AMERICAN PSYCHOLOGICAL ASSOCIATION

Journal of Educational Psychology

ISSN: 0022-0663

2023, Vol. 115, No. 3, 460–474
https://doi.org/10.1037/edu0000782

Enrollment in Pre-K and Children's Social–Emotional and Executive Functioning Skills: To What Extent Are Associations Sustained Across Time?

Lillie Moffett[1], Amanda Weissman[1], Meghan McCormick[2], Christina Weiland[1], JoAnn Hsueh[2], Catherine Snow[3], and Jason Sachs[4]

[1] School of Education, University of Michigan
[2] MDRC, New York, New York, United States
[3] Harvard Graduate School of Education, Harvard University
[4] Boston Public Schools

Pre-kindergarten (Pre-K) improves the school readiness of all children, but less is known about whether associations between enrollment in Pre-K and different indicators of social–emotional and executive functioning (EF) skills are sustained as children move into and across elementary school. The current study examines associations between enrollment in the Boston Public Schools (BPS) Pre-K program and children's ($N = 508$) social–emotional, approaches to learning, and EF skills at both the start and end of kindergarten. Results from multilevel regression models revealed that children who enrolled in BPS Pre-K started kindergarten with lower internalizing behaviors and higher levels of task orientation than their peers. These associations, however, were not sustained through the end of kindergarten. Instead, there were emerging associations between BPS Pre-K and two dimensions of EF—working memory and inhibitory control—at the end of the kindergarten year. The results were robust to different model specifications, including inverse probability of treatment weighting. Taken together, the results highlight the importance of examining links between high-quality Pre-K and different indicators of children's social–emotional and EF skills across time in order to provide a more complete picture of how Pre-K supports different types of skills across time.

Educational Impact and Implications Statement

While many studies of Pre-kindergarten (Pre-K) programs focus on academic outcomes, this study investigates nuances in Pre-K attenders' social–emotional and executive functioning (EF) skills at the beginning and end of kindergarten. We found that children who attended the high-quality Boston Public Schools Pre-K program entered kindergarten with lower internalizing behavior and higher academic engagement compared to their peers who attended other programs prior to kindergarten or no program at all. Interestingly, these associations were attenuated by the end of the kindergarten year, and a new gap in attenders' and nonattenders' EF skills emerged that was not present at the beginning of kindergarten. This highlights the importance of further study of Pre-K program impacts on children's nonacademic skills. It is possible that while kindergarten may "catch up" children in their social–emotional skill development, Pre-K may be particularly important for nurturing young children's EF skills.

Keywords: pre-kindergarten, sustained associations, social–emotional, executive functioning

Supplemental materials: https://doi.org/10.1037/edu0000782.supp

This article was published Online First December 22, 2022.

Lillie Moffett https://orcid.org/0000-0003-1233-5185

The authors would like to thank the Boston Public Schools, Brian Gold, Blaire Horner, Annie Taylor, the BPS Department of Early Childhood coaches and staff, the BPS Department of Research, the MDRC team (Mirjana Pralica, Rama Hagos, Desiree Alderson, Marissa Strassberger, and Sharon Huang), the Harvard Graduate School of Education research team (Sibyl Holland, Maia Gokhale, and field-based data collection staff), and the University of Michigan research team (Paola Guerrero Rosada, Kehui Zhang).

The research reported here was conducted as a part of a study funded by the Institute of Education Sciences to MDRC (Grant R305N160018-17) with subcontracts to the University of Michigan, the Boston Public Schools, and the Harvard Graduate School of Education. Lillie Moffett's and Amanda Weissman's work was supported by the Institute of Education Sciences Predoctoral Fellowship at the University of Michigan (Grant R305B150012). Lillie Moffett is further supported by the NSF Graduate Research Fellowship (Grant 1650114).

Lillie Moffett served as lead for writing—original draft, writing—review and editing and contributed equally to conceptualization. Amanda Weissman served as lead for formal analysis and contributed equally to writing—original draft. Meghan McCormick served as lead for conceptualization and investigation. Christina Weiland served as lead for funding acquisition and investigation. JoAnn Hsueh served as lead for funding acquisition and investigation. Catherine Snow served as lead for funding acquisition and investigation. Jason Sachs served as lead for funding acquisition and investigation. Amanda Weissman and Meghan McCormick contributed equally to methodology. Amanda Weissman, Meghan McCormick, and Christina Weiland contributed equally to writing—review and editing. Meghan McCormick and Christina Weiland contributed equally to supervision.

Correspondence concerning this article should be addressed to Lillie Moffett, School of Education, University of Michigan, 530 Church Street, Ann Arbor, MI 48103, United States. Email: lillmoff@umich.edu

There is widespread popular and political support for expanding access to high-quality Pre-kindergarten (Pre-K) due in part to substantial evidence linking participation in these programs to children's kindergarten readiness. Yet, there is less consensus about how long the benefits of Pre-K actually last. There are some instances where children who did not attend Pre-K programs quickly "catch up," sometimes partially and sometimes fully, to their Pre-K-attending peers in early elementary school (Lipsey et al., 2013; Puma et al., 2012). However, recent evidence has found that this pattern varies depending on skill type (Bailey et al., 2017). For example, as evidenced by research (Ansari et al., 2020; Burchinal et al., 2022; McCormick et al., 2021) and supported by theory (Paris, 2005; Snow & Matthews, 2016), the benefits of high-quality Pre-K on children's academic outcomes may be more likely to persist for skills like vocabulary and problem solving, compared to competencies like letter knowledge and early numeracy skills. Studies of Pre-K programs more commonly assess these types of foundational, finite academic skills, which are easier to measure and teach (McCormick et al., 2021).

Researchers are expanding the types of academic skills that they are measuring in their work to capture more broadband competencies that are harder to teach and measure but are more likely to develop across the life course (McCormick & Mattera, 2022). However, less is known about how high-quality early learning programs can support different types of *nonacademic* outcomes—such as social–emotional, approaches to learning, and executive functioning (EF) skills—across time. For decades, early educators have stressed the importance of social–emotional skills and learning-related behaviors for children's successful functioning in elementary school (Alexander et al., 1998; Heckman & Masterov, 2007; Rimm-Kaufman et al., 2000). More recent work has demonstrated the potential importance of EF skills—working memory, cognitive flexibility, and inhibitory control—to further enhance classroom learning (Finders et al., 2021). And studies that have found long-term impacts of Pre-K participation on outcomes into adolescence and adulthood—despite initial convergence on academic skills—have theorized that social–emotional skills, learning-related behaviors, and EF skills may be key mechanisms linking Pre-K to longer-term outcomes like health, wealth, and educational attainment (Gray-Lobe et al., 2021; Schweinhart et al., 1993). Yet, it is difficult to empirically evaluate this theory with limited evidence that Pre-K programs can indeed have a sustained boost on these nonacademic skills as children transition into the first few years of elementary school.

In the current study, we add to this literature by examining associations between enrollment in the Boston Public Schools (BPS) Pre-K program—a high-quality public Pre-K program available to 4-year-old children—and children's social–emotional skills, approaches to learning behaviors, and EF skills in the fall and spring of kindergarten. We include a comprehensive array of multimodal outcomes, including teacher reports of children's externalizing behaviors, internalizing behaviors, and social skills (i.e., social–emotional skills), as well as task orientation (i.e., approaches to learning) and four direct assessment measures of children's EF skills. Findings from this study stand to highlight *which* nonacademic skills undergo critical development even after the end of the Pre-K year, providing timely evidence on how large-scale investments in high-quality public programs like the BPS model can benefit children's development across time.

