



## RESEARCH BRIEF

for the Houston Independent School District

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### *The Benefits of HISD Pre-Kindergarten: The Relationship between Years of Exposure and School Readiness*

By Erin M. Baumgartner, Ph.D., Postdoctoral Fellow

*To better understand the relationship between participation in public pre-kindergarten and school readiness, this study examines the verbal school readiness of students who participate in the state-funded pre-k programs offered through the Houston Independent School District. In addition to assessing whether students who attend HISD pre-k are more likely to be ready for school than their peers who attend no HISD pre-k, it also examines whether there is a bonus associated with enrolling in HISD pre-k for two years versus one year. Findings suggest that overall, students who attend one or two years of HISD pre-k are significantly more likely to be ready than their peers who attend zero years of HISD pre-k on both English and Spanish assessments. However, while students benefit from attending a second year of HISD pre-k on the English assessment, students do not appear to benefit from a second year on the Spanish assessment. There are slight differences between demographic groups in their returns to HISD pre-k, with students who are language minorities experiencing fewer returns from a second year of pre-k than their peers.*

### BACKGROUND

Increasingly, education researchers and practitioners are looking toward the earliest years of a student's educational trajectory to understand where gaps in achievement begin. It is of no surprise to many educators that differences between students of different demographic backgrounds can be identified as early as school entry, which is generally kindergarten, for most children (Booth and Crouter, 2007; Janus and Duku, 2007; Lee and Burkham, 2002; West et. al., 1992).

In an effort to address these disparities, state boards of education are offering earlier learning opportunities, in the form of state-funded pre-kindergarten programs. Pre-kindergarten, or "pre-k", provides children a structured learning environment in the year before kindergarten entry. While this generally includes children who are four-years-old, some states offer programs to three-year-old children as well (Barnett, et al., 2016).

Like other early childhood educational and care settings, it is expected that children in state-funded pre-k programs will be developing the academic, social, and emotional skills that are needed to be successful upon school entry. Broadly, these skills are referred to as "school readiness".

School readiness is important for a number of reasons. Students who are better prepared at school entry have greater academic achievement, are less likely to drop out of school, have fewer behavioral problems, participate in higher levels of education, higher rates of employment, and greater earnings in adulthood than their peers who are not ready (Duncan et al., 2007; Hair et al., 2006; Heckman et. al., 2010a, 2010b; Rouse, Brooks-Gunn, and McLanahan, 2005).

Some groups of children are less likely to be school ready than their peers. In particular, children from economically disadvantaged families are at greater risk of being unprepared for formal schooling than their more economically advantaged peers, with less than half of economically disadvantaged children

displaying school readiness at age five (Isaacs, 2012). With regards to racial and ethnic gaps, some evidence shows that differences in readiness between some racial and ethnic groups have slightly narrowed over time, namely, the Black-White and Hispanic-White gaps, but if rates of school readiness continue at the current pace, it is likely to take more than two decades to eliminate gaps in readiness (Baumgartner, 2016).

*...at the current pace, it is likely to take more than two decades to eliminate (racial and ethnic) gaps in readiness.*

And children identified as experiencing multiple risk factors (e.g., low economic resources, single-parent household, minority status) have lower school readiness than their peers experiencing fewer risk factors (Pratt et al., 2016).

Early childhood education is viewed as one means of narrowing these gaps. Children who participate in center-based early educational experiences, like center-based child care, preschool, or pre-kindergarten, have greater odds of being ready than children who do not participate in these programs (Camilli et al., 2010; Diamond et al., 2007; Isaacs, 2012). Work by Isaacs (2012) and others, which includes simulations that estimate the effect of expanding early childhood programs (like preschool or pre-k) to children who are not currently participating, suggests that the expansion of these programs would lead to a greater proportion of children being prepared to succeed at school entry (Magnuson and Waldfogel, 2005). In some cases, it is estimated that increasing participation in preschool/pre-k may be particularly important in decreasing racial and ethnic gaps and socioeconomic gaps in readiness, and later economic inequality (Loeb, et al., 2007; Magnuson and Duncan, 2016; Magnuson, Ruhm, and Waldfogel, 2007; Magnuson and Waldfogel, 2005).

In Texas, school districts are mandated to provide half-day pre-kindergarten programs for four-year old students if they have at least 15 students

identified in one or more of the following risk groups: unable to speak and comprehend English, educationally disadvantaged,<sup>1</sup> homeless, child of a member of the armed forces who is in active duty or who was killed or injured while serving, or has ever been in the care of the Department of Family and Protective Services (Texas Education Code §29.153).

The Houston Independent School District (HISD) has

exceeded this mandate by offering full-day pre-kindergarten programs for qualifying four year olds (Houston Independent School District, 2016). Additionally, when space is available, families can enroll their three year old children in pre-kindergarten. This means that by the time children in HISD reach public kindergarten classrooms, they may have had exposure to zero, one, or two years of state-funded pre-kindergarten.<sup>2</sup>

A growing body of research suggests that children who are exposed to additional years of early childhood education in the U.S. are better prepared upon school entry (Barnett & Lamy, 2006; Loeb et al., 2004; Skibbe, et al., 2011). Beyond the U.S. context, international studies examining years of pre-k have also found that children who participate in two years of early childhood education have higher academic achievement than children who participated in fewer years or no early childhood education (Mullis et al., 2012; Sammons et al., 2014).

Given the significant resources needed to provide full-day, fully-funded pre-kindergarten programs to students, it is important to understand whether students in Houston are benefiting from participating in the district’s pre-kindergarten program and whether a second year of early childhood education provides an added benefit to students. In addition, when considering existing research on gaps in school readiness among children

<sup>1</sup>Note: The measurement of this indicator relies solely on parental income, reflecting what many would consider “economically” disadvantaged, rather than “educationally” disadvantaged.

<sup>2</sup> Children who do not attend HISD pre-k programs are not necessarily missing all opportunities for early education. These children may attend other types of early educational programs, like center-based child care,

preschool, or home-based programs. To date, the school district has little information regarding what types of programs kindergarteners who did not attend HISD pre-kindergarten were enrolled in during the year or years prior to kindergarten entry. This means that any comparisons between students who enrolled in HISD pre-k and students who did not are underestimates.

of different demographic groups, it is important for the district to understand whether there are differential returns on years of pre-kindergarten.

## RESEARCH QUESTIONS

This study addresses the following questions:

- 1) To what extent is exposure to HISD pre-kindergarten programs associated with student readiness at kindergarten entry?
- 2) What, if any, is the added benefit of an additional year of pre-kindergarten education?
- 3) To what extent do students in various social and demographic groups benefit differently from participation in HISD pre-kindergarten programs?

## DATA AND METHODS

### *Data*

The data for this study were provided by HISD for students who were enrolled in kindergarten during the 2013-2014 or 2015-2016 school years. In addition to student demographic data collected through the Public Education Information Management System (PEIMS), this analysis uses student assessment data collected as part of the Istation Early Reading Assessment administered in the fall of kindergarten, measuring overall reading ability, phonemic awareness, letter knowledge, and vocabulary in English or Spanish (Mathes, Torgesen, & Herron, 2016).

Students who were in special education classes or repeated kindergarten were omitted from this analysis.<sup>3</sup> Additionally, only students who were tested in the fall of kindergarten were included, resulting in a total of 25,417 students who participated in the English version and 13,622 who participated in the Spanish version of the Istation assessment. Students may not have been tested if they were not enrolled in kindergarten by September, the month in which the beginning of the year Istation testing takes place.

