hemphill & Rahman (2011) report that there is a narrowing but persistent achievement gap between white and Hispanic students on the NAEP math and English assessments, and there is an additional gap between non-ELL Hispanic students and ELL-Hispanic students, putting these students with limited English proficiency far behind their non-ELL peers. According to a report by the PEW Hispanic Center (2008), ELL students have average proficiency rates on state tests that lag behind white students by double digits, and they are also more likely to attend schools that qualify for Title 1 funding, have higher teacher to student ratios, and serve higher proportions of low-income students (Fry, 2008).

In a similar vein, ELL students score, on average, lower than their non-ELL peers on traditional tests that qualify students for G/T programs, and there is evidence that this difference is linked to English ability (Peters & Engerrand, 2016). In an analysis of elementary school student G/T screenings in a medium-sized Midwestern school district, researchers found that ELL classification was associated with a 0.72 standard deviation decrease on the composite Cognitive Abilities Test (CogAT), but only a 0.07 standard deviation decrease on the non-verbal subtest (CogAT-NV), indicating that lack of English proficiency serves as a barrier to G/T-qualifying test performance (Giessman et al., 2013). There are a variety of other special considerations for these students in the school context. A case study analysis of ELL students in a California school district documented instances of students who required Special Education services not receiving them because teachers could not distinguish developmental delays from language challenges. Students with the ELL designation also perceived that their educators had low expectations for them and found the courses they had to take at the secondary level stigmatizing (Thompson, 2015).

While there is certainly evidence that this label is associated with barriers, it is necessary to emphasize that removing barriers for these students means increasing English proficiency, not reducing identification. It would be detrimental for ELL students to go unidentified and not receive the resources they need. In a large urban district in California, researchers used a regression-discontinuity design to determine that among students near the cutoff for ELL classification, receiving the ELL label and associated services led to significantly positive impacts on academic achievement in elementary school (Shin, 2018). While evidence that ELL services are beneficial to students is encouraging, advocates should be interested in exploring a variety of interventions that can increase English proficiency for ELL's as early as possible.

Evidence of Pre-K Impact on ELL Students

Pre-Kindergarten is a promising intervention for students identified as English Language Learners. It provides an extra year or two before Kindergarten for students to be exposed to English and build language skills, and it occurs during a “critical period” of language acquisition, where individuals are more likely to be successful in mastering a second language (Bleakley & Chin, 2008).

Prior research suggests that pre-K produces positive outcomes for this student subgroup in certain contexts. Georgia’s state-funded universal pre-K program is free and open to all four year-olds, and in 2011, researchers reported that approximately 10% of the pre-K population had limited English proficiency. An analysis of growth scores found that participation in the program led to significant gains for ELL students in several language, literacy, and math skills on both English and Spanish assessments, with greater growth demonstrated in English (Peisner-Feinberg et al. 2013).

Oklahoma also serves four year-olds universally in its pre-K programs. Teachers in these programs are required to have bachelor’s degrees and teaching certifications, which are more rigorous requirements than typically in place for private and public pre-K providers. Gormley (2008) used a regression discontinuity design (RDD) to compare students who participated in the program to others who also selected into it but did not attend, and he found that the full sample of Hispanic students experienced significant gains in reading, writing, and math skills compared to the control group. Children who came from Spanish-speaking homes or who had parents from Mexico experienced greater cognitive benefits than Hispanic students whose families spoke English at home.

Lipsey (2018) used a randomized controlled trial to study the impact of the Tennessee Voluntary Pre-Kindergarten Program on student outcomes through 3rd grade, and he found significant positive effects of the program after the pre-K year and particularly large effect sizes for non-English speaking students, but whole group effects mostly faded out by early elementary school.

Researchers at Rutgers University evaluated the Arkansas Better Chance pre-K program in 2007, and they found that program participation led to significant impacts on language, literacy and math development following the pre-K instructional year. They did not examine subgroup effects for ELL students, and due to the use of birthdate as the discontinuity for the RDD, the scope of the causal analysis is limited to short-term effects (Hustedt et al., 2007).

III. DATA AND CONCEPTUAL CHALLENGES

The data used for this analysis only includes pre-K information for students who were enrolled in ABC programs in Arkansas public schools. Comparison students could have participated in private pre-K, public pre-K in another state, or any other early childhood education service other than ABC, including Head Start. Our study is limited by not being able to fully define the alternative to ABC, and we also recognize that there could be positive selection into this program, meaning that students and families that enroll in ABC might have certain characteristics that are also related to later academic success.

It is reasonable to assume that there are unobserved characteristics of the students who select into ABC that differ from those who do not. Program information and application materials are universally available, but parents must seek them out. Doing so might indicate greater investment in education, and community connectedness. For adults with limited English proficiency, enrolling children in this program could also indicate a higher comfort level with the

English language and navigating the local culture. These parental characteristics could also be associated with improved academic outcomes for students, as parents with more cultural capital and motivation might be able to assist and seek out resources for their children throughout their educational journeys. Due to this threat of selection bias, the results of this analysis will be descriptive in nature.

