



What Sustains the Pre-K Boost?

New evidence from Boston Public Schools

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Introduction

Children who attend a prekindergarten (Pre-K) program generally score higher on academic, social-emotional, and cognitive assessments at the start of kindergarten than children who do not. However, Pre-K non-attenders typically catch up to Pre-K attenders—sometimes partially and sometimes fully—by the end of kindergarten or first grade.¹ Pre-K attenders still tend to outperform nonattenders in longer-term outcomes such as high school graduation, college attendance, and health status.² But with the majority of American children scoring below proficiency in critical reading and math skills in elementary school, there has been considerable research and policy attention paid in recent years to what factors best sustain the Pre-K boost in the elementary school years. Drawing on four papers that use data from students enrolled in the Boston Public Schools (BPS), this brief explores evidence from testing three interconnected theories on how to sustain Pre-K benefits: skill type, sustaining environments, and instructional (mis)alignment.

Key Findings

- 1 Skill type: Benefits of attending the Boston Public Schools (BPS) Pre-K were more likely to be sustained for more complex, unconstrained skills like receptive vocabulary, math skills that involve problem solving and critical thinking, and executive functioning. Benefits on foundational constrained skills (i.e., letter sounds, counting) were less likely to be sustained.
- 2 Skill type: Benefits for two dimensions of executive functioning—working memory and inhibitory control—emerged at the end of the kindergarten year.
- 3 Sustaining environments: The lasting benefits of BPS Pre-K did not differ when children enrolled in kindergarten classrooms that spent more time on academic instruction, had higher-quality teacher practices, and exposed students to more advanced instructional content. However, there was some evidence that the Pre-K boost was more strongly sustained when students were exposed to more unconstrained language/literacy and math instruction in kindergarten.
- 4 Instructional (mis)alignment: Associations between BPS Pre-K and students' math and literacy skills in the spring of first grade were more likely to be sustained when children experienced stronger instructional alignment across Pre-K, kindergarten, and first grade. In contrast, convergence for literacy skills in kindergarten and language skills in first grade was strongest when students experienced misalignment.

Boston Public Schools

The Boston Public Schools (BPS) is an excellent setting for exploring theories on how to sustain the Pre-K boost. For the past 15 years, the district has offered full-day high-quality Pre-K in public school settings to all four-year old children living in the city regardless of income. The program has garnered a high profile since its inception due to its attention to quality and research-backed practices.³ For instance, lead Boston Pre-K teachers are compensated on the same pay scale as BPS K-12 teachers and must hold a minimum of a bachelor's degree and either have a master's degree or be working to attain a master's degree within five years. BPS Pre-K teachers also receive curriculum-specific training and in-class support from experienced early childhood coaches. Beginning in 2012, due to concern about a disconnect between Pre-K and the early elementary grades, the BPS Department of Early Childhood rolled out a curricular and professional development approach called Focus on Early Learning that aimed to align content, instruction, and teachers' training and coaching from Pre-K to 2nd grade.⁴

Three Theories for Sustaining the Pre-K Boost

There are three leading theories for Pre-K convergence/fadeout that we have examined in our research in the Boston Public Schools, described here as skill type, sustaining environments, and instructional alignment (or misalignment). In the following pages we feature four empirical studies from BPS—two for the skill type theory, one for sustaining environments, and one for instructional (mis)alignment—and explain their findings in more detail.

Theory 1: Skill Type

The skill type theory posits that Pre-K can have differential effects on constrained and unconstrained skills, as well as executive functioning and social-emotional learning skills.

As shown in Table 1, unconstrained skills are broadband skills like vocabulary, problem solving, and critical thinking that are acquired gradually and can be more difficult to measure.