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<sup>3</sup> This study also tested the retention of these groups and their inclusion in models as control variables. Results did not differ substantively from those presented here.

### *Measures*

*Verbal school readiness* (herein referred to as “school readiness”) is based on the Istation assessment administered at the beginning of the kindergarten school year in either English or Spanish. Students who achieve a score that indicates they score “at grade level” at kindergarten entry are considered school ready on this indicator, in each respective language. (In supplemental analyses, continuous versions of this variable were also used).

*Exposure to HISD pre-kindergarten* is a categorical variable indicating the number of years each student attended HISD pre-kindergarten, 0 years (did not attend HISD pre-k), 1 year (at approximately 4 years of age), or 2 years (at approximately 3 and 4 years of age).

Control variables include race/ethnicity, immigrant status, economically disadvantaged (qualifies for free/reduced price lunch or other means tested government assistance), language,<sup>4</sup> gender, age (standardized), attends zoned school, and cohort.

### *Analytic Strategy*

This study consists of three stages of analysis. The first stage is a descriptive comparison of the socio-demographic characteristics of students at each level of exposure to HISD pre-k. It also includes a bivariate examination of the relationship between exposure to HISD pre-kindergarten programs and student readiness at kindergarten entry.

The second stage of analysis attempts to isolate the effects of HISD pre-k from other factors that affect school readiness. It utilizes multilevel logistic regression to predict readiness in literacy at kindergarten entry for students who received different years of exposure to HISD pre-kindergarten programs, net of a series of controls. This strategy allows for the research to account for student characteristics and the nesting of children within schools in the district.

The final stage of this analysis evaluates whether the relationship between dosage of HISD pre-kindergarten and student readiness is the same for

<sup>4</sup> Given significant overlap between non-English home language, limited English proficiency classification, and participation in any bilingual programs, this analysis tests each of these indicators of language proficiency, but unless otherwise specified uses “non-English home language”.

students of all social and demographic groups, by examining the interactions between student characteristics and years of HISD pre-k, net of a series of controls.

All analyses were conducted separately for English and Spanish test scores.

## RESULTS

### Student characteristics

The first column of Table 1 shows the demographic characteristics of HISD kindergarten students in the study. Approximately one-third (33.5 percent) of kindergarten students were not enrolled in an HISD pre-kindergarten program in the year prior to kindergarten entry, though they may have participated in some other type of early learning program. Of the students who enrolled in HISD pre-k programs, a majority of students enrolled for one year (approximately 90 percent of students who participated in any HISD pre-k).

The racial/ethnic, gender, and economic characteristics of all students in the sample are similar to the overall demographic characteristics of students in HISD in the 2014-15 and 2015-16 school years (see HISD reports: 2014-2015 & 2015-2016 Facts and Figures). The average age of students in the sample is 5.5 years, which aligns with the requirement that children must be 5 years old by September 1<sup>st</sup> of the kindergarten year.

Nearly half of HISD kindergarteners in the sample lived in homes where English was not the primary language spoken. Therefore, it is not surprising that over 43 percent of students in the sample were enrolled in a bilingual program, and over 45 percent of students were classified as having limited English proficiency.

Table 1 also provides a breakdown of student characteristics by the number of years a student participated in HISD pre-k programs.

	All students N=31,460	Years of HISD Pre-Kindergarten		
		Zero N=10,551	One N=18,652	Two N=2,257
<b>Years of HISD Pre-kindergarten</b>				
Zero	0.335	1.0	--	--
One	0.593	--	1.0	--
Two	0.072	--	--	1.0
<b>Race/ethnicity</b>				
White	0.087	0.205	0.027	0.029
Black	0.224	0.228	0.212	0.319
Hispanic	0.633	0.459	0.730	0.646
Asian	0.042	0.082	0.024	0.006
Other	0.014	0.027	0.007	0.009
<b>Economically disadvantaged</b>				
No	0.237	0.456	0.125	0.141
Yes	0.763	0.544	0.875	0.859
<b>Gender</b>				
Male	0.494	0.508	0.488	0.481
Female	0.506	0.492	0.512	0.519
<b>Age (in years)</b>				
	5.510	5.510	5.500	5.590
<b>Enrolled in any bilingual program</b>				
No	0.569	0.752	0.464	0.578
Yes	0.431	0.248	0.536	0.422
<b>Limited English proficiency</b>				
No	0.545	0.704	0.457	0.524
Yes	0.455	0.296	0.543	0.476
<b>Non-English speaking household</b>				
No	0.516	0.662	0.434	0.505
Yes	0.484	0.338	0.566	0.495

The sample includes students who were enrolled in HISD kindergarten in 2014-2015 and 2015-2016.

When comparing racial and ethnic characteristics of students who attended no HISD pre-k versus those who attended one or two years, it is clear that a greater proportion of Hispanic students participate in these programs than any other racial or ethnic group. Similarly, the proportion of students in HISD pre-k programs who are economically disadvantaged is substantially higher than the proportion of economically disadvantaged students who participated in zero years of HISD pre-k. And finally, students participating in any years of HISD pre-k are more likely to be limited English proficient, participate in a bilingual program, and live in homes where English is not the primary language.

These findings are not surprising when one considers that two of the possible ways students can gain access to these programs is by being identified as having limited English proficiency, which is significantly more likely for Hispanic students than other racial/ethnic groups, or being identified as educationally (economically) disadvantaged. Across those characteristics that are not associated with selection into HISD pre-k programs, including gender and age, there is no difference between groups.

**School readiness by exposure to HISD pre-kindergarten**

The next stage of analysis examines variations in verbal school readiness for students who were exposed to varying levels of HISD pre-k. Shown in Table 2, approximately 35 percent of all kindergarten students in HISD who took the English Istation assessment were performing at grade level, or school ready, at kindergarten entry. For students who took the Spanish Istation, over half of students (53 percent) were performing at grade level at kindergarten entry.

There are significant mean differences when comparing students who participated in various years of HISD pre-k, ranging from zero to two years. For students who participated in the English assessment, students with two years of HISD pre-k had the highest rates of school readiness, significantly higher than students who participated in one or zero years of HISD pre-k. However, school readiness rates were higher

among those who attended no HISD pre-k (36.0 percent), compared to those who attended only one year of HISD pre-k (33.0 percent). One possible interpretation of this finding is that because this table only represents mean differences, it does not account for the variation in student characteristics between the students who enrolled in zero versus one year of HISD pre-k. Students who are in zero years of HISD pre-k are not necessarily attending no preschool or pre-k type programs; some of these students are in families that would not qualify for free state-funded pre-k, and, thus, they may be choosing to enroll their children in other types of high quality early childhood education.

**Table 2. Proportion of students who are school ready.**

	English	Spanish
All students	0.350	0.528
Years of HISD pre-k		
Zero	0.360 <sup>ab</sup>	0.294 <sup>ab</sup>
One	0.333 <sup>bc</sup>	0.594 <sup>c</sup>
Two	0.427 <sup>ac</sup>	0.560 <sup>c</sup>

<sup>a</sup> Indicates significant difference from one year of HISD pre-k  
<sup>b</sup> Indicates significant difference from two years of HISD pre-k  
<sup>c</sup> Indicates significant difference from zero years of HISD pre-k

When examining mean differences for students who participated in the Spanish Istation, overall, the high proportion of students who achieved a score which indicated they were likely to be school ready appears to be driven by students who participated in HISD pre-k programs. As shown in Table 2, Column 2, over half of students who were enrolled in one or two years of HISD pre-k and took the Spanish Istation were school ready at kindergarten entry, with rates of 0.59 and 0.56, respectively. Though there is not a significant difference in the proportion of students school ready on the Spanish Istation between those who were enrolled in one versus two years of HISD pre-k, these proportions are both significantly higher than for students who participated in zero years of HISD pre-k.