Our analytic sample is also limited due to the longitudinal nature of the dataset. In the analysis, we only capture on-time grade progressors who are enrolled in Arkansas public schools for at least Kindergarten through 3rd grade, which is the first year that students take standardized state exams. Thus, we do not include students who move out of the state or who are retained or skip a grade in early elementary school, and it is reasonable to believe that students who exit the sample could be differently affected by pre-K than those who progress through elementary school on-time. All of these conceptual challenges are important to consider as we interpret the long-term outcomes of ABC participants, and we recognize that this report is a description of outcomes of ELL ABC participants rather than a causal analysis of the program's impact on students' educational outcomes.

For the current analysis, only math and reading test scores are examined. Arkansas students took two different exams over the course of the analysis period: the PARCC exam in 2014-15 and then ACT Aspire beginning in 2015-16. The dataset includes scale scores for these exams, and in order to meaningfully compare achievement over time, we standardize student scale scores within grade and academic year. We only use data from students who took regular state assessments, but we include those who used accommodations as allowed by state testing protocols. All students, regardless of English proficiency, must take the regular state exam unless identified as needing an alternative assessment through Special Education. The other outcome of

interest is exiting the ELL program. A binary (Yes/No) indicator of this status is reported for every student in the sample in every academic year.

Sample

The data for this analysis were provided by Arkansas's Department of Elementary and Secondary Education and are accessed through the Office for Education Policy at the University of Arkansas. The dataset includes anonymized student-level records for academic years ranging from 2010-11 through 2018-19. These records capture several types of information for each student enrolled in any public school in Arkansas in the given years, including school and district of attendance, demographic information, standardized test scores, and designation as an English Language Learner or special education (SPED) student. From this data, we created three cohorts of analysis, based on the following criteria:

1. Student was enrolled in Kindergarten in Arkansas public schools in 2011-12, 2012-13, or 2013-14.
2. Student was consistently enrolled through at least 3rd grade and did not skip or repeat a grade during enrollment.

Students who participated in ABC pre-K prior to Kindergarten are flagged as program participants, and all other Kindergarten enrollees from each cohort are used as a comparison group. We run the analysis on the full sample of students, but we then identify and report subgroup effects for English Language Learners. In the following table and description, we present the total sample sizes of each Kindergarten cohort, the proportions of these student groups that attended ABC, and the proportions of students in the overall sample as well as the ABC sample that are designated ELL:

Table 1: Proportion of Kindergarten and Pre-K Sample as ELL by Cohort, Kindergarten classes of 2011-12 through 2013-14

	Cohort 1	Cohort 2	Cohort 3
Total	37,257	40,420	39,844
ELL in Kindergarten	9.3%	8.8%	8.7%
	(N = 3,464)	(N = 3,556)	(N = 3,466)
Pre-K	26.2%	26.3%	25.7%
	(N = 9,761)	(N = 10,630)	(N = 10,239)
ELL in Pre-K	11.0%	10.8%	10.4%
	(N = 1,077)	(N = 1,148)	(N = 1,068)

The cohort of students who began Kindergarten in 2011-12 (Cohort 1) included 37,257 unique observations, with 9.3% of students being designated ELL, 26.2% having attended ABC pre-K, and 11% of those pre-K attendees being ELL students. The cohort which entered Kindergarten in 2012-13 (Cohort 2) included 40,420 observations. Of these, 8.8% were designated ELL, 26.3% attended ABC, and of those ABC attendees, 10.8% were ELL. For the cohort which began Kindergarten in 2013-14 (Cohort 3), 8.7% of students were ELL, 25.7% attended ABC, and 10.4% of those ABC attendees were ELL students. In each cohort, there is a higher proportion of ELL students enrolled in ABC than in Kindergarten, indicating that this student subgroup is over-enrolled in this program, relative to their enrollment in K-12 public schools. As this program is targeted toward academically at-risk students, it makes sense that there would be higher enrollment of academically vulnerable students in ABC.

To describe the outcomes of interest, we follow these students through 3rd, 4th, and 5th grades. Third grade is the first year that students take standardized state achievement tests, and we follow the sample through 5th grade in order to determine whether the program is contributing to lasting outcomes for students. We merge data for each of these academic years to the initial cohort of Kindergarteners, acknowledging that we are only capturing on-time grade progressors

and students who remain in the Arkansas public school system from Kindergarten until at least 3rd grade. After completing this data merge, we are left with 3rd grade records for 29,565 of the original 37,257 students in Cohort 1 (79.4%), 32,173 of the original 40,420 students in Cohort 2 (79.6%), and 31,870 of the original 39,844 students in Cohort 3 (80.0%). The demographic compositions of the 3rd, 4th, and 5th grade samples in each cohort are detailed in tables included in the appendix. The biggest drop in sample size occurs between Kindergarten and 3rd grade, and in each subsequent year, there is a decrease of smaller magnitude. These sample sizes reflect the total number of unique student ID’s captured in our dataset. The counts of students included in the analyses of academic outcomes are slightly smaller because they exclude alternative test-takers.

Of particular interest is the number of ELL students that remain in the sample over time. In the following table, we present the number of students who were designated ELL in Kindergarten that remain in the 3rd, 4th, and 5th grade samples in each cohort.