Alternatively, constrained skills like letter naming and counting skills are more finite and directly teachable. Constrained and unconstrained skills exist on a continuum, and both types of skills are critical for children’s success. However, Pre-K programs in general may focus more time on teaching and assessing children’s constrained skills compared to unconstrained skills. Effects of Pre-K on constrained skills may be less likely to be sustained across time because kindergarten teachers may put more focus on teaching constrained skills, like knowing the alphabet, reading high-frequency words, recognizing shapes, and counting. This allows non-Pre-K enrollees to catch up more quickly on some skills but means they may miss out on

building core unconstrained skills.⁵

Pre-K can also affect “non-academic” skills such as executive functioning (EF) and social-emotional learning (SEL) competencies. In general, children are more likely to succeed in school if they are able to exhibit skills such as following directions, waiting their turn, and regulating their emotions. These skills are part of the domains of EF and SEL. More specifically, early education researchers have long emphasized the importance of EF skills—including working memory, response inhibition, and cognitive flexibility—and SEL skills—such as externalizing and internalizing behaviors—on academic achievement and later life outcomes.⁶ Researchers have theorized the EF and SEL skills may be the key mechanisms linking Pre-K participation to longer-term outcomes like health, wealth, and educational attainment, despite an initial convergence in academic skills.⁷

Table 1: Summary of Constrained and Unconstrained Skills

	Constrained Skills	Unconstrained Skills
Characteristics	<ul style="list-style-type: none"> Foundational skills Directly teachable Easily assessed 	<ul style="list-style-type: none"> More complex skills Harder to teach Harder to assess
Literacy and Language		
Examples	<ul style="list-style-type: none"> Alphabet recognition Writing letters Practicing letter sounds Basic spelling 	<ul style="list-style-type: none"> Vocabulary building Reading comprehension
Measures	<ul style="list-style-type: none"> Dynamic Indicators of Basic Literacy Skills - NEXT (DIBELS) 	<ul style="list-style-type: none"> Peabody Picture Vocabulary Test (PPVT)
Mathematics		
Examples	<ul style="list-style-type: none"> Numeral recognition Counting Basic arithmetic Identifying shapes 	<ul style="list-style-type: none"> Algebraic thinking Composing shapes Patterning Comparing numbers Relational thinking
Measures	<ul style="list-style-type: none"> Woodcock Johnson Applied Problems III (WJAP) 	<ul style="list-style-type: none"> Research-Based Early Math Assessment (REMA)

Related Studies

Is Skill Type the Key to the Pre-K Fadeout Puzzle? Differential Associations Between Enrollment in Pre-K and Constrained and Unconstrained Skills Across Kindergarten⁸

Main Research Question: Are the initial benefits of the BPS Pre-K program more likely to be sustained through the end of kindergarten for more unconstrained language and math skills compared to more constrained literacy and math skills?

Sample: 508 students who attended BPS kindergarten during the 2017-2018 school year. About half of students attended the BPS Pre-K program while the other half attended another type of program in the community or did not attend Pre-K at all.