It is important to note that any differences in school readiness observed in this analysis, and subsequent analyses, between students who participated in zero years of HISD pre-k and any years of HISD pre-k, may actually reflect an underestimate of the true difference. As noted earlier, the children classified

*...the high proportion of students who... were likely to be school ready appears to be driven by students who participated in HISD pre-k programs (for Spanish Istation)*

as having participated in zero years of HISD pre-k include children that may have actually participated in some other type of early educational experience. This means that if we were able to separate students who truly received no pre-k of any type, the proportion of students who are school ready in this population would probably be lower than our estimates shown here, and the differences between these students and those who participated in HISD pre-k are likely larger.

It is also important to note that this table only provides a bivariate comparison of student readiness. In other words, it only examines the average proportion of students in a given HISD pre-k exposure group who are considered verbally school ready at kindergarten entry, without taking into consideration other factors that may also explain school readiness. Considering the findings provided in Table 1, which demonstrate that there are indeed significant demographic differences between exposure groups, in order to accurately assess the relationship between participation in HISD pre-kindergarten and student readiness for school, further analyses must also include a set of student-level characteristics. Thus, the following results are based on regression models which account for student characteristics.

**Is HISD pre-kindergarten exposure associated with school readiness?**

***English Istation***

In analyses examining the relationship between years of enrollment in HISD pre-k programs and student likelihood of being ready for school at kindergarten entry, findings indicate that enrollment in HISD pre-k programs is associated with greater odds of being prepared at school entry on the English Istation.

<b>Table 3. Odds of verbal school readiness on English Istation</b>	
	Odds
<b>Years of HISD pre-k</b>	
Zero years vs. One year	1.0 vs. 2.8***
Zero years vs. Two years	1.0 vs. 3.8***
One year vs. Two years	1.0 vs. 1.4***
*** p<0.001 ** p<0.01 *p<0.05	
Full table in Appendix A.	

In Table 3, the differences in odds of school readiness are presented. In the first cell of results, the value of 2.8 indicates that the odds of a student

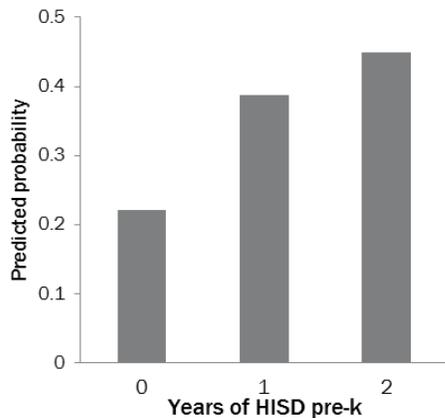
who attended one year of HISD pre-k being ready for kindergarten are 2.8 times greater than the odds of a student who attended zero years of HISD pre-k (2.8 versus 1.0). Similarly, the odds of being ready for school are 3.8 times greater for students who attended two years of HISD pre-k than students who attended zero years of HISD pre-k. This means that students who attend two years of HISD pre-k have 280 percent greater odds of being ready for school than their peers who attended zero years of HISD pre-k. When compared to students who attended one year of HISD pre-k, the odds of being school ready are 1.4 times, or 40 percent, higher for those who attended for two years.

While considering odds allows us to understand how

*The odds of a student who attended one or two years of HISD pre-k being school ready are 2.8 and 3.8 times higher than those who attended zero years of HISD pre-k (on English Istation).*

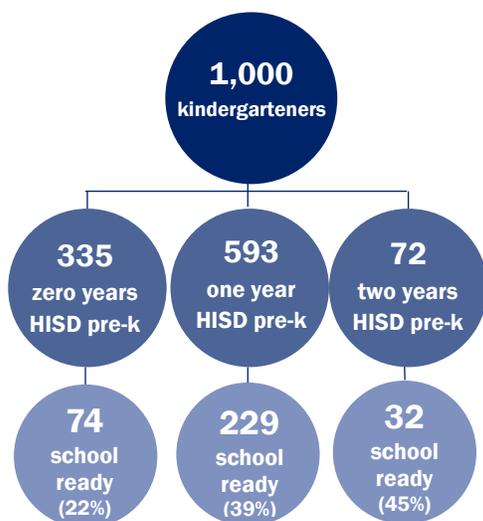
groups compare to one another, it does not tell us much about whether those odds are associated with high or low rates of being ready for school. The odds for one group might be 3 times the odds of another group, but if the likelihood of being school ready is very low for the first group, 3 times a low number may still be a low number.

Thus, another way to understand these results is to estimate the probabilities of school readiness of students at each year of exposure to HISD pre-k. A “probability” is the likelihood that an event will occur. In this example, the probability that is being modeled is whether a student is likely to be “school ready”. As shown in Figure 1, the predicted probability of being school ready is lowest for students who attended zero years of HISD pre-k (0.22), and is higher for students who attended one (0.39) or two years (0.45) of HISD pre-k. These groups are all significantly different from one another, which means that the probability of readiness for students who attended one year of HISD pre-k is greater than for students who attended zero years, and the probability for students who attended two years is greater than that of students who attended one year.



**Figure 1. Predicted probability of school readiness (English Istation).**

Based on these predicted probabilities, envision a hypothetical scenario where there were 1,000 kindergarten students who took the English Istation assessment in the fall of kindergarten (Figure 2). Of these 1,000 students, 335 did not attend HISD pre-k, 593 attended one year of HISD pre-k, and 72 students attended two years of HISD pre-k. Based on the estimates from the results presented above, of the 335 students who did not attend HISD pre-k, 74 students (or 22 percent) were ready at school entry, based on their performance on the English Istation assessment. Of the 593 students who participated in one year of HISD pre-k, approximately 229 students (or 39 percent) were ready at kindergarten entry. And, finally, of the 72 students who attended two years of HISD pre-k, 32 students (or 45 percent) were ready at kindergarten entry.



**Figure 2. Scenario of school ready students, by HISD pre-k enrollment (English Istation).**

Across levels of exposure to HISD pre-k, it is evident that the highest proportion of students who are school ready are those who participated in the most HISD pre-k (two years).

These analyses account for student-level demographic characteristics which do little to explain the relationship between years of exposure to HISD pre-k and school readiness on the English Istation assessment. This means that if we consider the differences in school readiness between the group of students who attended zero and one year of HISD pre-k that are associated with student demographic characteristics, a significant difference between these groups in the predicted probability of school readiness remains.

While these findings suggest that there is a positive relationship between attending HISD pre-k and school readiness on the English Istation, some or all of this relationship may be explained by unobserved variables that are not included in this study. For example, parental education may explain variations that exist between groups if students who participated in HISD pre-k were more likely to have highly educated parents than students who did not participate in HISD pre-k. Given the risk characteristics required for enrollment in state-funded public pre-k and other demographic characteristics of the sample, it is unlikely that this is the case, but this is an example of how other variables not included in the study could account for some of the variation observed here. Because information about parental education is not available, this cannot be tested. Student prior academic ability may also explain the variation that exists between students who participate in zero versus one or two years of HISD pre-k, in that students who attend HISD pre-k may have higher academic ability before they begin pre-k, but because we do not have data for the year before kindergarten for the children who attended zero years of HISD pre-k, this cannot be tested.