Table 2: Proportion of Students Designated ELL in Kindergarten Remaining in 3rd-5th Grade Samples, by Cohort

	Kindergarten	3rd Grade	4th Grade	5th Grade
Cohort 1	9.3% (N=3,483)	9.6% (N=2,835)	9.6% (N=2,777)	9.7% (N=2,723)
Cohort 2	8.8% (N=3,561)	9.1% (N=2,942)	9.2% (N=2,889)	9.3% (N=2,869)
Cohort 3	8.7% (N=3,490)	9.2% (N=2,935)	9.2% (N=2,889)	9.3% (N=2,860)

These proportions do not represent the number of students in each sample with current ELL designations, but rather the proportion of students in each sample who were designated as ELL in Kindergarten. As evidenced here, there is a relatively constant proportion of initially-ELL students remaining in the analytic sample across grades in each cohort. The total sample size

decreases each year, and similarly, the number of ELL students in the sample also decreases over time, but their contribution to the total enrollment actually increases slightly over time. This is encouraging yet surprising pattern, as it indicates that they are equally as likely as English-proficient students to be on-time grade progressors and stay in Arkansas schools over time.

Empirical Approach

The most significant threat to the validity of these estimates is the presence of selection bias. Enrollment in any pre-K program is voluntary, and students who enroll in ABC may differ on unobservable characteristics from those who do not enroll. For the analysis, we utilize a selection on observables design that estimates the association between ABC pre-K enrollment and several outcomes (math and reading achievement and ELL designation). To mitigate selection bias, we control for several factors that might influence outcomes, including race, gender, Free or Reduced-Price lunch (FRL) status, which is used as a proxy for low socioeconomic status, Special Education status, and school district. This means that comparisons between program participants and non-participants only occur within these groups, making the comparisons occur between demographically similar students. We also recognize that the quality of ABC pre-K programs could vary throughout the state. Rather than controlling for location of pre-K program, which only applies to treated students in the analytic sample, we include district fixed effects to account for school quality differences. These district variables reflect the school districts that students attend in 3rd, 4th, or 5th grade, depending on the model specification. This is intended to control for differences between school districts, and likewise, it means that the comparisons between treated and non-treated students are within-district rather than between.

We compile a dataset for each cohort that contains records for 3rd, 4th, and 5th graders for the appropriate academic years, and we merge this dataset to the initial cohort of Kindergarteners

using anonymized student research ID's. A visual representation of these cohorts is shown below:

Table 3: Cohort Grade by Academic Year

Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Cohort 1	Pre-K	K	Gr. 1	Gr.2	Gr. 3	Gr. 4	Gr. 5		
Cohort 2		Pre-K	K	Gr. 1	Gr. 2	Gr. 3	Gr. 4	Gr. 5	
Cohort 3			Pre-K	K	Gr. 1	Gr. 2	Gr. 3	Gr. 4	Gr. 5

For each cohort, we standardize math and reading exam scale scores within grade and academic year for all students who took the regular assessment in 3rd, 4th, and 5th grades. That is, any students who took alternative assessments, which are scored on different scales, were excluded from the academic outcome portion of the analysis. In the final merged dataset, we exclude students from the Kindergarten sample who do not have at least 3rd grade data as well as any students who do not have a Kindergarten record match. This creates a panel dataset of records for students from either pre-K or Kindergarten through at least 3rd grade.

We run the following Ordinary Least Squares (OLS) regressions for the initial cohort of students who began Kindergarten in 2011-12, 2012-13, or 2013-14 on their 3rd, 4th, and 5th grade outcomes.

$$y_i = \beta_0 + \beta_1 ell_i + \beta_2 prek_i + \beta_3 ell * prek_i + \mathbf{X}_i + \gamma_d + \varepsilon_i \quad (1)$$

Outcomes (y_i) to be measured include standardized math and reading state test scores for each of the three grades, separately. The dichotomous variable ell_i represents initial ELL status, or being labeled ELL in Kindergarten, regardless of later status, $prek_i$ is a dichotomous variable indicating ABC pre-K participation, and $ell * prek_i$ is the interaction between the two that will

determine the ELL subgroup effect. The matrix \mathbf{X}_i consists of student-level demographic characteristics, including race, gender, FRL status, and special education status, and γ_d is a set of school district dummy variables.

Another outcome of interest, the likelihood of maintaining the ELL designation, is examined using the following regression model for only the subpopulation of students who were initially ELL in Kindergarten, on their status in 3rd, 4th, and 5th grade:

$$ELL_i = \beta_0 + \beta_1 prek_i + \mathbf{X}_i + \gamma_d + \varepsilon_i \quad (2)$$

Here, ELL_i is the outcome indicating ELL designation, and the rest of the model remains the same, aside from removing the indicator for initial ELL status, because every student included in this analysis was initially designated ELL in Kindergarten. We create binary indicators for all of the student-level demographic characteristics and school district of attendance, which are allowed to vary over time. All regressions are run with the robust option, to estimate heteroskedastic-robust standard errors.

