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# Children's exposure to sustainability practices during the transition from preschool into school and their learning and socioemotional development

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## Abstract

Evidence that the learning gains of preschool fade as children transition into elementary school has led to increased efforts to sustain preschool advantages during this key transitional period. This study explores whether the observed benefits of sustainability practices for a range of child outcomes are explained and/or moderated by family and school mechanisms selecting children into experiencing these practices. Analyses of the Early Childhood Longitudinal Study-Birth Cohort revealed that both family and school factors predicted children's exposure to several PK-3 sustainability practices. PK-3 sustainability practices were associated with reading (but not math) gains and better interpersonal skills (but not fewer externalizing behaviors) following the transition into kindergarten. These links were not conditioned by the selection mechanisms. The findings highlight who is more likely to seek out (at the family level) or offer (at the school level) sustainability practices and how relevant they are to fighting preschool fadeout.

The case for investment in early childhood education is strong. Preschool education is increasingly viewed as a means of promoting the development of children's cognitive and academic skills and reducing disparities among diverse groups in these barometers of future educational success. Studies have documented the short-term benefits of preschool education for children's school readiness and later school achievement (Duncan & Magnuson, 2013; Keys et al., 2013; Magnuson, Ruhm, & Waldfogel, 2007 ; NICHD Early Child Care Research Network, 2002), and the effects of such high quality early childhood programs tend to be stronger for children considered to be most at risk for problems in school, including those from socioeconomically disadvantaged families (Burchinal, Vandergrift, Pianta, & Mashburn, 2010; Peisner-Feinberg et al., 2001). On a broader scale, proactive programs targeting human capital development among young children appear to maximize long-term returns to investment and be far more cost-effective than later remediation support, suggesting the economic value of early education programs for society as a whole, not just for children themselves (Heckman, 2006). The strength of the case for preschool investment is increasingly evidenced in policy action, including the expansion of Head Start and Early Head Start and the creation of targeted early childhood education programs.

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Yet some serious concerns underlie, and potentially undercut, this broad support for preschool investment. Perhaps most pressing is evidence of a fadeout of preschool benefits as children move into and through formal schooling (Brooks-Gunn, 2003; Duncan & Magnuson, 2013; Kauertz, 2006; see Barnett & Carolan, 2014 for debate on fadeout effects). Several theoretical perspectives attempt to contextualize and explain this phenomenon by conceptualizing the transition into elementary school as a critical period when children are often socially, emotionally, and cognitively challenged by the new environment while many of the resources of early education programs are not carried through (Alexander, Entwisle, Blyth, & McAdoo, 1988; Heckman & Masterov, 2007). One broad conceptual model that addresses these issues and their direct policy applications is the prekindergarten 3rd grade (PK-3) model. This model highlights the critical nature of continuity between preschool and the primary grades to better serve the needs of children during their first decade of life (Takanishi & Bogard, 2007).

In this study, we not only examine whether sustainability practices associated with the PK-3 model are linked to children's well-being following the transition to elementary school, but we further contextualize the PK-3 model by incorporating a more explicit conceptualization of differential selection into educational contexts. We focus on PK-3 sustainability practices that are tied directly to educational continuity and smooth children's entry into formal schooling, helping sustain learning gains achieved prior to this transition. Then, we consider how family and school factors predict children's exposure to sustainability practices and potentially condition their associations with key child outcomes.

## Sustainability of children's early learning and development

Although many early education programs have documented effects on the cognitive and academic skill development of young children, their effects often fade as children transition into the formal K-12 educational system. Head Start is a good example of this trend, with Head Start graduates exhibiting more school readiness than their similar peers who did not attend Head Start but then losing this advantage over time (Duncan, Ludwig, & Magnuson, 2007; Magnuson et al., 2007). Although many factors may account for this fadeout, the discontinuity between preschool and the primary grades is increasingly recognized as part of the problem. In short, these two levels of education do not always fit together well, and, as a result, much of the momentum of early enrichment is lost (Brooks-Gunn, 2003; Fuller, 2007).