Pre-K Enrollment and Children's Development of Social–Emotional Skills and Approaches to Learning Across Time

Research has long highlighted the importance of children's social–emotional skills in predicting later school success (Arnold et al., 2012; Doctoroff et al., 2006; Girard & Girolametto, 2013). In the current study, we focus on three social–emotional constructs that have particular salience in the literature. The first is children's *externalizing behavior* (teacher-reported), which is characterized as an amalgamation of disruptive behaviors including impulsivity, aggression, noncompliance, and symptoms of attention deficit hyperactivity disorder and oppositional defiant disorder. Second is children's *internalizing behavior* (teacher-reported), which encompasses observable anxiety and shyness, being withdrawn, and overall disengagement in children (Gresham & Kern, 2004). And third is children's *social skills* (teacher-reported), which are defined as "successful initiation of peer relationships" (Denham et al., 2003, p. 238), where children practice helping, sharing, cooperating, and engaging in positive interactions with their peers. Overall, these three social–emotional constructs are directly linked to peer acceptance, positive relationships with teachers, and overall behavioral adjustment in kindergarten (Denham et al., 2012; Downer et al., 2010; Ladd et al., 1999). And social–emotional competence has been shown to support better classroom engagement, which further contributes to children's academic achievement (Ladd et al., 1999; McClelland et al., 2006).

Theoretically, the Pre-K environment can be an optimal setting for nurturing social–emotional skills in the short term. Social learning theory posits that children become more socially competent by observing others, imitating, and responding to instruction and verbal feedback (Bandura & Walters, 1977). In the Pre-K classroom, there is ample opportunity to participate in sociodramatic peer play, experience peer conflict, and practice coping strategies with teacher-mediated emotion regulation (Bierman, 2004).

Although there is limited empirical evidence that participation in any Pre-K program consistently predicts improvements in social–emotional skills through kindergarten (Coley et al., 2016), enrollment in *high-quality* preschool environments has predicted gains in these competencies in Pre-K and kindergarten entry. For example, using fixed effects regression with propensity score matching, children enrolled in the Tulsa Public Pre-K Program (compared to Head Start) had lower timidity and higher attentiveness in kindergarten, measured via teacher report (Gormley et al., 2011). In a prior study and sample of the BPS public Pre-K program using an age-based regression discontinuity design, researchers also found small, positive impacts on children's directly assessed emotion recognition skills (Weiland & Yoshikawa, 2013). And in a study of 11 state Pre-K programs, authors found that children in high-quality Pre-K settings—defined as those that scored above a certain threshold on the Classroom Assessment Scoring System (Pianta et al., 2008)—had higher levels of teacher-reported social competence and lower levels of problem behaviors at the end of Pre-K compared to students enrolled in lower-quality classrooms (Burchinal et al., 2010).

The benefits of Pre-K on social–emotional skills measured *after* the start of kindergarten seem to be less promising. For example, research has found negative links between enrollment in Pre-K and children's social–emotional skills, with more teacher-reported

conduct problems observed in Pre-K graduates than their peers at the end of kindergarten (Ansari et al., 2020), third grade (Bassok et al., 2019; Durkin et al., 2022), and sixth grade (Durkin et al., 2022). Yet, empirical work has demonstrated that long-term developmental trajectories in children's externalizing behavior, internalizing behavior, and social skills are typically nonlinear—with 50%–70% of children achieving levels of stability over time regardless of early intervention or Pre-K participation (Bongers et al., 2008; Feng et al., 2008; Nix et al., 2016; Zhou et al., 2007). This work also suggests that exposure to kindergarten may be just as effective as Pre-K as nurturing this skill set in young children (Bierman et al., 2014; Zhai et al., 2012), with family variables attributing more variance to social–emotional outcomes than schooling experiences (Baker & Rimm-Kaufman, 2014; McWayne & Bulotsky-Shearer, 2013). For example, a child who has not learned how to effectively cooperate with peers in Pre-K may eventually advance in this skill after spending a year in kindergarten and continuing to socially engage with other children. In other words, similar to how most children eventually learn to count to 10, it could be the case that most children—regardless of Pre-K experience—eventually reach stable levels of social–emotional functioning, at least when measured via teacher report on observed classroom behavior.

Related to social–emotional skills are children's task orientation and engagement in the classroom. The commonly termed "approaches to learning" domain of child development is included in 39 states' early learning standards, and studies have found that preschoolers' ability to successfully "approach" learning by actively engaging in learning tasks predicts later academic achievement (Li-Grining et al., 2010; Razza et al., 2015). This skill also appears to be malleable in the Pre-K context. For example, in the Head Start CARES study, both the Incredible Years and Promoting Alternative Thinking Strategies interventions in Pre-K had positive impacts on children's approaches to learning (measured via the Cooper-Farran Behavioral Rating Scale) at the end of the Pre-K year (Morris et al., 2014). Yet, similar to social–emotional skills, less is known about how these skills fare *beyond* Pre-K, an important limitation given the theory that approaches to learning may be a mechanism linking Pre-K to longer-term benefits for children.

Pre-K Enrollment and Children's Executive Functioning Outcomes Across Time

Preschoolers' EF skills, including working memory, response inhibition, and cognitive flexibility (Carlson et al., 2013), have reliably predicted children's later academic achievement (Blair & Razza, 2007), as well as health and wealth outcomes in adulthood (Moffitt et al., 2011). There are several theories on the neurological basis of children's EF development—such as dynamic systems theory (Lewis, 2000)—positing that children incrementally build on their EF skills as they interact with more complex rules, rewards, and consequences that ultimately contribute to successful, goal-oriented behaviors (e.g., resisting the urge to take a toy away from a peer; Perone et al., 2021).

However, there is a limited theory on how EF development is influenced by *schooling* over time. From what the field has gathered, children make the most significant gains in their EF skills between the ages of 3–5 years (e.g., 1 *SD* per year; Willoughby et al., 2012), followed by less dramatic change from ages 5 to 8 years and even less change after 8 years (Best & Miller, 2010). As such, the Pre-K and kindergarten years are a sensitive period for intervening in the development of these types of skills, especially since EF skills contribute to children's successful classroom functioning. For example, EF skills are particularly helpful in the transition to kindergarten because they facilitate learning in the classroom by helping children remember and execute teacher directions (working memory), shift attention from one task to another (cognitive flexibility), and follow classroom behavior expectations (response inhibition). These kinds of "learning-related behaviors" are hypothesized as the mechanism by which directly assessed EF skills predict academic achievement gains in Pre-K (Nesbitt et al., 2015). When there is stability in the early childhood environment, such as a routine and schedule often found in high-quality Pre-K settings, this may prevent delays in prefrontal cortex stimulation and development in the brain (Shonkoff, 2011).

Unlike other school readiness skills that are arguably more "teachable" (e.g., learning how to count), EF skills are less straightforward to nurture in young children (Arnold et al., 2012; Lipsey et al., 2017) and may be less malleable. For example, while social–emotional skills follow a more nonlinear trajectory and stabilize over time, after the initial sensitive period of EF development, the linear trend tends to remain stable (e.g., if a child is behind in their EF skills after age 7, they will continue to grow in their EF skills but remain behind their peers through adolescence; Best et al., 2009; Taylor et al., 2015), and child individual differences, like family income, do not seem to account for much variation in EF *growth* (Hughes et al., 2009; Willoughby et al., 2012). Thus, it is valuable to understand the extent to which Pre-K can provide a jumpstart in EF skills, and whether or not this persists across the kindergarten year.