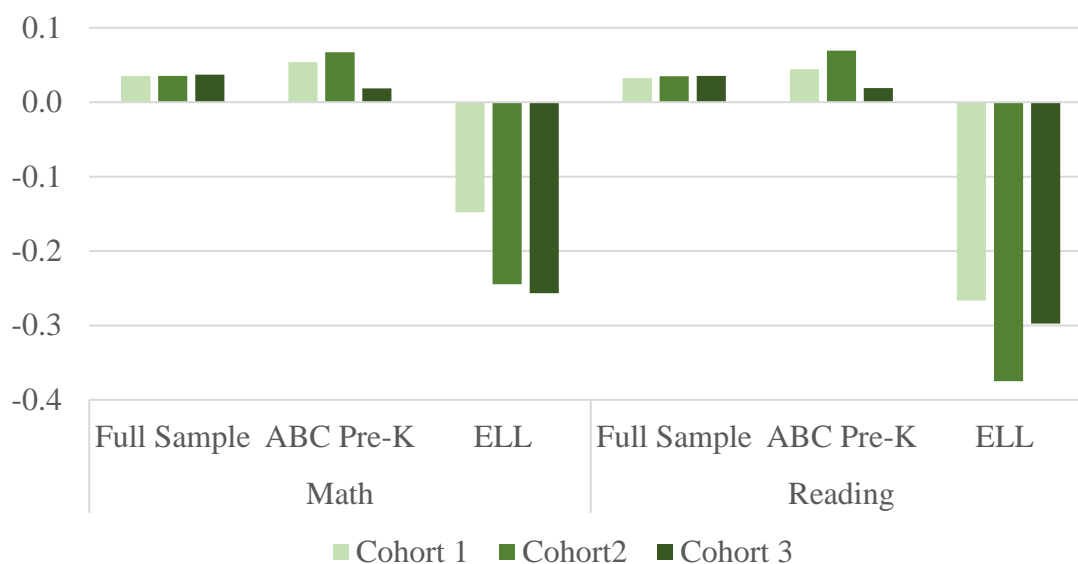
The controls in the model are intended to reduce the impact of selection bias, but we are limited to controlling for observable characteristics, and we recognize that there are very likely unobservable factors, as mentioned above, that differentiate otherwise similar pre-K participants from non-pre-K participants. Therefore, these results should be interpreted as descriptive information about the outcomes of ABC pre-K participants, rather than evidence of the program's causal impact on outcomes.

IV. FINDINGS

Academic Outcomes

To measure academic performance over time and on different exams, we standardize students' test scores within grade and academic year, meaning that test scores are transformed from scale scores to units of standard deviation, where the average score becomes 0, and students' z-scores represent whether and to what extent they score above or below average. We conduct this standardization process within an entire grade, rather than within the analytic sample. As a result, the average z-score for the analytic sample, which includes only on-time grade progressors who stay in Arkansas schools from Kindergarten through 3rd grade, is slightly above zero. In the following figures, we present the average z-scores for the full sample, ABC pre-K participants, and students with a current ELL status in 3rd and 5th grade for each cohort:

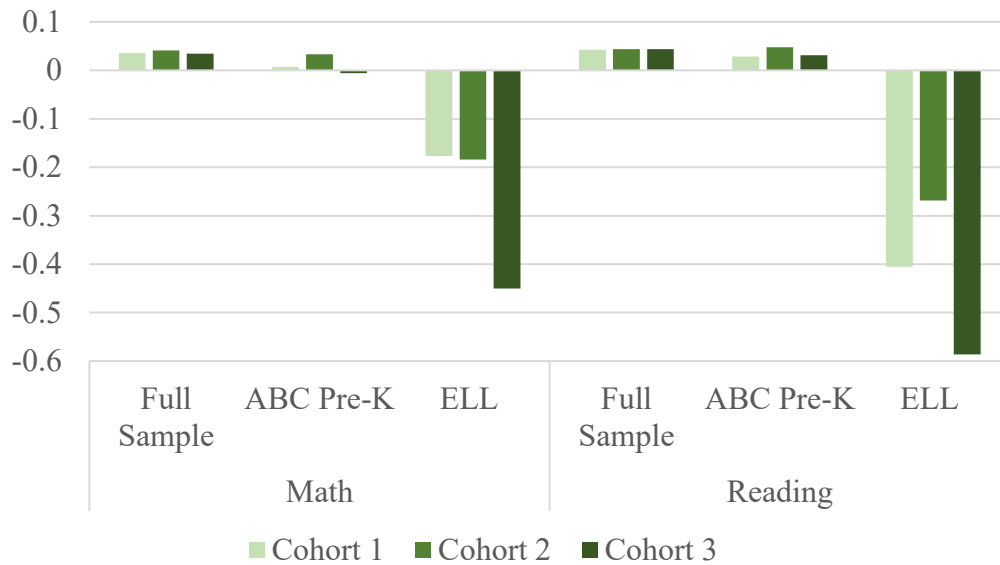
Figure 1: Average 3rd Grade Z-scores by Subject and Cohort