**Spanish Istation**

Unlike the results for the English Istation, there does not appear to be a straightforward relationship between years of exposure to HISD pre-k and student readiness for school on the Spanish Istation. While the difference between students who participated in zero years of HISD pre-k versus those who participated in any number of years of

HISD pre-k is positive and significant, there appears to be no added benefit of a second year of enrollment with regards to school readiness on the Spanish Istation.

Presented in Table 4, findings suggest that students who enroll in one or two years of HISD pre-k have over 3 times greater odds of being school ready than students who were enrolled in zero years of HISD pre-k (3.6 and 3.0 times greater, respectively). And though the difference in odds of readiness between students who attended one and two years of HISD pre-k is significant, it occurs in an unexpected direction, where the odds of being school ready on the Spanish Istation are 20 percent higher for students who attended one year of HISD pre-k than for students who attended two years.

Table 4. Odds of verbal school readiness on Spanish Istation	
	Odds
<b>Years of HISD pre-k</b>	
Zero years vs. One year	1.0 vs. 3.6***
Zero years vs. Two years	1.0 vs. 3.0***
One year vs. Two years	1.0 vs. 0.8*
*** p<0.001 ** p<0.01 *p<0.05	
Full table in Appendix B.	

This finding can be more clearly observed when considering the predicted probability of school readiness at each year of exposure to HISD pre-k as presented in Figure 3. Of students who took the Spanish Istation, those who participated in one year of HISD pre-k have a significantly greater probability of being ready for school than students who participated in zero years of HISD pre-k, with predicted probabilities of 0.57 and 0.30, respectively. Similarly, students who participated in two years of HISD pre-k have a significantly greater probability of being ready for school (0.53) than students who participated in zero years of HISD pre-k (0.30) on the Spanish Istation.

However, there is not a clear advantage between one and two years of HISD pre-k for students who participated in this assessment, as students who were enrolled in a single year of HISD pre-k actually have a significantly higher probability of being ready for school than students who were enrolled in two years of HISD pre-k. Potential explanations for

*On the English Istation, most students, regardless of demographic background, find incremental benefits from exposure to HISD pre-k.*

this finding are considered in the Discussion section.

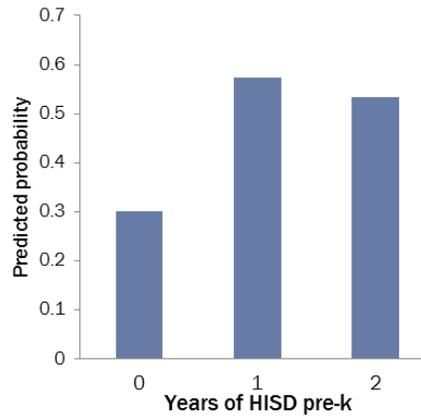


Figure 3. Predicted probability of school readiness (Spanish Istation).

Again, these results may be an underestimate of the benefit of attending one or two years of HISD pre-k versus attending zero years of HISD pre-k, as the group of students who attend zero years of HISD pre-k may actually attend some other type of early childhood educational program.

**Do all students benefit from additional years of pre-kindergarten?**

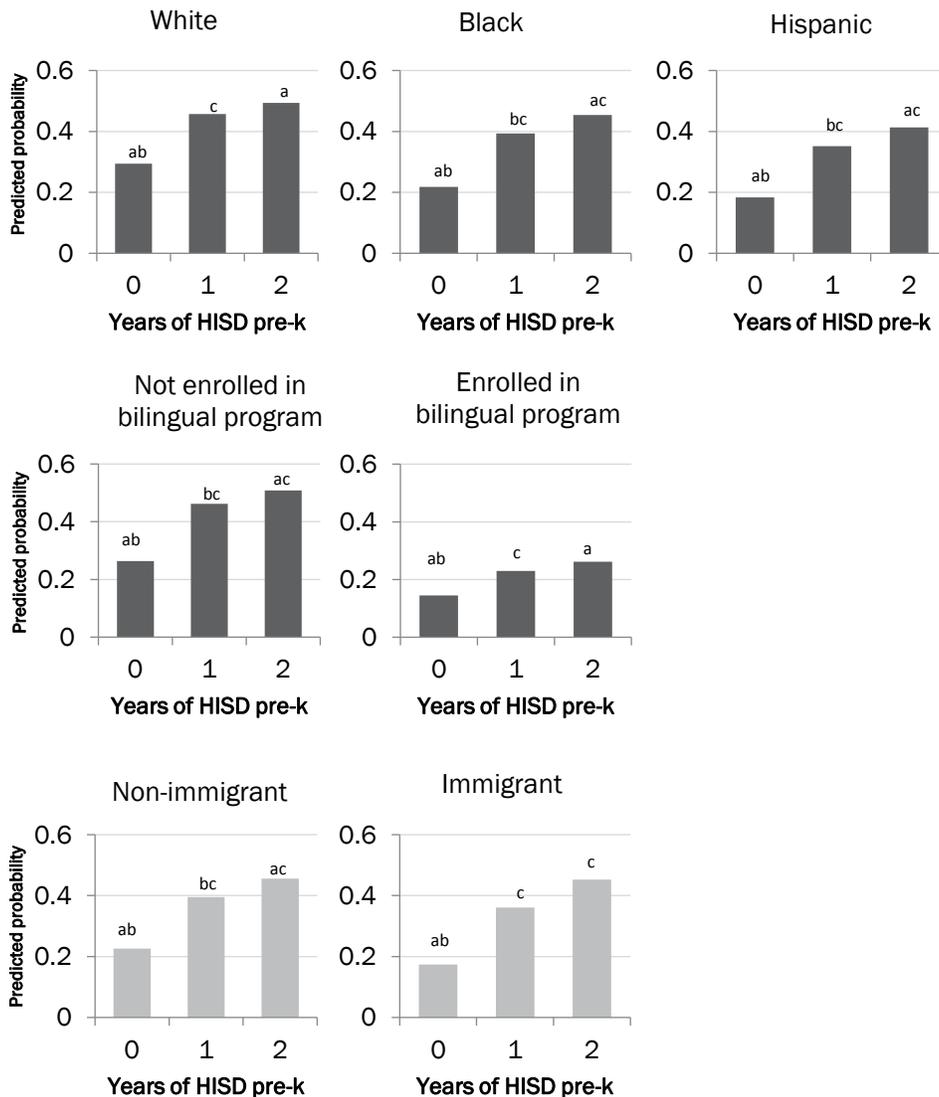
In order to better understand the findings presented above, the final stage of this analysis examines whether there are differential returns to years of HISD pre-k for students in various demographic groups. If, for example, we observe that students in all racial and ethnic groups have the same relationship between years of HISD pre-k and the probability of school readiness, we might assume that students of all races and ethnicities benefit equally from enrollment in HISD pre-k programs. Results of a subset of these demographic analyses will be discussed here, with figures for all results appearing in Appendix C. As with previous stages of this analysis, all findings are separated by Istation language (English and Spanish).

On the English Istation, most students, regardless of demographic background find incremental benefits from exposure to HISD pre-k, with students who attended zero years of HISD pre-k exhibiting the lowest probabilities of school readiness, followed by

students who attended one year of HISD pre-k, and students who attended two years of HISD pre-k with the highest probability of readiness.

In particular, when comparing economically disadvantaged and non-disadvantaged students, male and female students, LEP and non-LEP students, and those whose home language is English and not, all find that one year of HISD pre-k is associated with higher probability of readiness than zero years, and two years is associated with higher

probability of readiness than one year. As shown in the graphs (Appendix C, Figures 4 and 5), the patterns for these groups all exhibit the same upward trend. Note, this is not to say that there are no differences in the likelihood of school readiness between economically disadvantaged and non-disadvantaged students, for example, but that for these two groups, there is a similar pattern in the relationship between years of exposure to HISD pre-k and student readiness.