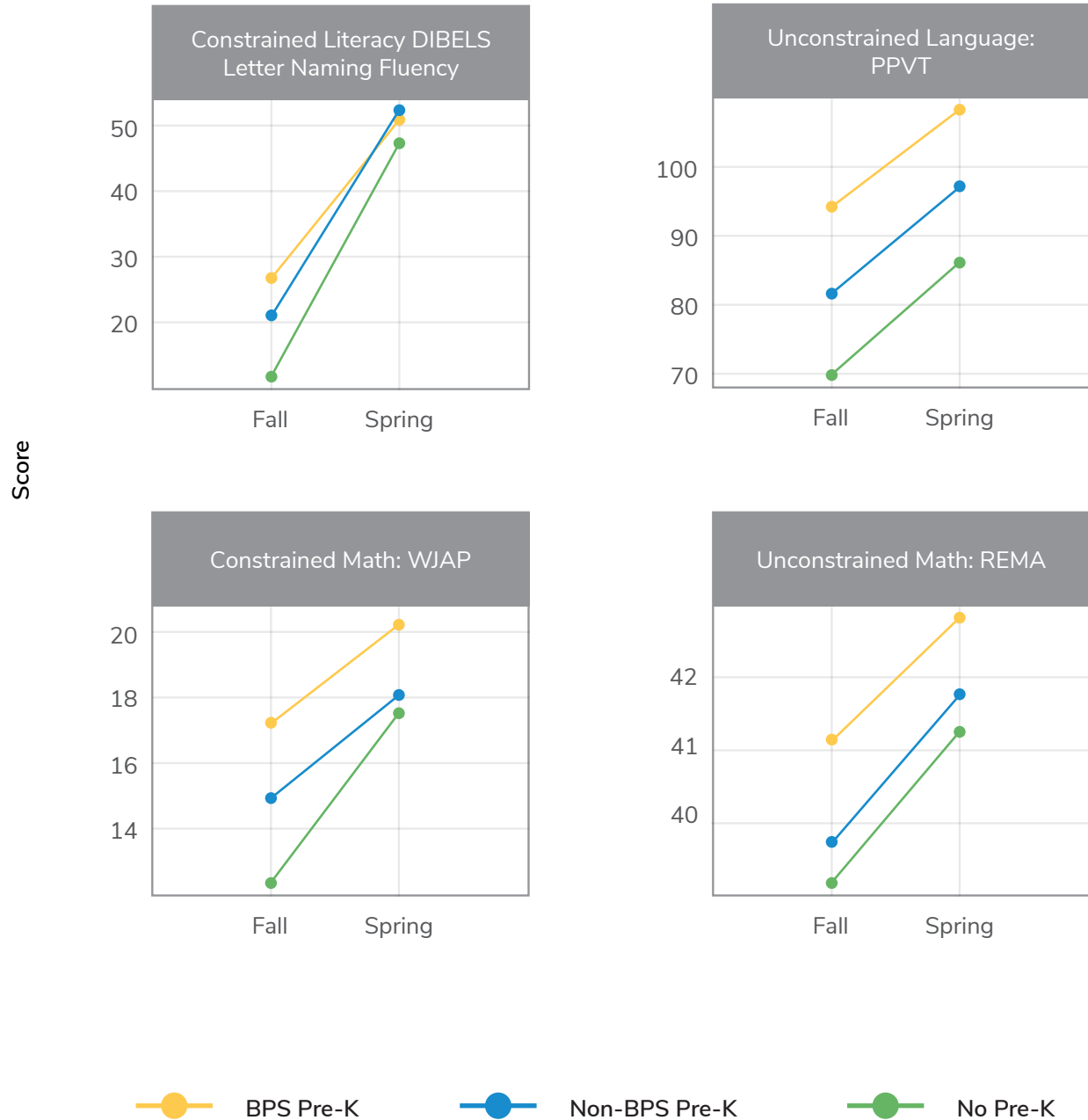
Main Findings: Benefits of Pre-K on foundational, constrained skills were less likely to persist over time. As shown in Figure 1, in the fall of kindergarten, there were sizeable associations between participation in

BPS Pre-K and children's language, literacy, and math skills, controlling for demographic characteristics such as child's race, gender, and family household size. However, the benefits of BPS Pre-K on literacy skills (more constrained) were fully diminished by the spring of kindergarten. In contrast, the association between BPS Pre-K and vocabulary skills (more unconstrained) was largely maintained. We found a similar pattern for math skills: the benefits of BPS Pre-K on more unconstrained math skills were more likely to be maintained through the spring of kindergarten compared to a more constrained measure.

These findings suggest that strengthening Pre-K and kindergarten instruction to support children's development of more unconstrained skills such as vocabulary or problem solving—and also collecting outcome measures of these skills—may be important for understanding the extent to which the initial benefits of Pre-K programs persist.



Figure 1: Differences in Math, Language, and Literacy Skills by Pre-K Experiences Kindergarten



Note: The above assessments were scored on different scales. Y-axis in figures differ by assesment accordingly.

Enrollment in Pre-K and children's social-emotional and executive functioning skills: To what extent are associations sustained across time?⁹

Main Research Question: What is the association between enrollment in the BPS Pre-K program and children's EF skills, SEL skills, and approaches to learning, in the fall and spring of kindergarten compared to students who did not attend BPS Pre-K?