As shown here, the analytic sample of 3rd graders in each cohort has an average z-score of slightly above zero, which is expected given its inclusion of only on-time grade progressors. It is also apparent that ABC participants overall score slightly higher in math and reading in Cohorts

1 and 2 and slightly lower in Cohort 3 than the entire grade, but these differences are relatively small. Students with the ELL designation score far below average in both subjects across all three cohorts, and this negative trend is especially pronounced for reading achievement. The following figure presents the same information for 5th grade students in each cohort:

Figure 2: Average 5th Grade Z-scores by Subject and Cohort



Again, we see that the full analytic sample consistently has average z-scores slightly above zero. Here, the ABC attendees are scoring slightly below the full-grade sample, indicating that the initial pre-K boost might be diminishing in magnitude by 5th grade, which is consistent with much of the pre-K research (McKenzie et al., 2021). Students with current ELL status, on average, are scoring lower on these standardized exams, especially in reading. However, these are purely descriptive patterns.

To determine the unique contribution of ABC to academic outcomes and explore the subgroup effect for ELL students, we must look to the multivariate regression analysis that controls for demographic characteristics. Results of the regression analysis of relationships

between ABC pre-K attendance and math and reading standardized test scores for the entire sample of students are presented in Tables 6, 7, and 8 in the appendix. All else equal, ABC attendees tended to have higher math and reading achievement for grades 3 through 5 in each cohort. For Cohorts 2 and 3, students who were initially identified as English Language Learner (ELL) in Kindergarten had an additional benefit over and above that of the main group, indicating that the ABC program was more helpful long-term for them than for English-proficient students. In this report, we present the subgroup effects, describing the relationship between ABC participation and outcomes for ELL participants.

Again, ELL designation for these regressions is based on initial designation in Kindergarten, rather than a student's designation in each year of analysis. Initially-ELL students demonstrated very low initial 3rd grade achievement, and there is a threat of capturing regression to the mean. Any average taken from an initially-extreme sample should get closer to the group mean over time. While this may be happening for the entire subgroup of ELL students, we are capturing a comparison of students who attended ABC to students who did not, within this extreme sample, and thus these comparisons reflect important differences in student outcomes related to program participation.

To determine subgroup effects for these students, we sum the overall pre-K effect and the interaction of pre-K and ELL, and run F-tests for the joint significance of these two terms. This sum provides a value relative to initially-ELL students who did not participate in ABC, and these combined coefficients are presented in Table 4 and described below:

Table 4: ELL Subgroup Analysis for Academic Outcomes

	Cohort 1		Cohort 2		Cohort 3	
	Math	Reading	Math	Reading	Math	Reading
Grade 3	0.0873***	0.0546***	0.1605***	0.1913***	0.1822***	0.1330***
Grade 4	0.0565***	0.0581***	0.1231***	0.1446***	0.1105***	0.0618***
Grade 5	0.1077***	0.0803***	0.1019***	0.0956***	0.0690***	0.0868***

Note: Coefficients represent summation of Pre-K*ELL interaction and overall pre-K coefficient, providing a program effect estimate relative to other ELL students in sample who did not attend ABC. F-tests conducted for joint significance of these two coefficients.

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

In Cohort 1, enrollment in ABC for ELL students was associated with a 0.0873 standard deviation increase in 3rd grade math and a 0.0546 standard deviation increase in 3rd grade reading achievement, a 0.0565 standard deviation increase in 4th grade math and a 0.0581 standard deviation increase in 4th grade reading achievement, and a 0.107 standard deviation increase in 5th grade math and a 0.0803 standard deviation increase in 5th grade reading achievement. Each of these estimates is statistically significant at the 99% confidence level.

In Cohort 2, ABC enrollment for ELL students was associated with a 0.1605 standard deviation increase in 3rd grade math and a 0.1913 standard deviation increase in 3rd grade reading achievement, a 0.1231 standard deviation increase in 4th grade math and a 0.1446 standard deviation increase in 4th grade reading achievement, and a 0.1019 standard deviation increase in 5th grade math and a 0.0956 standard deviation increase in 5th grade reading achievement. Again, all of these estimates were statistically significant with 99% confidence.

In Cohort 3, all else equal, ABC enrollment for ELL students was associated with a 0.1822 standard deviation increase in 3rd grade math and a 0.1330 standard deviation increase in 3rd grade reading achievement, a 0.1105 standard deviation increase in 4th grade math and 0.0618 standard deviation increase in 4th grade reading achievement, and a 0.0690 standard deviation increase in 5th grade math and 0.0868 standard deviation increase in 5th grade reading achievement, and these estimates are also all statistically significant at the 99% confidence level.

These are impressive and meaningful gains that are both statistically and practically significant. The indication is that early English exposure and pre-K instruction for this vulnerable student group may help them overcome some of the academic challenges of limited English proficiency. Unfortunately, by comparing these effects to the coefficients for initial ELL status in our regression outputs, we can see that in most cases, the program impact is still too limited to outweigh the negative association of ELL status with achievement outcomes. In the following table, we present the joint coefficients of pre-K, pre-K and ELL interaction, and the coefficient for initial ELL status. These values represent the relationship between pre-K and outcomes for ELL students, relative to non-ELL students who did not attend ABC.