The Present Study

This study examines associations between enrollment in the BPS Pre-K program and children's social–emotional, approaches to learning, and EF skills at the start and end of kindergarten, compared to children who did not attend BPS Pre-K. Importantly, BPS Pre-K has been shown to have considerably higher-than-average instructional quality and similar levels of emotional support and classroom organization compared to other large-scale Pre-K programs (Chaudry et al., 2017). We seek to answer the following exploratory research questions:

1. What is the association between enrollment in the BPS Pre-K program and children's EF, approaches to learning, and social–emotional skills in the fall of kindergarten compared to students who did not attend BPS Pre-K?
2. What is the association between attending BPS Pre-K and children's EF, approaches to learning, and social–emotional skills in the spring of kindergarten compared to students who did not attend BPS Pre-K?

The findings will provide important evidence on how high-quality early learning programs may support critical nonacademic skills over time.

Method

Setting

The BPS Pre-K program is an example of a well-known, publicly funded, high-quality Pre-K program. This model combines two

evidence-based curricula: an adapted version of Opening the World of Learning (Schickendanz & Dickinson, 2005), a language and literacy curriculum that includes a social–emotional skills component in each unit, and Building Blocks (Clements & Sarama, 2007), an early mathematics curriculum that also promotes language development by requiring children to explain their mathematical reasoning verbally. Implementation of curricula is supported through teacher training and coaching (Weiland et al., 2018). Although the curricula explicitly aim to support students' language, literacy, and math development, this instructional approach is play-based and involves substantial peer interaction through student engagement in centers and small groups, as well as the aforementioned social–emotional skills component in Opening the World of Learning. In public Pre-K classrooms housed within elementary public schools, Pre-K and kindergarten teachers are subject to same education requirements (master's degree within 5 years of teaching) and pay scale.

Participants

The study sample consists of 508 students who attended the BPS kindergarten program during the 2017–2018 school year. We recruited students from 51 classrooms and 32 schools in kindergarten as part of a larger longitudinal study examining the effects of the BPS Pre-K program (McCormick et al., 2021). Of the 508 students in our sample, 290 (57%) had enrolled in the BPS Pre-K program during their 4-year-old year. Students were diverse with respect to gender, race/ethnicity, income, and home language and were demographically representative of the wider school district (McCormick et al., 2021). On average, students were 5.46 years old ($SD = .30$) on September 1st of the kindergarten year, with 67% of the sample eligible for free/reduced-price lunch (FRPL), 50% female, 53% dual language learners (DLLs), 18% Asian, 26% Black, 32% Hispanic, 20% White, and 4% other race (see Table 1).

Procedure

The Institutional Review Boards at the lead and partner organizations for this study approved the human subjects plan prior to the commencement of study activities (HUM00114067).

Transparency and Openness Statement

We report how we determined our sample size, all manipulations, and all measures in this study. Data were analyzed using Stata Version 17 (StataCorp, 2017). This study's design and its analysis were not preregistered.

School and Classroom Recruitment

In 2016, before the start of the Pre-K year, we randomly selected 25 public schools to participate in the study from the 76 schools in the district offering the BPS public Pre-K program. Twenty-one agreed. We used one school as a pilot school for developing new measures, and the remaining 20 schools made up the public school sample in the first year of the study. We asked all Pre-K teachers assigned to general education or inclusion classrooms in each of the 20 public schools to participate in the study in the fall of 2016. Overall, 96% ($N = 51$) of teachers across public schools ($N = 20$) agreed. In addition to a comparison group of children who did not attend BPS Pre-K and children who attended a community-based organization (CBO) that implemented the BPS Pre-K model, we followed BPS Pre-K children into kindergarten across 52 schools and 98 kindergarten classrooms. We asked the children's kindergarten teachers to participate, and 95% agreed.

Table 1
Demographic Characteristics for Study Sample

Characteristic	Full sample ($n = 508$)		Attender ($n = 290$)		Nonattender ($n = 218$)		Difference	
	M or %	*SD*	*M* or %	*SD*	*M* or %	*SD*	*M* or %	*SD*
Student demographic characteristic								
Child age	5.46	0.30	5.48	0.28	5.44	0.31	0.04	0.03
FRPL	0.67		0.59		0.78		−0.19***	0.04
Female	0.50		0.48		0.54		−0.06	0.05
DLL	0.53		0.54		0.52		0.02	0.04
Asian	0.18		0.18		0.19		−0.01	0.03
Black	0.26		0.18		0.36		−0.18***	0.04
Hispanic	0.32		0.32		0.31		0.01	0.04
Other race	0.04		0.06		0.01		0.05**	0.02
White	0.20		0.26		0.13		0.13***	0.04
Parent demographic characteristic								
Mother's age at first child birth	26.28	6.76	27.21	6.93	24.77	6.20	2.44	0.65
Household size	4.25	1.32	4.28	1.23	4.22	1.45	0.06	0.13
At least one adult works 35 hr/more	0.90		0.93		0.85		0.08**	0.03
Parent married	0.53		0.59		0.42		0.17***	0.05
Parent age	36.56	7.15	37.18	7.19	35.58	6.99	1.60*	0.69
Parent ed.: HSD/GED or less	0.32		0.29		0.37		−0.08	0.04
Parent ed.: 2-year degree	0.30		0.26		0.38		−0.12**	0.04
Parent ed.: 4-year degree	0.18		0.21		0.13		0.07*	0.04
Parent ed.: advanced degree	0.20		0.25		0.12		0.13***	0.04

Note. DLL = dual language learner; FRPL = free/reduced-price lunch; GED = general education diploma; HSD = high school diploma; Parent ed. = parent's level of education.
*$p < .05$. **$p < .01$. ***$p < .001$.

Student Recruitment

We attempted to collect active consent for all Pre-K students enrolled in participating classrooms. Research staff sent home backpack mail providing an overview of the study and a consent form for the parent to complete and return. We did regular sweeps to pick up consent. Eighty-one percent of all children in participating classrooms had parent consent to participate in the study. Of the children with parent consent, the team randomly selected 50% (~6–10 per classroom) to participate in student-level data collection activities. We repeated this process in the kindergarten classrooms participating in the study in the fall of 2017 and enrolled 78% of students in the participating classrooms who had not attended the public school BPS Pre-K program in the 2016–2017 academic year. Again, this comparison group included children who attended a CBO implementing the BPS model during their 4-year-old year, as well as children who attended a private childcare center or Head Start center or did not experience any formal center-based Pre-K during their 4-year-old year.