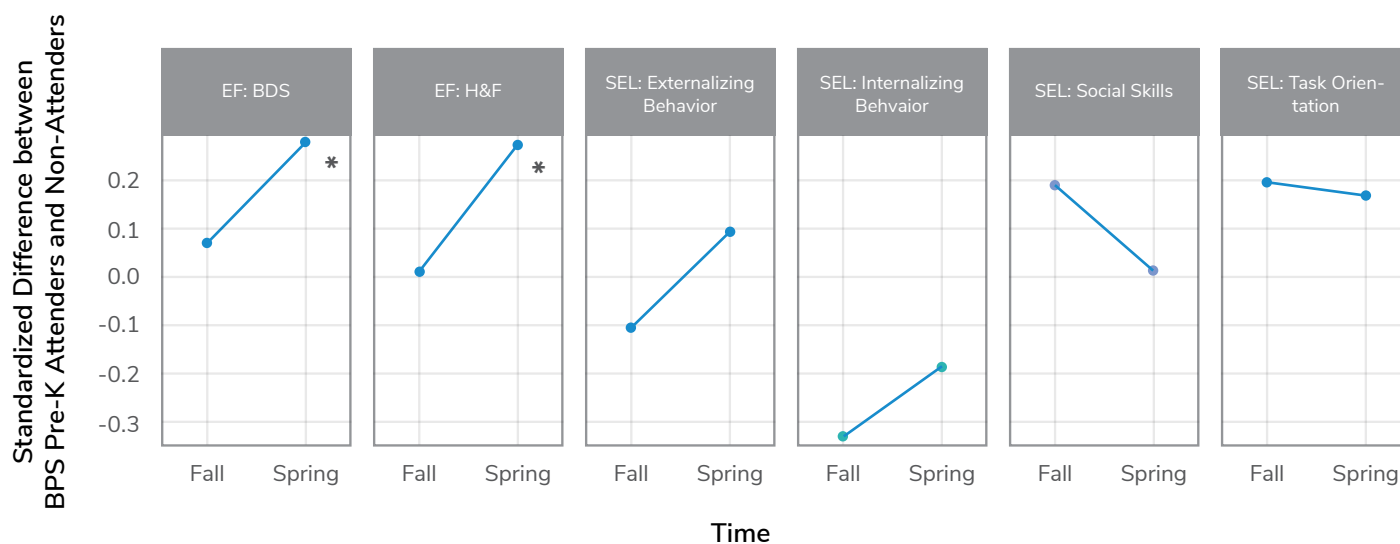
Sample: 508 students who attended BPS kindergarten during the 2017-2018 school year. About half of students attended the BPS Pre-K program while the other half attended another type of program in the community or did not attend Pre-K at all.

Main Findings: BPS Pre-K attenders entered kindergarten with lower internalizing behaviors (e.g. observed anxiety and shyness, being withdrawn, and overall disengagement) and higher task orientation compared to BPS Pre-K non-attenders. However, these differences were less pronounced by the end

of kindergarten, and there were no differences in externalizing behavior (disruptive behaviors such as impulsivity and aggression) or social skills at the end of kindergarten. For EF, which was measured by the Backwards Digit Span (BDS) and the Hearts and Flowers Task (H&F), there were no observed differences between BPS Pre-K attenders and non-attenders at the beginning of kindergarten. However, statistically significant differences in EF skills benefitting Pre-K attenders emerged at the end of kindergarten.

Figure 2 illustrates how various SEL differences between Pre-K attenders and non-attenders grew less pronounced over time and how statistically significant gains in EF emerged. These findings underscore the importance of treating SEL skills as distinct competencies instead of grouping them together as “non-academic” outcomes. For EF, the “sleeping effect” findings may help explain the pattern of positive Pre-K effects in early adulthood despite earlier convergence or fadeout.

Figure 2: Relationship between Attending BPS Pre-K and Skills from Fall to Spring of Kindergarten



Note: Statistical significance is indicated as * $p < 0.05$. EF stands for Executive Functioning, BDS for Backwards Digit Span, H&F for Hearts and Flowers, SEL for Social-Emotional Learning.