Table 5: ELL Subgroup Analysis for Academic Outcomes, Relative to Non-ELL Students

	Cohort 1		Cohort 2		Cohort 3	
	Math	Reading	Math	Reading	Math	Reading
Grade 3	-0.0347***	-0.1354***	0.0566***	-0.0305***	-0.0338***	-0.0660***
Grade 4	-0.0173***	-0.0509***	-0.0238***	-0.0532***	-0.0665***	-0.1191***
Grade 5	0.0505***	-0.0347***	0.0530***	-0.0852***	-0.0983***	-0.1106***

Note: Coefficients represent summation of Pre-K* ELL interaction, overall pre-K coefficient, and ELL coefficient, providing a program effect estimate relative to non-ELL students in the sample who did not attend ABC. F-tests conducted for joint significance of three coefficients.

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

Aside from 5th grade math in Cohort 1 and 3rd and 5th grade math in Cohort 2, all coefficients relative to non-ELL students are negative. This means that ELL students who participate in ABC still experience achievement gaps in elementary school relative to their English-proficient peers. These negative coefficients are generally larger in magnitude in reading, indicating that beginning school as an ELL student is likely to present more challenges to reading achievement than math.

However, the positive associations between ABC and outcomes for ELL students, presented in Table 4, are encouraging. Observing such positive results for students in 3rd through 5th grade, years after the intervention, potentially demonstrates the ability of ABC to set up ELL students for lasting success.

ELL Designation Outcomes

Another outcome of interest is the incidence of students exiting the ELL program. The exact process for this switch is complicated, and it involves students demonstrating English

proficiency on a variety of measures, which potentially tests academic reading skills on top of language proficiency. Still, it would be encouraging to see more ELL students exit the program in elementary school after attending ABC pre-K. For this portion of the analysis, the sample is restricted to only students who were designated ELL in Kindergarten, and the relationship between ABC enrollment and likelihood of being designated ELL in grades 3-5 is presented in Table 5:

Table 6: Likelihood of ELL Designation for Initially-ELL Students, by Cohort

	Cohort 1	Cohort 2	Cohort 3
Grade 3	-0.0135 (-0.0145)	-0.0581*** (-0.0149)	-0.0616*** (-0.0172)
Grade 4	0.0010 (-0.0148)	-0.0901*** (-0.0179)	-0.0574*** (-0.0187)
Grade 5	-0.0158 (-0.019)	-0.0920*** (-0.0193)	-0.0400** (-0.0200)

Note: Regression models additionally control for student race and school district fixed effects. Robust standard errors in parentheses.

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

Here, negative coefficients indicate positive outcomes, as they imply a lesser incidence of being designated as ELL and thus a higher incidence of exiting the ELL program. For initially-ELL students in Cohort 1, none of the estimates are statistically significant, meaning we cannot distinguish them from random chance. In this cohort, ABC attendance was associated with a 1.35 percentage point decrease in likelihood of being classified as ELL in 3rd grade, a 0.09 percentage point increase in likelihood of being ELL in 4th grade, and a 1.58 percentage point decrease in likelihood of being ELL in 5th grade.

Cohorts 2 and 3 demonstrate slightly more positive results. For initially-ELL students in Cohort 2, ABC enrollment was associated with a 5.81 percentage point decrease in likelihood of being classified as ELL in 3rd grade, a 9.01 percentage point decrease in likelihood of being ELL in 4th grade, and a 9.20 percentage point decrease in likelihood of being ELL in 5th grade. Each of these estimates was statistically significant with 99% confidence. For Cohort 3, ABC attendance was associated with a 6.16 percentage point decrease in likelihood of being classified as ELL in 3rd grade, a 5.74 percentage point decrease in likelihood of being ELL in 4th grade, and a 4.00 percentage point decrease in likelihood of being ELL in 5th grade, and these estimates were also statistically significant at the 99% confidence level.

Higher likelihood of exiting the ELL program in the two later cohorts could indicate that ABC programs are improving in their ability to serve students with limited English proficiency, which is plausible given the larger results from these two cohorts on academic measures. It could also indicate a change in the process of reclassification of ELL students. Thus, the mechanism for these findings is a little more unclear, but the results are still encouraging and align with our findings that ELL students who attend ABC have, on average, improved academic reading skills in these grades.

V. CONCLUSIONS AND POLICY RECOMMENDATIONS

We follow three cohorts of students with limited English proficiency through elementary school and find that Arkansas Better Chance (ABC) pre-K participants generally have higher standardized test scores, relative to demographically similar peers who did not enroll in an ABC pre-K program. These effects are particularly pronounced for ELL students in Cohorts 2 and 3 of the analysis, representing ABC participation in the academic years of 2011-12 and 2012-13. In each cohort, ABC participants see statistically and practically significant increases in math and

reading achievement that persists through 5th grade. Students who are initially designated ELL are also more likely to exit the ELL program by 5th grade if they attended ABC pre-K.

Importantly, while we find that ELL students who participate in this program demonstrate increased school success by several measures, we do not find that the benefits associated with the program are large enough to close the achievement gap between ELL and non-ELL students.