<sup>a</sup> Indicates significant difference from one year    <sup>b</sup> Indicates significant difference from two years  
<sup>c</sup> Indicates significant difference from zero years

Figure 4a. Predicted probability of school readiness (English I station) by years of HISD pre-k, by race/ethnicity.

However, there are some groups experiencing differential returns to years of HISD pre-k. When comparing racial/ethnic groups, Black and Hispanic students benefit from an additional year of HISD pre-k (two versus one), but White students do not, as shown in the figures below (taken from Appendix C). Additionally, non-immigrant students and students not enrolled in bilingual programs benefit from a second year of HISD pre-k as they exhibit higher probabilities of school readiness when enrolled in two versus one year of HISD pre-k, while immigrant students and students in bilingual programs do not, as measured on the English Istation.

When comparing within demographic groups on the Spanish Istation, there appear to be more differences than on English Istation (see bottom panel of Appendix D). Notably, within each demographic category (ex. race/ethnicity, gender, etc.), there are no instances where the relationship between exposure to HISD pre-k and school readiness is the same for all subgroups. For example, when comparing students of different racial/ethnic groups, the relationship between years of exposure to HISD pre-k and student probability of school readiness is different for White, Black, and Hispanic students.

Overall, there are no demographic subgroups which experience a positive bump in the probability of being ready for school when comparing students who attend for two years versus one. And, in all cases where there is a significant difference between one and two years of HISD pre-k, the differences are negative,

which means that students who were enrolled in

*On the Spanish Istation, students benefit from any exposure to HISD pre-k, but find no added benefit from a second year.*

one year of HISD pre-k had higher readiness probabilities than students who were enrolled in two years. In particular, Hispanic students, economically disadvantaged students, females, non-immigrant students, students whose home language is not English, and limited English proficiency students all exhibit higher probabilities of readiness with one rather than two years of HISD pre-k (Appendix C, Figures 6 and 7). This finding is addressed in greater detail in the Discussion section.

When examining specific groups, White, Black, and Hispanic students who are exposed to one year of

HISD pre-k have a greater probability of school readiness versus students who were enrolled in zero years of HISD pre-k on the Spanish Istation. White and Hispanic students who attended two years of HISD pre-k also are at an advantage compared to their White and Hispanic peers who attended zero years of HISD pre-k, but Black students who attend two years of HISD pre-k do not see the same advantage. As noted above, though there is a significant difference in readiness between Hispanic students who participate in one versus two years of HISD pre-k, this does not occur in the expected direction. Hispanic students enrolled in one year of HISD pre-k have a higher probability of readiness than students enrolled in two years.

There are a number of other demographic groups which also experience differential returns to years of exposure to HISD pre-k programs. Nearly all student subgroups who attend one year of HISD pre-k in comparison to zero years of HISD pre-k exhibit greater probabilities of being school ready on the Spanish Istation (with the exception of students who are not in bilingual programs). But, there are a number of groups who do not find any benefit from being enrolled in two years of HISD pre-k versus zero years of HISD pre-k. In particular, immigrant students, English speaking students, and those who are not LEP who attend two years of HISD pre-k are not different than their respective counterparts who attend zero years of HISD pre-k. To note, the proportion of immigrant students who were enrolled in two years of HISD pre-k across the two cohorts is very small, thus, the findings regarding the second

year of HISD pre-k for this group should be considered with this in mind.

However, there are groups which benefit from any years of exposure to HISD pre-k (one or two) with regards to the Spanish Istation, but do not necessarily find an added benefit between one and two years. In particular, economically disadvantaged and non-disadvantaged students and male and female students all benefit on the Spanish Istation from one or two years of HISD pre-k, when compared to their peers who were enrolled in zero years of HISD pre-k.

**Supplemental analyses**

To more fully account for the differences that exist between students who enroll in any HISD pre-k program versus those who never enroll, there were two additional sets of analyses conducted: the inclusion of school-level variables in the existing multilevel models and propensity score matching. The inclusion of school-level variables provided a means of testing whether some demographic characteristics of schools students were attending in kindergarten would account for variation in student readiness. Propensity score matching is a quasi-experimental method to evaluate the influence of the “treatment” (any HISD pre-k versus none, one versus two years) on an outcome (school readiness) by comparing students who did and did not receive the treatment, who are otherwise similar across a number of background characteristics.

Both supplemental analyses suggest that the findings provided above are robust. The inclusion of school-level variables did not explain the relationship between years of enrollment in HISD pre-k and school readiness (English or Spanish). A variety of propensity score matching techniques reached a similar

conclusion, where any exposure to HISD pre-k is associated with increases to

school readiness on the English Istation, and two years of HISD pre-k is associated with greater probability of being ready than one year of HISD pre-k. The results are also consistent with those described above for the Spanish Istation. Students who participate in any number of years of HISD pre-k have a greater probability of being school ready than those who participate in no HISD pre-k. However, there is no benefit gained from participating in two versus one year of HISD pre-k for students who take the Spanish Istation. In fact, students with two years of HISD pre-k have a lower probability of school readiness on the Spanish Istation than their peers who participate in one year of HISD pre-k.

*The inclusion of student- or school-level demographic characteristics does little to explain the relationship between years of exposure to HISD pre-k and school readiness.*

**DISCUSSION AND RECOMMENDATIONS**

It is clear to many educators that children who arrive at school prepared to learn have the greatest likelihood of being successful in their educational careers. This preparedness begins as early as school entry, which is typically kindergarten for many children. Many of the educational disparities that are observed between children of different backgrounds can be traced back to disparities that exist between children when they enter school.

One of the ways policymakers, educators, and families have worked to improve the odds of school readiness for children is to utilize early educational learning opportunities to provide children a base for their future learning, particularly those at risk of being unready at school entry. Although this may occur through child care centers and preschools, families may also enroll their children in pre-kindergarten programs offered as part of a school district’s public school system.

Kindergarteners who were enrolled in an early learning program like those outlined above are more likely to be ready at school entry than their peers who participate in other types of care. In Houston, it is clear that students who participated in HISD pre-k have a greater probability of being verbally ready for school than students who did not participate in HISD pre-k. And for a number of students, being in two years of HISD pre-k is associated with an even greater probability of school readiness.

Notably, when evaluating whether students have the verbal skills that indicate they are at grade level at kindergarten entry (or “school ready”), this study finds that with each additional year of HISD pre-k, students have a greater probability of being school ready on the English Istation. This finding would suggest that students are benefiting from participation in HISD pre-k, and that more years of HISD pre-k are better than fewer. Further, the results presented in this brief may underestimate the relationship between HISD pre-k participation and student readiness for school, because the reference

group of students who participated in zero years of HISD pre-k may include students who participated in some other type of early educational program.

For students who participate in the Spanish Istation, the same pattern is not observed. Although most students benefit from one year of HISD pre-k with regards to their probability of being ready on this assessment versus students who participate in zero years of HISD pre-k, students who participate in two years of HISD pre-k do not have a greater probability of being ready than students who participate in only one year. And, counterintuitively, for many students a second year of HISD pre-k is actually associated with a lower probability of school readiness (though not lower than zero years of HISD pre-k). One possible reason for no added benefit from a second year of HISD pre-k could be a ceiling effect. Students who participated in the Spanish Istation and one year of HISD pre-k had nearly a 60 percent predicted probability of being ready for school. As this rate is relatively high, a second year of pre-k might not lead to much of a change in the overall probability of readiness. Another possibility is that HISD pre-k programs might not be set up in a way that is prepared to serve language minority students for two years. For example, if students who participate in two years of HISD pre-k receive the same curriculum each year, there may be less opportunity for growth between the first and second years. It is noted that this could particularly influence language minority students, as results from this study show that students from non-English households, who are LEP, and who are enrolled in bilingual programs are not benefiting from a second year of HISD pre-k.