Theory 2: Sustaining Environments

The sustaining environments theory posits that one of the main reasons behind convergence/fadeout is a decrease in the quality of learning environments after Pre-K. Indeed, some studies have found that the Pre-K boost is more likely to persist when children receive high-quality teaching in high-quality elementary schools.¹⁰ In other words, what happens after Pre-K matters. The early skill advantages of Pre-K appear more likely to persist if children experience high-quality learning environments afterward.

Related Study

Does Kindergarten Instruction Matter for Sustaining the Pre-K Boost? Evidence from Individual- and Classroom-level Survey and Observational Data¹¹

Main Research Question: To what extent are the quality of children’s kindergarten experiences associated with sustained benefits of the BPS Pre-K program on students’ language, literacy, and math skills in the spring of kindergarten? Does the answer depend on how quality is measured (i.e., time spent in certain types of instruction, global classroom quality, and advanced instructional content exposure)?

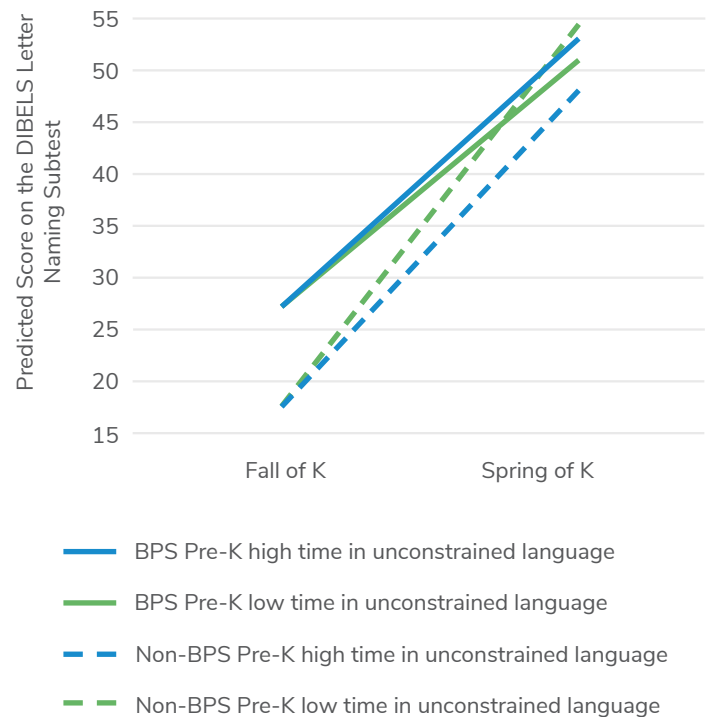
Sample: 462 students who attended BPS kindergarten during the 2017-2018 school year and have valid observational and videotaped data from kindergarten. About half of the students attended the BPS Pre-K program in the prior year and the other half attended some other program in the community or stayed at home with a parent, other family member, or babysitter/nanny.

Main Findings: Overall, there was little consistent evidence that the quality of kindergarten instruction—as measured by time spent in different learning domains, global quality of teacher practices, and exposure to advanced instructional content—explained the extent to which the benefits of BPS Pre-K were sustained over time. This finding aligns with meta-analytic evidence.¹² However, some child-level

observational measures of kindergarten learning experiences – particularly those capturing constrained versus unconstrained instruction – were more predictive of Pre-K persistence than observed global classroom quality measures or survey-based measures of advanced instruction. For example, Figure 3 illustrates that the Pre-K boost in literacy skills was sustained when children were exposed to more unconstrained language instruction. In contrast, there was a clear pattern of convergence between BPS Pre-K attenders and non-attenders when children were exposed to less unconstrained instruction in kindergarten.

In line with the above research supporting the skill type theory, this study suggests that the Pre-K boost may be more likely to persist when children spend a balanced amount of time in kindergarten exposed to both unconstrained and constrained instruction as opposed to mostly constrained instruction.