Based on the findings presented here, policymakers and community leaders should consider efforts to increase ABC pre-K enrollment of ELL students, as this subpopulation seems to differentially benefit from the program. The current strategy for advertising this program is through public schools, churches, and other community spaces. Additional efforts could include outreach in organizations that include many linguistic-minority community members. Also, program organizers in school districts across the state should ensure that there are applications and program information available in all non-English languages represented in their districts, including Spanish and Marshallese. Education leaders should also brainstorm ways to provide sustained support to this student subgroup, as ABC pre-K participation alone does not seem to be sufficient for closing the ELL/non-ELL achievement gap.

In the current study, we present descriptive patterns of academic success for students who do or do not participate in ABC pre-K. In future research, we hope to utilize an experimental or quasi-experimental design that could allow us to determine this program's causal impact on student outcomes, which would indicate the program's true contribution to outcomes and lead to the most helpful recommendations for program development. We would also like to do a close analysis, including qualitative interviews, of district programs that enroll large numbers of ELL students and employ bilingual staff in their classrooms. Findings from such an investigation could identify best practices for serving ELL students which could be recommended for use in

other districts. While there is reason for optimism about the ability of ABC pre-K to help students with limited English proficiency, there is more work to do to determine how well the program is truly serving this student population and how it could be even more successful.

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APPENDIX

Table 7: Demographic Composition of Sample, Cohort 1

	Kindergarten (2011-12)	3rd Grade (2014-15)	4th Grade (2015-16)	5th Grade (2016-17)
ABC Pre-K	26.2%	27.5%	27.6%	27.6%
Female	48.3%	49.2%	49.3%	49.3%
White	62.8%	63.0%	63.1%	63.1%
Black	19.8%	19.8%	19.7%	19.6%
Hispanic	12.5%	12.6%	12.7%	12.8%
FRL	66.5%	66.1%	63.5%	62.7%
ELL	9.3%	9.1%	9.3%	8.2%
SPED	-	12.7%	12.9%	12.9%
	(N=37,257)	(N=29,565)	(N=28,861)	(N=28,175)

Table 8: Demographic Composition for Sample, Cohort 2

	Kindergarten (2012-13)	3rd Grade (2015-16)	4th Grade (2016-17)	5th Grade (2017-18)
ABC Pre-K	26.3%	27.7%	27.8%	27.8%
Female	48.1%	49.2%	49.3%	49.3%
White	61.7%	61.8%	61.8%	61.7%
Black	20.8%	20.7%	20.7%	20.8%
Hispanic	12.3%	12.7%	12.8%	12.9%
FRL	66.9%	64.9%	64.0%	63.5%
ELL	8.8%	9.1%	8.3%	7.5%
SPED	-	12.5%	13.0%	12.9%
	(N=40,420)	(N=32,173)	(N=31,315)	(N=31,030)

Table 9: Demographic Composition for Sample, Cohort 3

	Kindergarten (2013-14)	3rd Grade (2016-17)	4th Grade (2017-18)	5th Grade (2018-19)
ABC Pre-K	25.8%	27.0%	27.1%	27.1%
Female	48.2%	49.3%	4.9%	49.4%
White	60.7%	60.9%	60.8%	60.9%
Black	21.4%	21.2%	21.4%	21.3%

Hispanic	12.5%	12.9%	12.9%	13.0%
FRL	65.8%	65.0%	64.2%	64.6%
LEP	8.7%	8.5%	7.9%	5.8%
SPED	-	12.5%	12.8%	13.0%
	(N=39,844)	(N=31,870)	(N=31,485)	(N=30,919)

Table 10: Relationship between Pre-K and Academic Outcomes for ELL Students in Grades 3-5 (Cohort 1)

Variables	Grade 3		Grade 4		Grade 5	
	Math	Reading	Math	Reading	Math	Reading
Pre-K	0.103*** (0.0128)	0.0903*** (0.0129)	0.0417*** (0.0132)	0.0572*** (0.0126)	0.0431*** (0.0131)	0.0471*** (0.0122)
ELL Status (K)	-0.122*** (0.0305)	-0.190*** (0.0304)	-0.0738** (0.0300)	-0.109*** (0.0291)	-0.0572* (0.0321)	-0.115*** (0.0289)
Pre-K*ELL	-0.0157 (0.0369)	-0.0357 (0.0368)	0.0148 (0.0366)	0.000909 (0.0356)	0.0646* (0.0367)	0.0332 (0.0337)
Constant	0.610*** (0.122)	0.597*** (0.119)	0.600*** (0.0911)	0.453*** (0.118)	0.474*** (0.104)	0.341*** (0.0875)
Observations	28,892	28,903	28,341	28,344	27,686	27,683
R-squared	0.285	0.278	0.254	0.315	0.263	0.370

Note: Control variables include race, gender, free or reduced lunch status, special education status and school district fixed effects. Heteroskedastic-robust standard errors in parenthesis.
*** p<0.01, ** p<0.05, * p<0.1

Table 11: Relationship between Pre-K and Academic Outcomes for ELL Students in Grades 3-5 (Cohort 2)