Direct Assessments

To directly assess children on their EF skills, we trained staff to reliability and conducted the assessments in the fall of 2017 (September 22–December 18) and again in the spring of 2018 (April 2–June 11). To ensure high-quality administration, a master's-level supervisor observed 10% of all field assessments. The team conducted all the assessments on the same day in a quiet place outside of the child's classroom, such as an empty office or classroom, and took an average of 45 min per child to administer all assessments at each time point. To determine the language of assessments, we used the Pre-language Assessment Scale (PreLAS) Simon Says and Art Show tests (Duncan & DeAvila, 1998) as a warm-up to the assessment battery and to determine the administration language for a subset of assessments (Barrueco et al., 2012). The PreLAS is widely used as a screening tool on large-scale studies—like Head Start FACES (Aikens et al., 2020) to determine whether multilingual children can be assessed in English or need to be assessed in their native language due to limited English ability (Morris et al., 2016). Using the measure as a screener in this way simply determines whether children have sufficient English language skills to complete assessments in English. It does not, however, account for the fact that children have Spanish language skills and may be able to complete the assessments in Spanish as well. 498 (97%) children participated in the fall PreLAS assessment, and 464 (91%) participated in the spring PreLAS assessment. Of the 508 children in the study sample, 15 did not pass the PreLAS and completed a subset of assessments in Spanish in the fall. Four students in the spring did not pass the PreLAS and completed assessments in Spanish. All students who did not pass the PreLAS at either time point spoke Spanish as their first language. Because the measure was used as a screener and the team was unable to use tools with conceptual scoring for multilingual children, the large majority of students were assessed in English, despite about half of them being designated as DLLs due to their exposure to other languages outside of school. The current study focused on children enrolled in kindergarten who have also had more time to develop the English language skills needed to pass the PreLAS screener than children who have not yet been exposed to formal schooling. Descriptive statistics for all outcome measures are presented in Table 2.

Table 2
Descriptive Statistics for Assessments

Assessment	Attender *M* (*SD*)	Nonattender *M* (*SD*)	Difference (*SD*)
Hearts and flowers, percentage correct mixed			
Fall	0.68 (0.26)	0.64 (0.25)	0.04* (0.02)
Spring	0.77 (0.24)	0.69 (0.25)	0.08*** (0.02)
Hearts and flowers, percentage correct incongruent			
Fall	0.81 (0.30)	0.75 (0.36)	0.06* (0.03)
Spring	0.91 (0.22)	0.87 (0.25)	0.04 (0.02)
Forward digit span			
Fall	3.61 (1.01)	3.39 (0.91)	0.22* (0.09)
Spring	3.87 (0.85)	3.68 (0.83)	0.19* (0.08)
Backward digit span			
Fall	—	—	—
Spring	2.64 (0.74)	2.34 (0.78)	0.30*** (0.08)
Attention impulsivity			
Fall	2.63 (0.44)	2.60 (0.48)	0.03 (0.04)
Spring	2.63 (0.44)	2.60 (0.48)	0.03 (0.04)
Internalizing behaviors			
Fall	1.40 (0.45)	1.62 (0.50)	−0.22*** (0.04)
Spring	1.41 (0.44)	1.53 (0.44)	−0.12** (0.04)
Externalizing behaviors			
Fall	1.48 (0.53)	1.60 (0.55)	−0.12* (0.05)
Spring	1.49 (0.52)	1.52 (0.57)	−0.03 (0.05)
Task orientation			
Fall	3.50 (1.09)	3.11 (1.11)	0.39*** (0.11)
Spring	3.69 (1.08)	3.39 (1.15)	0.30** (0.11)
Social skills composite			
Fall	3.18 (0.57)	2.98 (0.58)	0.20*** (0.06)
Spring	3.25 (0.53)	3.18 (0.56)	0.07 (0.05)

Note. $N = 508$ for the full sample, $n = 290$ for attenders, $n = 218$ for nonattenders.
*$p < .05$. **$p < .01$. ***$p < .001$.

Administrative Data

We used administrative data from the BPS school district to get information on student demographic characteristics and classroom enrollment. We also used these administrative data to accurately determine whether a student had enrolled in BPS Pre-K during their 4-year-old year.

Parent Survey

In the fall of 2017, we contacted the parents of the consented study students via email and text message to ask them to complete a 20-min parent survey and report on demographic information for their child and family. We also sent biweekly reminders to the parents, asking them to complete the survey, and used backpack mail to send home hard copy surveys for parents who did not complete the survey electronically. Although most parents completed the survey in English, we also translated it into Spanish, Vietnamese, and Mandarin. For completing the survey, parents received a $25 gift card. Of the 508 students in our study, 408 (80%) of parents completed the survey in kindergarten. When possible, we replaced missing values of the parent survey with data from the parent survey from the first year of the larger study, bringing the total parent survey completion rate to 445 (87%).

Teacher Reports on Children

We asked teachers of participating students to complete a short report on each student assessing behaviors and social–emotional

skills. Teachers completed these reports in the fall of 2017 (September 25–January 30) and again in the spring of 2018 (April 23–July 24). Of the 508 students in the study, 431 (85%) had completed teacher reports in the fall, and 447 (88%) had them in the spring.

Measures

Experience in Early Childhood Education

In the fall of 2017, we asked parents to report where their child spent the majority of his or her time during a regular week during the 2016–2017 year. We then coded these responses to describe whether children were primarily enrolled in the BPS Pre-K program ($n = 290$; coded as 1) or not ($n = 218$ of our sample; coded as 0). Within this latter group, the majority of students ($n = 147$; 29% of the study sample) enrolled in some other type of center-based Pre-K during their 4-year-old year, including attending a CBO implementing the BPS Pre-K model (47% of students enrolled in another type of center-based Pre-K), a private child care center (24%), or a Head Start program (29%). We confirmed these categorizations through online searches of the reported locations coupled with follow-up phone calls to centers. In addition, there are $n = 71$ students (14% of the sample) who did not enroll in any type of center-based care during their 4-year-old year.

In our study, we consider children who attended one of the CBOs implementing the BPS Pre-K model as nonpublic Pre-K attenders. We did so because the experiences of students in these CBOs are likely qualitatively different from students enrolled in the public Pre-K classrooms because teachers were only in the early implementation phases of the model during the 2016–2017 year and the centers continued to operate outside the purview of the broader public school system. Furthermore, the teachers in CBO centers were not subject to the same educational requirements (master's degree within 5 years) as public school-based teachers, nor were they paid on the same scale. However, the full group of nonpublic Pre-K attenders consists of these students enrolled from the CBOs, as well as students who enrolled in the study in the fall of kindergarten and attended a private childcare center during their 4-year-old year and students who attended a Head Start program during their 4-year-old year.

Because we recognize the heterogeneity of prior learning experiences within the comparison group—and find it to be meaningful—we also conduct the exploratory analyses presented in the robustness check section of the paper where, within the comparison group, we distinguish between those who enrolled in different types of programs during their 4-year-old year. We found our results to be robust when considering the programs these students attended.

Executive Functioning Direct Assessments

Working Memory. To assess children's short-term memory, which is a developmental precursor to the working memory component of EF, we used the categorical score of the Forward Digit Span measure (Gathercole & Pickering, 2000). We chose to use this measure because it exhibits more variability for young children (Gathercole, 1999) yet is equally predictive of academic achievement from preschool to age 7 (Bull et al., 2008). During this task, children are asked to repeat a string of numbers in order. A score of "0" indicates that a child was unable to pass the practice test (child given two attempts to repeat two numbers forwards), a score of "1" indicates that the child passed the practice test but could not complete the first test trial, and a score of "2–6" indicates how many digits the child could repeat in order. In our sample, 19 (4%) students did not pass the practice test in the fall and 8 (2%) in the spring; for these students, we marked their scores as missing for our analysis. Forward Digit Span demonstrates high correlations with other related memory tasks—both verbal and spatial (Carlson et al., 2002), as well as good test–retest reliability ($r = .73$; Lipsey et al., 2017). We used this assessment in both the fall and spring of kindergarten and assessed students in Spanish if they did not pass the PreLAS.