Figure 3: Associations Between Enrollment in BPS Pre-K and Gains in Literacy Skills Vary by Time in Unconstrained Language Instruction in Kindergarten



Theory 3: Instructional (Mis)alignment

The instructional (mis)alignment theory posits that the redundancy of instructional content in kindergarten and early elementary grades, in which children are exposed to content they already learned instead of being exposed to new and increasingly challenging tasks that build on their Pre-K gains, can help explain convergence/fadeout.¹³ In fact, one study found that kindergarten teachers spent about 13 days a month reteaching basic counting and shape recognition even though a majority of children already mastered these skills.¹⁴ Instructional alignment, which refers to standards, curriculum, and assessments building on each other from one grade to the next, has thus emerged as a promising strategy for reducing this redundancy and sustaining the Pre-K boost.¹⁵ Experimental, researcher-driven demonstration studies testing the effects of Pre-K curricula paired with aligned instruction in kindergarten and first grade have found that effects are more likely to be sustained for children who experience this curricular alignment.¹⁶

Related Study

Instructional Alignment is Associated with a Sustained Pre-K Boost: Descriptive Evidence from the Boston Public Schools (McCormick, MacDowell, Weiland, Hsueh, Pralica, Maier, Maves, Snow, & Sachs, under review)

Main Research Question: To what extent do teachers in Pre-K, kindergarten, and first grade implement aligned, domain-specific language/literacy and math curricula with high levels of intervention fidelity (i.e., dosage, adherence, quality) within and across grades? Is exposure to higher levels of intervention fidelity of domain-specific curricula from Pre-K to first grade (more instructional alignment) associated with sustained associations between enrollment in the BPS public school Pre-K program and students' language, literacy, and math skills at the end of kindergarten and first grade?

Sample: 498 students who attended BPS kindergarten during the 2017-2018 school year. Of this sample, 256 students attended the BPS public school Pre-K program, 169 attended a non-public Pre-K program, and 73 stayed at home.

Main Findings: Alignment of BPS's Focus on Early Learning curriculum was moderate to high and fairly consistent across grades. Results from a latent profile analysis revealed that about one quarter of BPS Pre-K attenders experienced high fidelity to the curriculum across grades and thus make up the high alignment group. As shown in Figures 4 and 5, children in this group had faster gains in literacy and math skills through the spring of first grade compared with non-BPS Pre-K attenders. They also had slower gains in language skills through the spring of first grade than non-BPS Pre-K attenders. In addition, fadeout/convergence on literacy skills in kindergarten appeared to be driven by Pre-K attenders who experienced a steep drop off in fidelity – and thus misalignment – between Pre-K and kindergarten.

Taken together, results highlight potential benefits of instructional alignment to sustain the Pre-K boost but through more distal time points and for a potentially limited set of outcome domains. Further experimental research is needed to make clear policy prescriptions.



Figure 4: Gains in Literacy Skills from Kindergarten to First Grade for BPS Pre-K Attenders by Alignment Type