Therefore, there are two significant implications for HISD from this study. First, it is clear that nearly all students who participate in HISD pre-k are more likely to be prepared for kindergarten than students who do not participate in HISD pre-k. As such, it is important for the district to consider what it might mean to offer HISD pre-k to all four-year-old children in the district, rather than only students identified in the TEA risk groups. While this is likely to come at significant financial cost to the district, the increases to student readiness and the possibility of positive longer term academic and behavioral outcomes is likely to offset some of the cost. A significant body of literature has suggested that the return on investment for each \$1 invested in early childhood could range from \$7 to 14 in the

long run, with more ready students, higher test scores, greater academic achievement, reduced likelihood of special education, lower rates of grade retention, and, in adulthood, increased income and lower rates of crime (Bartik, Gromley, and Adelstein, 2012; Burger, 2010; Camilli et al., 2010; Campbell et al., 2012; Heckman et al., 2010a; Heckman, 2011; Karoly et al., 1998; Reynolds et al., 2001; Reynolds, Temple, and Ou, 2011; Rolnick and Grunewald, 2003).

Second, the district would benefit from an evaluation of the existing pre-k programs to better understand what characteristics are associated with greater odds of student readiness and why some student groups are not benefiting from year two of HISD pre-k, particularly those who participate in the Spanish Istation. This could include understanding whether there are different curricula for three- and four-year-old students, examining teacher training and certifications, and assessing overall program characteristics, such as student-to-teacher ratios and the offering of other language services to families.

There are a few caveats to the findings presented in this study that should be noted. One major challenge is that for kindergarteners in the district who did not attend HISD pre-k programs, it is unclear whether and where they attended any other early learning programs in the year before kindergarten. Thus, the group of students who are considered to have zero years of HISD pre-k may not have zero years of any pre-k/preschool-type program. While this information is requested from families on the HISD enrollment card, it is either not captured well or has a low response rate. It is unclear if this is because the question is unclear to families, they are choosing not to answer it, or school clerks are not entering these data into the district's data management system.

Another point to consider is that there are likely differences between the students whose families chose to enroll them in HISD pre-k and who were eligible but whose families chose not to enroll them in HISD pre-k. The only differences between students who enroll and do not enroll that can be measured at this point are demographic differences as presented in the descriptive statistics of each group in Table 1. Differences in parenting behaviors or other family/home characteristics which may explain the differences between these populations of

students and are predictive of school readiness cannot be measured in this study.

Finally, there are students in this sample who are not eligible for HISD pre-k according to the state guidelines for eligibility, but are enrolled in HISD pre-k because their families have elected to pay for HISD pre-k. This may result in inflated estimates of the relationship between exposure to HISD pre-k and student readiness, as students who are in households which are not considered “at risk” may have more resources to support early learning opportunities for their children at home which may be associated with higher rates of school readiness. Schools do not report data about which students are paying for pre-k to the district, so this study cannot control for this difference, but the number of families utilizing this option is likely small as it is only available when there are open spaces in public pre-k programs and not all campuses offer tuition based pre-k.

Overall, this study provides evidence that HISD pre-k is beneficial to students, with those who attend exhibiting a higher probability of being ready for school than for those who do not, and that many students benefit from a second year of pre-k. This research provides further support for the provision of state-funded pre-k programs to increase student readiness for school. It also leads to important questions about the potential benefits that might be associated with offering these programs to all students in the year before kindergarten entry. While the programs are currently targeting at-risk students, not all at-risk students are participating in these programs. With the offering of a universal pre-k program, pre-k attendance has the potential to become more normative throughout the district, with the upside of raising the rates of attendance for students who are at greatest risk of being unready at school entry.

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This is an abbreviated version of a longer research study written for peer review. For additional information on the findings presented here, or to obtain the full peer-review version of this research brief, contact the Houston Education Research Consortium at 713-348-2802 or email [herc@rice.edu](mailto:herc@rice.edu).

## APPENDIX A

<b>Table 3. Odds ratios of school readiness, English Istation</b>		
	Model 1	Model 2
	Odds Ratio (SE)	Odds Ratio (SE)
Years of HISD Pre-kindergarten (ref: zero years)		
	1.783*** (0.064)	2.800*** (0.113)
One		
	2.857*** (0.154)	3.849*** (0.249)
Two		
Race/ethnicity (ref: White)		
		0.640*** (0.043)
Black		
		0.507*** (0.031)
Hispanic		
		1.742*** (0.148)
Asian		
		1.189 (0.145)
Other		
Economically disadvantaged (ref: no economic disadvantage)		0.492*** (0.021)
Gender (ref: male)		
		1.245*** (0.038)
Female		
Household language (ref: English)		
		0.303*** (0.013)
Not English		
		0.739*** (0.062)
Immigrant status (ref: non-immigrant)		
		3.918*** (0.203)
Age (in years, standardized)		
	0.286*** (0.021)	0.000*** (0.000)
Constant		

Odds ratios >1 indicate higher odds of readiness than the reference group.  
All models also include a control for cohort not presented here.  
p<0.001\*\*\* p<0.010\*\* p<0.05\*