In the spring of kindergarten, we also assessed students' working memory using the Backward Digit Span assessment. This task is similar to the Forward Digit Span task, except children are asked to repeat a string of numbers in reverse order. In our sample, 39 (8%) of the students did not pass the practice test for this measure; for these students, we marked their score as missing for our analysis. This measure is commonly used to measure working memory (Coulacoglou & Saklofske, 2017; Holdnack, 2019) and has strong test–retest reliability ($r = .83$; Waters & Caplan, 2003). Like the Forward Digit Span, we used the Spanish version if students did not pass the PreLAS.

Executive Functioning. We also used the percent correct for two subscales (incongruent and mixed trials) of the Hearts and Flowers assessment to assess the inhibitory control and cognitive flexibility subdomains of EF, respectively. In this task, children either press a key on the same side of an image appearing on a screen (if they see a heart) or on the opposite side of the image (if they see a flower). In the incongruent trials, children are only presented with flower images, which measure their inhibitory control. In the mixed trials, children are presented with both hearts and flowers, so they must switch between hitting a button on the same or opposite side of the image, which measures their cognitive flexibility. This measure has demonstrated adequate reliability scores for children aged 4–14 years, with Cronbach's αs ranging from .70 to .87 for the Mixed and Incongruent trials (Davidson et al., 2006; Shing et al., 2010). Similar to the Forward and Backward Digit Span assessments, we used a practice assessment to determine if students could complete the full assessment. 36 (7%) students in our sample did not pass the practice test for the incongruent trial in the fall of kindergarten, 27 (5%) did not pass for the mixed trials in the fall, 8 (2%) did not pass for the incongruent trials in the spring, and 16 (3%) did not pass for the mixed trials in the spring. We marked these students as having missing test scores in our analysis. We used both trials of Hearts and Flowers in the fall and spring of kindergarten and administered the assessment in Spanish for students who did not pass the PreLAS.

Preschool Self-Regulation Assessment–Assessor Report. To measure children's self-regulation, which is considered a behavioral manifestation of children's EF skills, we used the raw scores from the Preschool Self-Regulation Assessment–Assessor Report (PSRA). For this measure, the assessor administering the battery of direct assessments for rated a child (0 = low, 3 = high) on 17 items capturing their concentration, distractibility, impulsivity, and regulation of arousal during the assessments. The PSRA was originally developed as a user-friendly tool to capture domains of self-regulation after completing other direct assessments. The original

version of the tool that was tested demonstrated good psychometric properties, and the measure has been used widely since in longitudinal studies across a range of contexts (e.g., Morris et al., 2016; Raver et al., 2011). The PSRA has strong reliability evidence, and we used the attention–impulsivity (AI) subscale that was previously validated with a Cronbach's α of .89 and an interrater reliability of .82 (Raver et al., 2011).

Social–Emotional Skills and Approaches to Learning From Teacher Report

Social–Emotional Skills. To measure social–emotional skills, teachers completed reports on every student in both the fall and spring using the Social Skills Improvement System (SSIS; Gresham & Elliott, 2008). This measure consists of a battery of Likert scale questions that have been validated to form constructs. From the SSIS, we measured students' cooperation, engagement, self-control, externalizing behavior, and internalizing behavior (Gresham & Elliott, 2008). These constructs have demonstrated high levels of reliability and validity in other work with similar populations of young children and early childhood teachers (Ansari et al., 2021; Burchinal et al., 2022). Given the high correlations between the subscales for cooperation, engagement, and self-control ($r = .82$–$.89$), we combined these three subscales to create one overall composite score to describe students' positive social skills in both the fall ($\alpha = .92$) and the spring ($\alpha = .94$). The three final SSIS constructs—internalizing behavior, externalizing behavior, and social skills—are all pairwise moderately correlated in both the fall and spring (externalizing behavior and social skills $r = -.70$ in the fall and $r = -.72$ in the spring; externalizing and internalizing behavior $r = .50$ in the fall and $r = .50$ in the spring; internalizing behavior and social skills $r = .54$ in the fall and $r = .53$ in the spring; see Appendix B Table 5 in the online supplemental materials).

Task Orientation. Teachers also reported on each students' task orientation skills using one subscale from the Teacher–Child Rating Scale (TCRS; Hightower et al., 1986). On a 1–5 Likert scale (1 = *not at all*, 3 = *moderately well*, and 5 = *very well*), teachers reported how well a given characteristic described the child. The task orientation comprised five items ("completes work," "well organized," "functions well even with distractions," "works well without adult support," and "a self-starter"). The construct has demonstrated good psychometric properties in prior work (Hightower et al., 1986) and had high levels of internal validity in both the fall ($\alpha = .96$) and spring of kindergarten ($\alpha = .94$) in the current study.

Covariates

Using administrative data, we created a series of indicators to describe children's race/ethnicity (Black, Hispanic, Asian, or Other Race/Ethnicity [including mixed race children]), coding 1 if the child fell into the indicated category and 0 otherwise (reference group White). We used similar indicators to describe eligibility for FRPL (1 = *if eligible*; 0 = *if not*) and gender (1 = *female*; 0 = *not female*). We set a dummy variable for DLL equal to 1 if the parent reported that there was a language other than English spoken at home and 0 otherwise. We used the child's birthdate to calculate the child's age on September 1, 2017.

We used information from the parent surveys to create additional covariates. These variables indicated whether there was at least one parent in the home working full time (35 hr/week or more) and whether the parent was married or lived with a partner. We used continuous variables to describe the age of the child's mother at her first birth, the number of people living in the household, and the parent respondent's age at the time of survey completion. We then included three dummy variables to describe the reporting parent's level of education: high school diploma or general education diploma (GED) or less, some college or 2-year degree, and 4-year degree (with graduate work or graduate degree as the reference group). Taken together, all covariates have been shown to predict children's outcomes across studies (Choi et al., 2018; Powell et al., 2010; Reardon & Portilla, 2016) and are aligned with previous work done with the sample (McCormick et al., 2021).

Analytic Approach

Missing Data

Overall, there was little missing data with a few exceptions (Appendix B Tables 1 and 2 in the online supplemental materials). No students had missing data on the child covariates from the administrative data, while 14% of students were missing data on family covariates, 16% were missing some fall assessment data, and 25% were missing some spring assessment data. Missingness was slightly higher for students who did not attend BPS Pre-K (see Appendix B Tables 1 and 2 in the online supplemental materials). We present results in the main text using a complete case analysis. As a robustness check—and given that we found evidence that data were Missing at Random conditional on? Pre-K attendance—we present results in Appendix A in the online supplemental materials using multiple imputation with Stata Version 17 to impute family covariates (Graham, 2009). For this imputation, we imputed 100 datasets using multivariate normal regression. In line with recommendations from von Hippel (2009), we did not impute outcomes.

Descriptive Analysis

We first computed descriptive statistics for our entire sample as well as separately for the BPS Pre-K attender group and the nonattender group. We also computed zero-order correlations between the binary indicator of BPS Pre-K attender status and our outcome variables in both the fall and spring to provide more insight into the overall relationship between BPS Pre-K attendance and EF and social–emotional skills.