Variables	Grade 3		Grade 4		Grade 5	
	Math	Reading	Math	Reading	Math	Reading
Pre-K	0.0888*** (0.0123)	0.0855*** (0.0122)	0.0533*** (0.0124)	0.0509*** (0.0117)	0.0306** (0.0123)	0.0411*** (0.0116)
ELL Status	-0.104*** (0.0284)	-0.222*** (0.0279)	-0.147*** (0.0303)	-0.198*** (0.0278)	-0.0490 (0.0303)	-0.181*** (0.0271)
Pre-K*ELL	0.0718** (0.0349)	0.106*** (0.0350)	0.0699* (0.0363)	0.0939*** (0.0342)	0.0714* (0.0366)	0.0547* (0.0332)

Constant	0.559*** (0.0762)	0.328*** (0.0961)	0.658*** (0.110)	0.483*** (0.0852)	0.618*** (0.106)	0.618*** (0.0834)
Observations	31,626	31,601	30,752	30,743	30,510	30,492
R-squared	0.258	0.280	0.258	0.344	0.257	0.352

Note: Control variables include race, gender, free or reduced lunch status, special education status and school district fixed effects. Heteroskedastic-robust standard errors in parenthesis.

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

Table 12: Relationship between Pre-K and Academic Outcomes for ELL Students in Grades 3-5 (Cohort 3)

Variables	Grade 3		Grade 4		Grade 5	
	Math	Reading	Math	Reading	Math	Reading
Pre-K	0.0512*** (0.0122)	0.0625*** (0.0121)	0.0394*** (0.0122)	0.0525*** (0.0116)	0.0276** (0.0121)	0.0511*** (0.0116)
ELL Status (K)	-0.216*** (0.0286)	-0.199*** (0.0277)	-0.177*** (0.0286)	-0.181*** (0.0271)	-0.1673*** (0.0293)	-0.1974*** (0.0269)
Pre-K*ELL	0.131*** (0.0355)	0.0705** (0.0344)	0.0711** (0.0354)	0.00938 (0.0328)	0.0414 (0.0351)	0.0357 (0.0335)
Constant	0.498*** (0.0828)	0.510*** (0.0876)	0.653*** (0.0986)	0.513*** (0.0823)	0.774*** (0.1239)	0.692*** (0.0880)
Observations	31,336	31,326	31,002	30,998	30,479	30,481
R-squared	0.282	0.305	0.278	0.349	0.284	0.364

Note: Control variables include race, gender, free or reduced lunch status, special education status and school district fixed effects. Heteroskedastic-robust standard errors in parenthesis.

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

Table 13: Likelihood of ELL Designation for Initially ELL Students (Cohort 1)

Variables	Grade 3	Grade 4	Grade 5
Pre-K	-0.0135 (0.0145)	0.0010 (0.0148)	-0.0158 (0.0190)
Female	-0.0033 (0.0125)	-0.0059 (0.0127)	-0.0328** (0.0165)
FRL	0.116***	0.117***	0.130***

	(0.0360)	(0.0309)	(0.0328)
SPED	0.088*** (0.0165)	0.105*** (0.0146)	0.219*** (0.0164)
Constant	0.510*** (0.170)	0.326* (0.188)	-0.288*** (0.0804)
Observations	2,835	2,776	2,723
R-squared	0.191	0.189	0.158

Note: Regression models additionally control for student race and school district fixed effects. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 14: Likelihood of ELL Designation for Initially ELL Students (Cohort 2)

Variables	Grade 3	Grade 4	Grade 5
Pre-K	-0.0581*** (0.0149)	-0.0901*** (0.0179)	-0.0920*** (0.0193)
Female	-0.0371*** (0.0125)	-0.0651*** (0.0150)	-0.0597*** (0.0166)
FRL	0.0754*** (0.0290)	0.0959*** (0.0312)	0.0686** (0.0291)
SPED	0.102*** (0.0165)	0.198*** (0.0159)	0.269*** (0.0174)
Constant	-0.0222 (0.0786)	-0.232** (0.110)	0.145 (0.309)
Observations	2,941	2,889	2,869
R-squared	0.181	0.180	0.165

Note: Regression models additionally control for student race and school district fixed effects. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 15: Likelihood of ELL Designation for Initially ELL Students (Cohort 3)

Variables	Grade 3	Grade 4	Grade 5
Pre-K	-0.0616*** (0.0172)	-0.0574*** (0.0187)	-0.0400** (0.0200)
Female	-0.0602*** (0.0147)	-0.0547*** (0.0160)	-0.0764*** (0.0178)
FRL	0.0726**	0.0858***	0.115***

	(0.0299)	(0.0258)	(0.0287)
SPED	0.165*** (0.0149)	0.233*** (0.0166)	0.406*** (0.0200)
Constant	-0.150** (0.0713)	-0.230*** (0.0755)	-0.312** (0.127)
Observations	2,937	2,901	2,861
R-squared	0.174	0.196	0.219

Note: Regression models additionally control for student race and school district fixed effects.
Heteroskedastic-robust standard errors in parenthesis.
*** p<0.01, ** p<0.05, * p<0.1