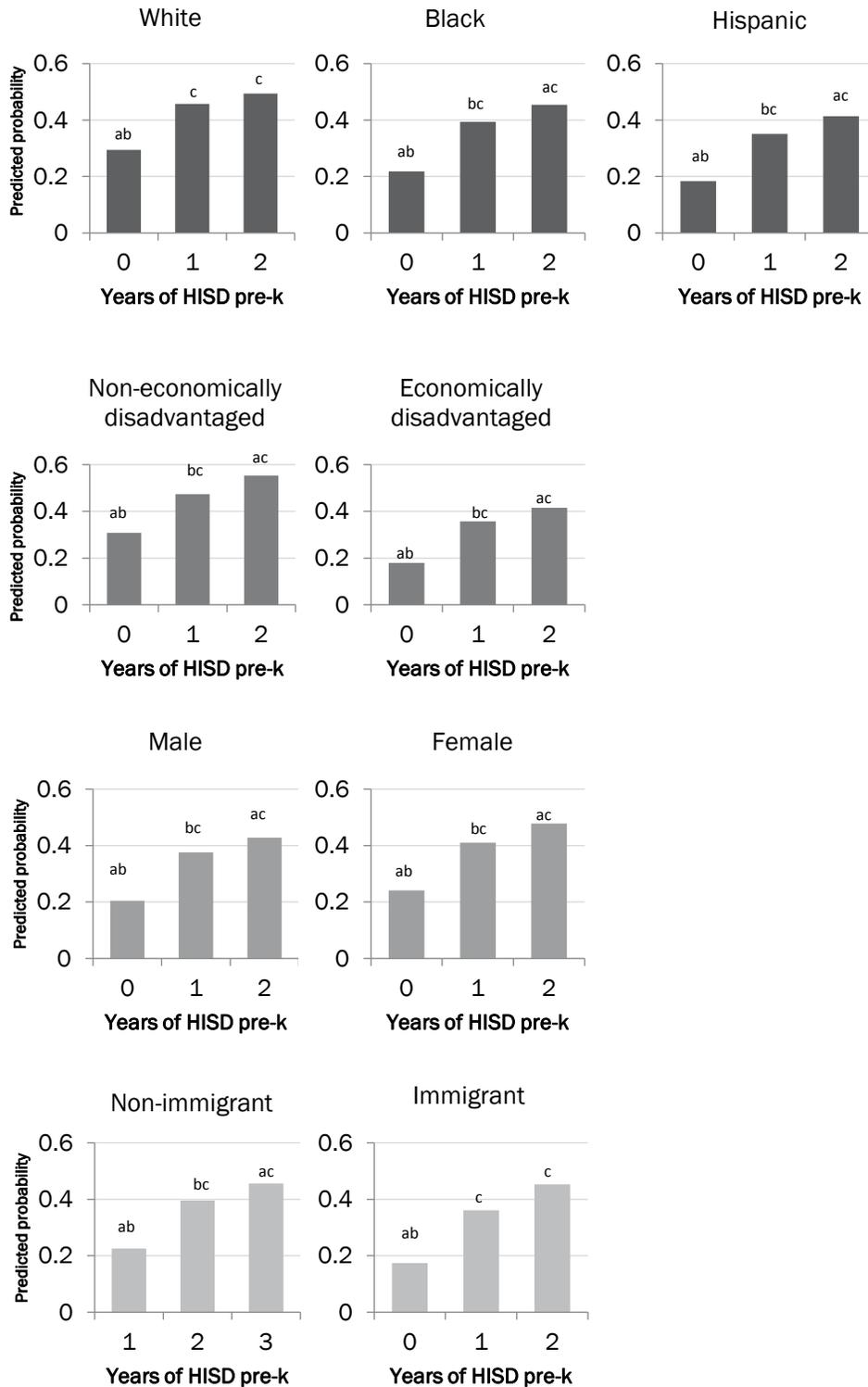
## APPENDIX B

<b>Table 4. Odds ratios of school readiness, Spanish Istation</b>		
	Model 1	Model 2
	Odds Ratio (SE)	Odds Ratio (SE)
Years of HISD Pre-kindergarten (ref: zero years)		
One	3.775*** (0.183)	3.642*** (0.188)
Two	3.522*** (0.298)	3.032*** (0.272)
Race/ethnicity (ref: White)		
Black		0.467** (0.117)
Hispanic		1.411 (0.286)
Asian		0.252** (0.115)
Other		1.647 (0.771)
Economically disadvantaged (ref: no economic disadvantage)		0.982 (0.067)
Gender (ref: male)		
Female		1.184*** (0.045)
Household language (ref: English)		
Not English		5.320*** (0.479)
Immigrant status (ref: non-immigrant)		1.340*** (0.115)
Age (in years, standardized)		1.854*** (0.119)
Constant	0.397*** (0.029)	0.000*** (0.000)

Odds ratios >1 indicate higher odds of readiness than the reference group.  
All models also include a control for cohort not presented here.  
p<0.001\*\*\* p<0.010\*\* p<0.05\*

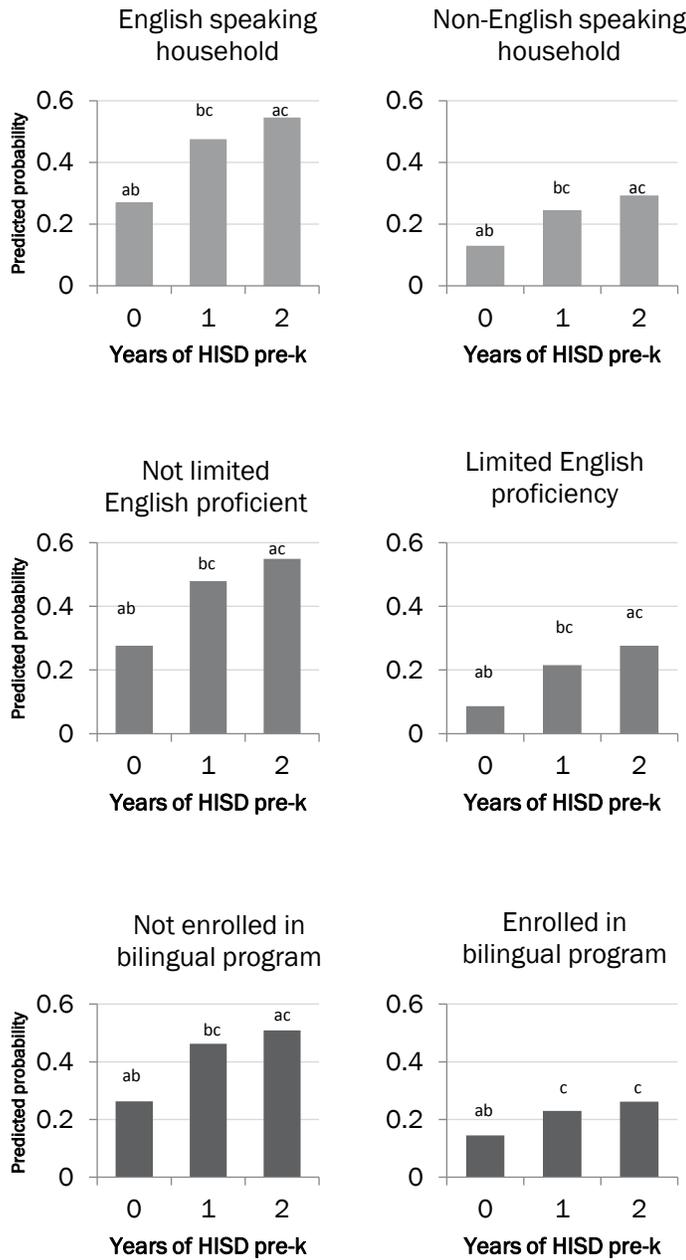
## APPENDIX C

Figure 4. Predicted probability of school readiness on English I station by demographic group.