RQ1 and 2: Multilevel Modeling

Due to the nested nature of our data, we used multilevel modeling to examine associations between enrollment in BPS Pre-K attendance and EF, approaches to learning, and social–emotional outcomes in the fall and spring of kindergarten. We fit null models for the fall and spring outcomes with random intercepts for both classrooms and schools to determine the amount of variability attributable to the levels of nesting via the intraclass correlations (ICC). The ICC for the fall outcomes ranged from .02 (Hearts and Flowers, percentage correct mixed) to .20 (internalizing behavior) at the classroom level and from .02 (Hearts and Flowers, percentage correct incongruent) to .12 (externalizing behaviors) at the school level. ICCs in the spring ranged from .00 (Hearts and Flowers, percentage correct mixed) to .24 (internalizing behavior) at the

classroom level and from .00 (Hearts and Flowers, percentage correct incongruent) to .15 (externalizing behaviors) at the school level. Because the percentage of variation attributable to differences between both teachers and schools was over 10% for some outcomes, we used three-level multilevel models with random intercepts for classrooms and schools—with all outcomes and covariates measured at the student level—to when conducting all predictive analyses (Snijders & Bosker, 2012).

To answer our main research questions, we regressed each outcome separately for the fall and spring of kindergarten on the binary indicator for enrollment in the BPS Pre-K program (where the comparison group includes any other learning experience during the 4-year-old year). We then added covariates in two conceptual blocks (first block = child covariates, second block = family covariates) and examined the stability of the point estimate for BPS Pre-K to determine the sensitivity of results to covariate inclusion.

Results

Descriptive Analysis

We found important descriptive differences between the students who did and did not attend the BPS Pre-K program. Consistent with prior work done on this sample (McCormick et al., 2021), the students who attended BPS Pre-K were 19 percentage points less likely than nonattenders to be eligible for free- or reduced-price, 18 percentage points less likely to be Black, 5 percentage points less likely to identify as a race other than White, Asian, Black, or Hispanic, and 13 percentage points more likely to be White. They were also more likely to have at least one adult in their household who works full time, to have parents who were married or partnered, to have slightly older parents, and to have more highly educated parents compared to their peers who did not attend the BPS Pre-K program (Table 1).

Similarly, at the beginning of kindergarten, we found the students who attended the BPS Pre-K program scored higher on their inhibitory control and cognitive flexibility assessments, working memory as assessed by the Forward Digit Span, task orientation, and social skills. Teachers also reported that these students had lower internalizing and externalizing behaviors, unadjusted for any covariates, compared to students who did not attend the BPS Pre-K program. By the end of kindergarten, students who attended the BPS Pre-K program scored higher on one of their inhibitory control and cognitive flexibility assessments, working memory as measured by both the Forward and Backward Digit Span and had lower levels of internalizing behaviors, unadjusted for any covariates, compared to students who did not attend the BPS Pre-K program (Table 2).

Unconditional on any covariates, attending the BPS Pre-K program was positively and statistically significantly associated with working memory as measured with the Forward Digit Span ($r = .11$), task orientation ($r = .17$), and social skills ($r = .17$) in the fall of kindergarten and negatively and statistically significantly associated with internalizing ($r = -.22$) and externalizing behavior ($r = -.11$) in the fall of kindergarten (Appendix B Table 3 in the online supplemental materials). We also found BPS Pre-K enrollment was positively and statistically significantly associated with inhibitory control ($r = .16$), working memory as measured on the Forward Digit Span ($r = .11$) and Backward Digit Span ($r = .19$), and task orientation ($r = .13$) in the spring of kindergarten and negatively and statistically significantly correlated with internalizing behavior ($r = -.13$) in the spring of kindergarten (Appendix B Table 4 in the online supplemental materials).

RQ1: Associations Between BPS Pre-K Enrollment and Executive Functioning, Approaches to Learning, and Social–Emotional Skills in Fall of Kindergarten

Table 3 displays results where Model 1 is the relation between BPS Pre-K attendance and outcomes, Model 2 adds child covariates, and Model 3 includes child and family covariates. Overall, we found null associations between attending the BPS Pre-K program and most EF and social–emotional skills in the fall of kindergarten after adjusting for both sets of covariates. However, we did find evidence of a statistically significant association between attending the BPS Pre-K program and a reduction in children's internalizing behavior ($\gamma = -.15$, $SE = .05$, $p < .01$, $d = -.31$) in the fall of kindergarten. We calculated the magnitude of this association in standard deviation units (−.31) by dividing the point estimate from Model 3 by the standard deviation of the outcome (Shadish et al.,

Table 3
Relationship Between Attending Public Pre-K and Skills, Fall of Kindergarten

	Model 1		Model 2		Model 3		
Fixed effect	*B*	*SE*	*B*	*SE*	*B*	*SE*	Std. association (Model 3)
Hearts and flowers, percentage correct mixed	0.04	0.03	0.01	0.03	0.00	0.03	0.013
Hearts and flowers, percentage correct incongruent	0.05	0.03	0.01	0.03	0.00	0.03	0.005
Forward digit span	0.18	0.10	0.08	0.09	0.07	0.09	0.075
Attention impulsivity	0.04	0.05	0.04	0.05	0.03	0.05	0.063
Internalizing behavior	−0.16**	0.05	−0.15**	0.05	−0.15**	0.05	−0.312**
Externalizing behavior	−0.09	0.06	−0.08	0.06	−0.06	0.06	−0.109
Task orientation	0.34**	0.13	0.25*	0.11	0.20	0.11	0.183
Social skills	0.16*	0.06	0.12	0.06	0.10	0.06	0.184
Covariates							
Child			X		X		
Parent					X		

Note. $n = 406$ for hearts and flowers, $n = 403$ for digit span, $n = 395$ for attention/impulsivity, $n = 362$ for internalizing behavior, externalizing behavior, task orientation, $n = 363$ for social skills. Model 1 includes no covariates, Model 2 includes child covariates, and Model 3 includes child and parent covariates. Models fit with random intercepts for classroom and school.
*$p < .05$. **$p < .01$.

2002). The full set of results from regression models is included in Appendix B Table 6 in the online supplemental materials.

There was also suggestive evidence of a positive relationship between attending the BPS Pre-K program and task orientation ($\gamma = .20$, $SE = .11$, $p = .08$, $d = .18$) in the fall of kindergarten, but the statistical significance of this relationship was sensitive to covariate inclusion across models.

RQ2: Association Between BPS Pre-K Enrollment and Executive Functioning, Approaches to Learning, and Social–Emotional Skills in Spring of Kindergarten

Table 4 displays the results for the spring of kindergarten and is formatted the same way as Table 3 (Model 1 = base model, Model 2 = base model with child covariates, Model 3 = base model with child and family covariates). We found evidence of a positive and statistically significant relationship between attending the BPS Pre-K program and inhibitory control in the spring of kindergarten ($\gamma = .07$, $SE = .03$, $p < .01$, $d = .27$). Similarly, we also found evidence of a positive and statistically significant relationship between attending the BPS Pre-K program and working memory as measured by the Backwards Digit Span ($\gamma = .20$, $SE = .09$, $p = .02$, $d = .27$) in the spring of kindergarten. Results from full regression models including covariates are in Appendix B Tables 7 and 8 in the online supplemental materials.