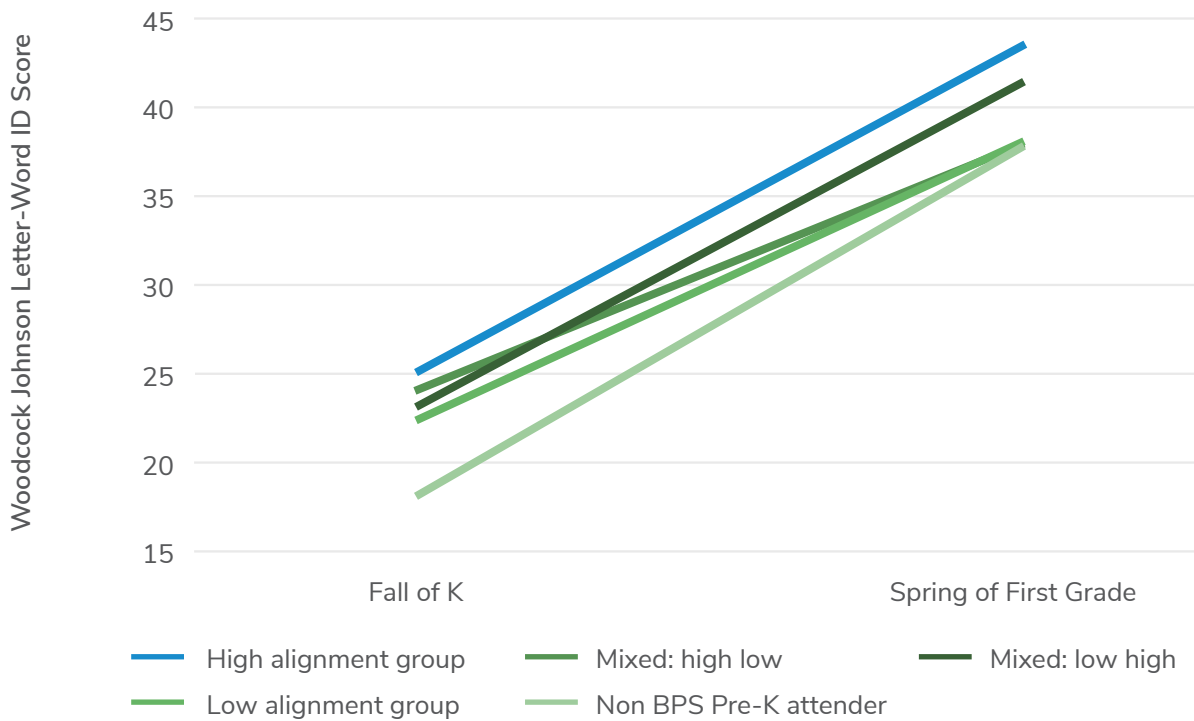
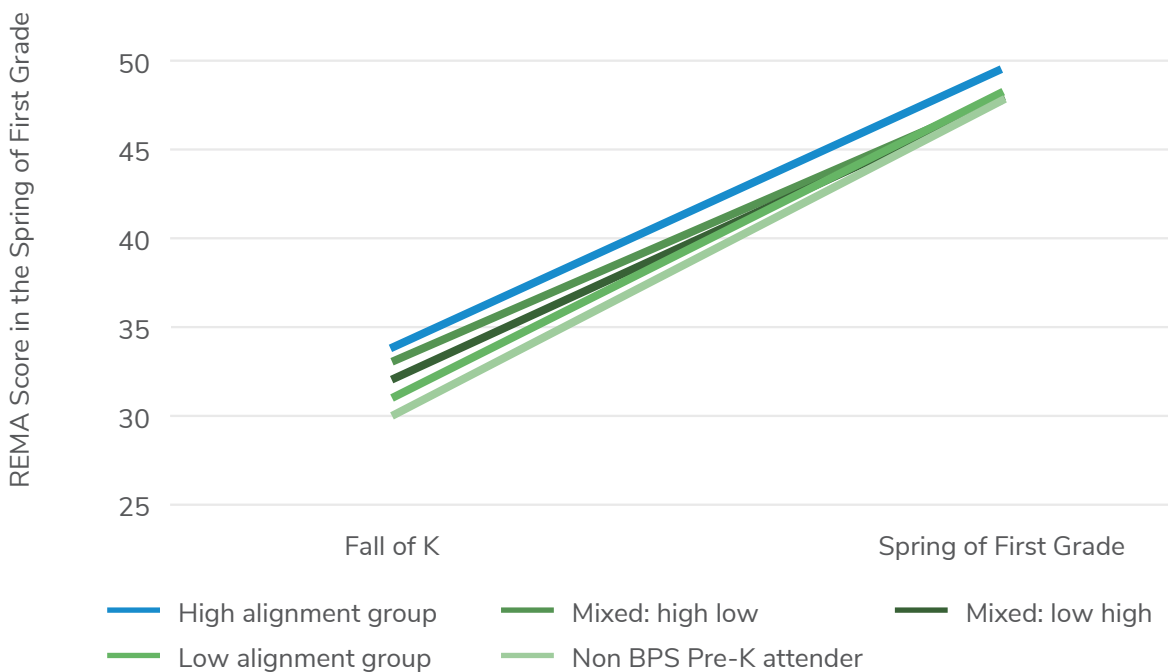


Figure 5: Gains in Math Skills from Kindergarten to First Grade for BPS Pre-K Attenders by Alignment Type



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