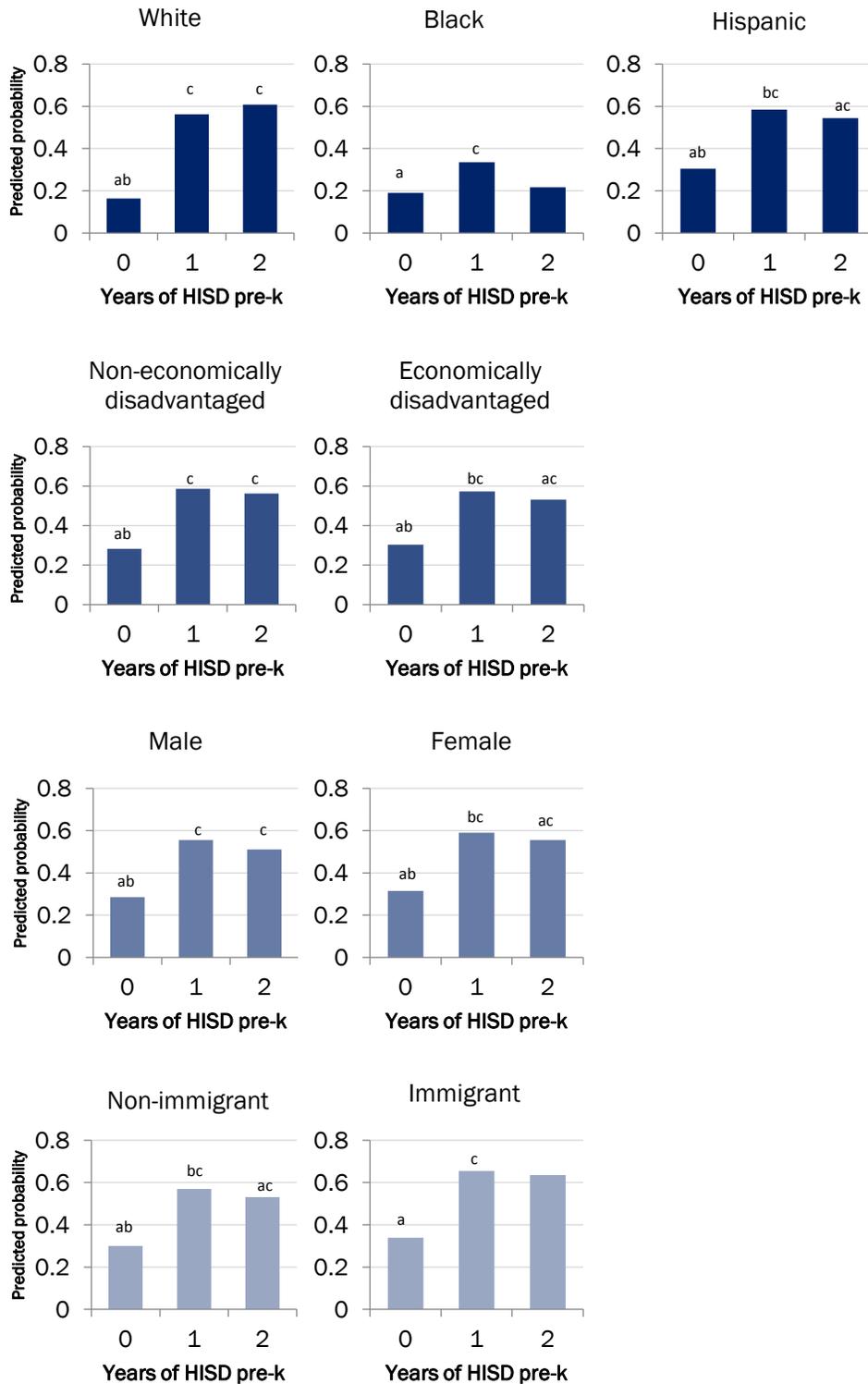
- <sup>a</sup> Indicates significant difference from one year of HSD pre-k
- <sup>b</sup> Indicates significant difference from two years of HSD pre-k
- <sup>c</sup> Indicates significant difference from zero years of HSD pre-k

Figure 5. Predicted probability of school readiness on English Istation by language classification.



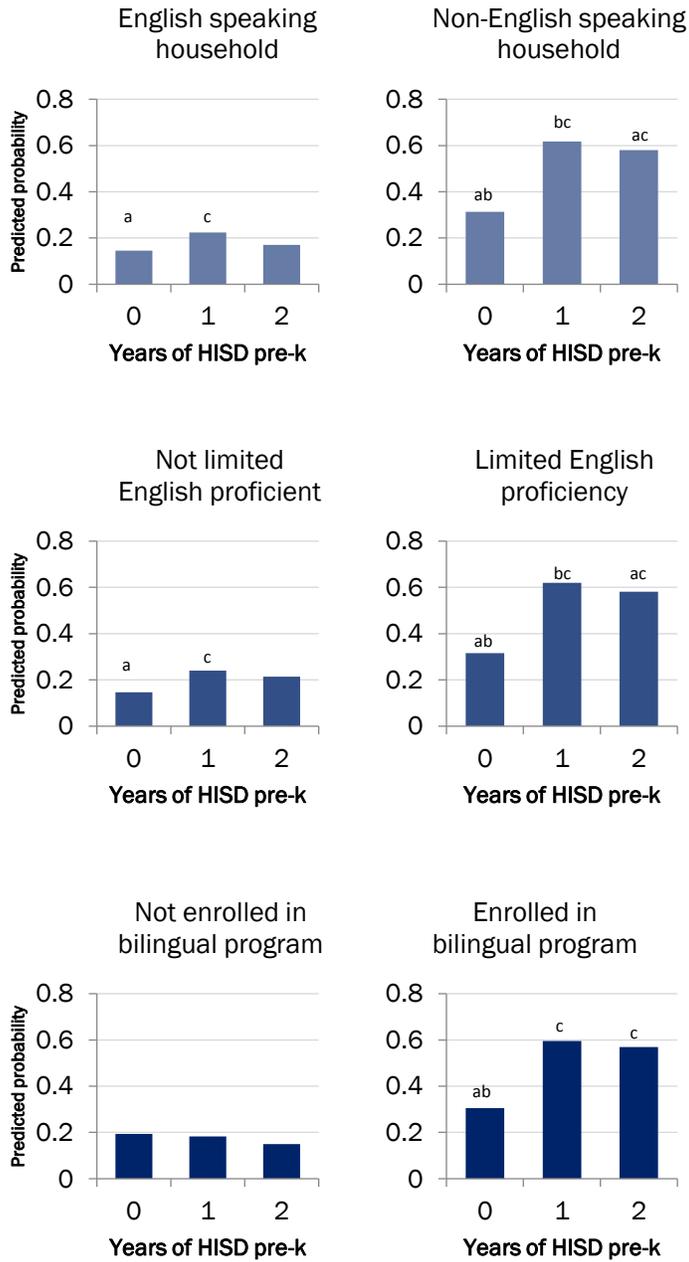
a Indicates significant difference from one year of HSD pre-k  
 b Indicates significant difference from two years of HSD pre-k  
 c Indicates significant difference from zero years of HSD pre-k

Figure 6. Predicted probability of school readiness on Spanish I station by demographic group.



a Indicates significant difference from one year of HISD pre-k  
 b Indicates significant difference from two years of HISD pre-k  
 c Indicates significant difference from zero years of HISD pre-k

Figure 7. Predicted probability of school readiness on Spanish Istation by language classification.



a Indicates significant difference from one year of HSD pre-k  
 b Indicates significant difference from two years of HSD pre-k  
 c Indicates significant difference from zero years of HSD pre-k

## APPENDIX D

**Significant differences in predicted probabilities of school readiness, within group**

English Istation	Years of HISD pre-k		
	0 vs. 1	0 vs. 2	1 vs. 2
Race/ethnicity <sup>a</sup>			
White	*	*	
Black	*	*	*
Hispanic	*	*	*
Economic disadvantage			
No	*	*	*
Yes	*	*	*
Gender			
Male	*	*	*
Female	*	*	*
Immigrant			
No	*	*	*
Yes	*	*	
English home language			
No	*	*	*
Yes	*	*	*
Limited English proficiency			
No	*	*	*
Yes	*	*	*
Enrolled in bilingual program			
No	*	*	*
Yes	*	*	
<b>Spanish Istation</b>			
	Years of HISD pre-k		
	0 vs. 1	0 vs. 2	1 vs. 2
Race/ethnicity <sup>a</sup>			
White	*	*	
Black	*		
Hispanic	*	*	- *
Economic disadvantage			
No	*	*	
Yes	*	*	- *
Gender			
Male	*	*	
Female	*	*	- *
Immigrant			
No	*	*	- *
Yes	*		
English home language			
No	*	*	- *
Yes	*		
Limited English proficiency			
No	*		
Yes	*	*	- *
Enrolled in bilingual program			
No			
Yes	*	*	

*Significant differences at  $p < 0.05$  level are indicated by \*  
Unless indicated by a negative sign (-), differences are positive in the favor of higher number of years having greater probability.*

<sup>a</sup>Due to small sample sizes in some cells, the only races/ethnicities included in this analysis are White, Black, and Hispanic.