Mapping on to our spring findings, we also found suggestive evidence of a negative relationship between attending the BPS Pre-K program and internalizing behavior ($\gamma = -.08$, $SE = .05$, $p = .09$, $d = -.18$) and a positive relationship with task orientation ($\gamma = .18$, $SE = .11$, $p = .10$, $d = .16$) in the spring of kindergarten. Both of these associations were sensitive to covariate inclusion in that they were statistically significant in both the base model and the model with child covariates but not in the model with child and family covariates. There was no evidence of a relationship between attending the BPS Pre-K program and cognitive flexibility, working memory as assessed on the Forward Digit Span, externalizing behaviors, social skills, or attention/impulsivity in the spring of kindergarten.

Variation in Associations by Race/Ethnicity, Family Income, and Linguistic Background

We conducted an additional exploratory analysis to understand the extent to which these associations varied by students' race/ethnicity, family income, and linguistic background. To conduct these analyses, we fit additional models for each outcome that included interactions between the indicator for enrollment in BPS Pre-K and the demographic variables of interest, including an indicator for whether the student was non-White, an indicator for whether the student was eligible for free- or reduced-price lunch, and an indicator for whether the student was a DLL. We split students into these two categories for power reasons due to sample size restrictions. Ideally, we would have enough students to examine each race/ethnicity category separately.

Overall, we found little evidence that associations varied by these demographic characteristics. There were no statistically significant interactions in the models examining eligibility for free- or reduced-price lunch (Appendix B Tables 9 and 10 in the online supplemental materials) and DLL status (Appendix B Tables 11 and 12 in the online supplemental materials). With respect to race (see full results in Appendix B Tables 13 and 14 in the online supplemental materials), we found one statistically significant interaction between BPS Pre-K enrollment and being non-White in the model predicting working memory in the fall of kindergarten as measured with the Forward Digit Span. While there was a positive relationship between BPS Pre-K enrollment and working memory on this task for White students, the association was negative for non-White students. All other interactions for race/ethnicity were null. Because we saw only one statistically significant interaction across a large number of tests, however, our main conclusion is that associations did not systematically vary by children's racial/ethnic, socioeconomic, or linguistic backgrounds.

Robustness Checks

We conducted multiple sensitivity analyses to address five different threats to the potential internal validity of our results. Although

Table 4

Relationship Between Attending Public Pre-K and Skills, Spring of Kindergarten

Fixed effect	Model 1		Model 2		Model 3		Std. association (Model 3)
	B	*SE*	*B*	*SE*	*B*	*SE*	
Hearts and flowers, percentage correct mixed	0.10***	0.03	0.08**	0.03	0.07*	0.03	0.265*
Hearts and flowers, percentage correct incongruent	0.05*	0.02	0.03	0.02	0.03	0.02	0.130
Forward digit span	0.21*	0.09	0.14	0.09	0.13	0.09	0.157
Backward digit span	0.27**	0.09	0.21*	0.09	0.20*	0.09	0.269*
Attention impulsivity	0.04	0.05	0.04	0.05	0.03	0.05	0.066
Internalizing behavior	−0.12*	0.05	−0.09*	0.05	−0.08	0.05	−0.180
Externalizing behavior	−0.02	0.06	0.03	0.06	0.04	0.05	0.086
Task orientation	0.37**	0.12	0.24*	0.11	0.18	0.11	0.161
Social skills	0.07	0.06	0.02	0.05	0.00	0.05	0.009
Covariates							
Child			X		X		
Parent					X		

Note. $n = 398$ for hearts and flowers, $n = 397$ for forward digit span, $n = 333$ for backward digit span, $n = 395$ for attention/impulsivity, $n = 385$ for internalizing behavior, externalizing behavior, social skills, $n = 384$ for task orientation. Model 1 includes no covariates, Model 2 includes child covariates, and Model 3 includes child and parent covariates. Models fit with random intercepts for classroom and school.
*$p < .05$. **$p < .01$. ***$p < .001$.

this study is nonexperimental in design, demonstrating that the results are robust across a range of possible threats can increase our confidence in these findings. Specifically, we fit models to examine how sensitive results were to: treatment of missing data, using alternative operationalizations of outcome measures, model error structure, a regrouping of students who attended other types of center-based care that used an alternative curriculum that may mirror that used in the BPS Pre-K program, and unobservable differences between students. A full description of these checks is included in Appendix A in the online supplemental materials.

Overall, four of our sensitivity checks demonstrated that our findings were robust to these possible threats to internal validity. The exceptions were the relations between attending the BPS Pre-K program and EF as measured by the Hearts and Flowers, percentage mixed and Backward Digit Span in the spring of kindergarten using an alternative error structure. These two relations were robust in terms of the magnitude of the standardized association but were not robust with respect to statistical significance. Yet, the increased *p*-values for both relationships increased very minimally ($p = .06$ for Hearts and Flowers; $p = .07$ for Backward Digit Span), implying that the pattern of findings continued to stay similar to the results reported above.

Discussion

Our findings demonstrate that children who attended the BPS Pre-K program entered kindergarten with lower internalizing behaviors ($d = -.31$) and higher task orientation ($d = .18$) compared to children who attended a non-BPS Pre-K program or did not attend any type of center-based Pre-K. But there were no differences at kindergarten entry in children's externalizing behavior, social skills, or EF skills. At the end of kindergarten, observed differences in children's internalizing behavior and task orientation remained, although they were less pronounced. Interestingly, children who attended the BPS Pre-K program demonstrated better inhibitory control and working memory skills in the spring of kindergarten ($d = .27$ on both outcomes) than children who did not attend. There continued to be no differences between the groups in children's externalizing behavior and social skills at the end of kindergarten. While there were demographic differences between the BPS Pre-K attender group and the nonattender group, these differences did not seem to account for differences in outcomes between the two groups. These findings add to a small literature on the effects of Pre-K on children's executive function and social–emotional skills (Ansari & Purtell, 2017; Goble & Pianta, 2017; Nguyen et al., 2020; Weiland & Yoshikawa, 2013). They also highlight the importance of treating these types of skills—sometimes lumped together and described as "nonacademic" or "noncognitive" skills—as distinct types of competencies in studies of Pre-K programs (Kautz et al., 2014; Reynolds et al., 2010). Below, we discuss the implications of our findings by domain.

BPS Pre-K and Sustained Associations With EF Skills

It is surprising that there were no observed differences between BPS Pre-K attenders and non-BPS Pre-K attenders on their EF skills at kindergarten entry. For example, results of a prior study examining short-term impact of the BPS Pre-K Program with an earlier cohort of children (2008–2009) found positive impacts on all four measures of children's EF skills ($ds = .20$–$.27$) (Weiland & Yoshikawa, 2013). Unlike the current study design, this earlier work utilized a regression discontinuity design with a much larger sample size to detect differences between attenders and nonattenders' skills and was unable to estimate impacts at the end of kindergarten. There are several explanations for this divergence in findings between the two studies. First, there may be selection bias in the current sample on variables uncontrolled in our study. Second, there may be key differences between the cohorts that were studied given changes in who enrolled in BPS Pre-K over time and what the program itself focused on. For example, in 2016–2017, the alternatives to BPS Pre-K that about 67% of the comparison group accessed could be of higher quality and better suited to nurture children's EF skills, yielding a negligible difference between the skills of attenders and nonattenders.

What is perhaps most notable about our findings, however, is that differences in EF skills favoring Pre-K attenders do emerge at the end of kindergarten. Post hoc, we tested whether there was indeed a meaningful difference in magnitude between the fall and spring on EF outcomes and found that the coefficients were statistically significantly different ($p < .007$) (Clogg et al., 1995). This apparent "sleeper effect" has been documented in a longitudinal study of ECLS-K data with children's EF skills (Little, 2021), as well as intervention work that found 1 year of a Pre-K math curriculum did not impact children's EF skills until follow-up testing at the end of kindergarten, after the children had already stopped participating in the intervention (Clements et al., 2020; Mattera et al., 2018). Due to the design of the current study, it is difficult to pinpoint exactly why these associations are not observed at the beginning of kindergarten but do appear at the end. Extant evidence would suggest that any observed differences in EF between children at age 5 tend to persist through the later grades (Gottfried & Ansari, 2021; Ready & Reid, 2019), but future work—including examining the pattern of associations through later elementary school—is needed to study this phenomenon in the context of BPS.

In general, more research is required to understand how children build on their EF skills from one grade to the next. By the end of kindergarten, BPS Pre-K attenders in this study had 2 years in a familiar school environment with similar routines, rules, classroom structure, and time spent in academic content; This gradual increase in cognitive load and scaffolding could ensure that EF skills were seamlessly built up (Carlson, 2009). On the other hand, non-BPS Pre-K attenders may have spent a good deal of the kindergarten year navigating a new environment that may have tested their EF beyond their zone of proximal development. Follow-up work should investigate more deeply the specific teacher practices or facets of the classroom environment—and alignment between Pre-K and kindergarten—that contribute to EF development. Indeed, in a recent study testing the impacts of an approach that aligned math instruction across Pre-K and kindergarten, Mattera et al. (2018) found evidence that this type of alignment yielded impacts on children's EF at the end of the kindergarten.

BPS Pre-K and Associations With Approaches to Learning and Social–Emotional Skills Across Time

In our study, children who attended the BPS Pre-K program had lower levels of internalizing behavior than their peers at the start

of kindergarten, which is not surprising considering that children who had attended the BPS Pre-K program were already adjusted to the routine and school building of their kindergarten classroom. This connects to past work on how internalizing behaviors tend to emerge in big school transitions, like between elementary and middle school (Hughes & Ensor, 2011). Yet, the evidence was only suggestive that this association was sustained through the end of kindergarten. Again, post hoc we tested whether there was a meaningful difference between the magnitudes in the fall and spring and found that the two coefficients were indeed statistically significantly different ($p < .002$). As touched upon in the introduction, children's family characteristics may account for more variance in children's social–emotional skills than whether or not they attended BPS Pre-K (Baker & Rimm-Kaufman, 2014; McWayne & Bulotsky-Shearer, 2013). Children in our study who attended BPS Pre-K also exhibited higher task orientation at the beginning of kindergarten than those who did not, but this difference was smaller by the end of kindergarten. Similar to how the kindergarten environment might just as well nurture children's social–emotional skills, exposure to kindergarten might be sufficient in providing children with the tools they needed to develop learning-related behaviors and stay on task.

Although our study did not demonstrate that BPS Pre-K attenders outperformed their peers in social skills or fewer instances of externalizing behavior, the Pre-K model was not detrimental to those skills either. For externalizing behavior, this null association could be in part because there was low variability in children's externalizing behavior, with most children exhibiting low levels of this behavior (mean score of 1.48 out of 4), so we may not have had the power to detect this association due to floor effects (Benner et al., 2017). We need to study these associations longer term, however, considering that our results demonstrated sustained associations with EF skills in kindergarten, which could potentially lead to fewer externalizing behaviors in later elementary school (Ciairano et al., 2007; Riggs et al., 2006). This latter point is important because although we looked at children's outcomes 1 year later, past work has stressed that the unique impact of Pre-K on social–emotional skills tends to be smaller compared to academic impacts, but they tend to *persist* longer than academic skills over time (Li et al., 2020; Welsh et al., 2020). Social skills have been found to serve as a mediator between Pre-K program impact and children's later elementary and middle school academic skills (Elango et al., 2015; Mackintosh & McCoy, 2019). It is also possible that we did not find differences in children's social skills by Pre-K attendance because the sample was drawn from an urban context. Indeed, prior work has found that associations between Pre-K quality and children's social skills may be stronger in rural settings, for reasons that are unclear (Schmitt et al., 2018). Taken together, future work should continue to study how public Pre-K programs relate to longer-term EF and social–emotional skills—how these relations may be different—and whether any of these factors explain long-term associations with academic outcomes.

Limitations

There are some important limitations in this study. First and foremost, the research design does not allow for causal inference. Although we did adjust for a host of potential differences between students who did and did not attend BPS Pre-K, there may be other unobserved differences between the groups that could affect our results. We did use the inverse probability of treatment weighting as a method in our robustness checks to create matched groups of attenders and nonattenders but we continued to be limited by the observable characteristics to which we had access. Relatedly, the group of students who did not attend any formal Pre-K program during their 4-year-old year split is fairly small relative to the groups of BPS Pre-K attenders and students who attended some other Pre-K program. The small sample size likely also posed a challenge to our models examining variation in associations by family income, race/ethnicity, and DLL status. Future work with more power to examine subgroup effects is needed. Although study participants were randomly sampled from the broader BPS population, the results from the current study may also not be wholly generalizable to this group. Aside from the students enrolled in the CBOs receiving supports from the school district, we lack rich information on the students in the comparison conditions and the supports they received during their 4-year-old year. Future work that documents the experiences of students across Pre-K attender groups could help fill these gaps. In this study, we were also only able to examine our hypotheses through the spring of kindergarten. As other studies in the field have found, it is possible that patterns of convergence could emerge in later elementary school grades. Future research examining later time points—particularly third grade—will provide needed information on the extent to which associations between enrollment in public Pre-K and skills are sustained across time. Lastly, prior work in Pre-K demonstrates the importance of attendance (Arbour et al., 2016); however, we did not control for attendance in Pre-K as we lacked equivalent data on the comparison group. Finally, we recognize that the BPS Pre-K program is somewhat unique in the field, given its focus on supporting a deep range of skills and its link to a kindergarten program that is intentionally aligned. As such, our findings may not generalize across all Pre-K programs. Further research involving a range of scaled Pre-K models is thus warranted.

Implications for Policy and Practice

Overall, our findings have implications for current efforts to expand access to high-quality Pre-K across the United States. Our findings suggest that publicly funded Pre-K programs—including programs that use evidence-based, domain-specific curricula supported by teacher training and coaching and treat Pre-K teachers with parity with their K-12 peers—can be beneficial for supporting children's social–emotional skills in the short term, but the kindergarten environment can just as well foster these skills in children who did not attend a public preschool. For EF skills, on the other hand, gaps in public Pre-K attending versus nonattending children continue to widen over time, which points to the importance of fostering this skill through Pre-K models that use evidence-based approaches. Overall, educators tasked with creating new Pre-K programs across the United States might look to the BPS Pre-K program as a model of a high-quality Pre-K environment that successfully fosters children's EF skills as they move into elementary school. Our findings also offer a signal relevant to theories that executive function skills could be part of the so-called Pre-K "sleeper effect"—that is, the pattern in which positive effects are found in early adulthood despite earlier convergence or fade-out.

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Received March 13, 2022
Revision received September 22, 2022
Accepted September 27, 2022 ■