The PK-3 conceptual model seeks to explicitly address issues of fadeout by encouraging continuity and consistency across levels. Although the model is concerned primarily with promoting alignment from preschool through the primary grades, it also subsumes specific strategies that more generally promote sustainability of early enrichment. Drawing from the PK-3 model, we examine sustainability practices highlighted in past research (Bogard & Takanishi, 2005): preschool enrollment itself, the high-quality features of kindergarten classrooms that contribute to a consistent learning environment over time (i.e., small class sizes and low student-to-teacher ratios, highly-qualified teachers staffing primary grade classrooms, dedicated time devoted to reading instruction), and the transition supports that elementary schools implement to smooth the move from preschool to school (e.g., parent

summer orientation, teachers contact parents with information about the kindergarten program). The PK-3 model targets these practices because they seem to promote consistent stimulation and support as children move from early enrichment through the first year of elementary school that facilitates more positive schooling outcomes (Reynolds, Magnuson, & Ou, 2010; Reynolds & Temple, 2008). Moreover, many of the individual sustainability components (e.g., full-day kindergarten, teacher certification, kindergarten transition support activities) have well-documented effects on children's well-being (Chatterji, 2006; Cooper, Allen, Patall, & Dent, 2010; Schulting, Malone, & Dodge, 2005).

Most of the limited literature base on PK-3 has focused on child outcomes in 3rd grade. We, in contrast, focus on the earlier effects of the PK-3 sustainability practices, when children transition to formal schooling, as the transition to elementary school has been found to be particularly important for children's educational trajectories through K-12 and beyond (Entwisle, Alexander, & Olson, 2005). Moreover, an explicit goal of PK-3 is to align preschool and early elementary to create a more seamless transition for students, and as such, examining child well-being immediately after making this key school transition is a relevant test of this educational goal.

## Family and school factors associated with sustainability

Historically, research and applied interest in the PK-3 model has primarily concerned the effects of sustainability practices on children's developmental outcomes rather than what predicts the sustainability practices themselves. Yet, this latter issue—why do some schools have sustainability practices consistent with the PK-3 model and others do not, and why do some children get exposed to such practices while others do not?—is important for two reasons.

The first reason concerns the larger stratification system of the American educational system. Schools in the United States are becoming increasingly racially/ethnically and socioeconomically segregated (Orfield & Lee, 2007). With these compositional shifts come differential access to instructional resources and supports that further reinforce social stratification (Lucas, 1999; Rothstein, 2004). The sustainability practices promoted by the PK-3 model are viewed as potential remedies to such stratification when conceptualized as a means to build on the learning experiences and positive developmental outcomes from early childhood education (Bogard & Takanishi, 2005). By exposing children deemed "at risk" for poor educational outcomes to high quality programs from preschool through early elementary school, these practices may be educational equalizers. Sustainability practices, however, could possibly be serving segments of the population not generally considered at-risk; for example, the children of socioeconomically advantaged parents who recognize the strengths of these practices and, therefore, seek out these educational opportunities as part of the concerted cultivation of their children's educational careers (Lareau, 2004). To the extent that sustainability practices are more common in schools serving more advantaged child populations, these practices move from a means of breaking stratification to one that reinforces it. In this way, differential provision of or exposure to sustainability practices can either combat educational inequality (when more educationally vulnerable youth have

greater exposure to PK-3 sustainability practices) or reinforce it (when youth with greater social capital have greater exposure to sustainability practices).

The second reason is that, policy-wise, investigating which schools integrate sustainability practices and which families tend to select into these schools illuminates who exactly is being served by the practices and who benefits most from them. A vast literature documents the achievement divide between low-income and race/ethnic minority children and their more affluent and White peers (Duncan & Magnuson, 2005; Lee & Burkam, 2002), and similar evidence shows that teachers tend to rate low-income and minority children's behavior and social skills more poorly (Pigott & Cowen, 2000). These educationally vulnerable children may gain particular benefit from exposure to sustainability practices, but the extent to which they are exposed to sustainability practices is an open question. Thus, although children who are most likely to benefit may have families who will choose educational options that embrace sustainability practices when available, an equally likely possibility is that children who would benefit most have families who will not choose such programs unless encouraged to do so. Such information is critical for policy efforts that seek to promote sustainability practices and the larger PK-3 model and to ensure that recruitment efforts target the populations most in need.

The implications of the sustainability practices under study here have been the focus of a nascent body of research that suggests they are potential remedies for the fadeout effects of early education programs. PK-3 programs (i.e., organized interventions that integrate sustainability practices from early childhood through early elementary school) have been linked to greater achievement gains through early adulthood, fewer delinquency referrals, and higher rates of school completion; even more limited applications that include only certain sustainability practices consistent with the PK-3 model have been found to yield lasting academic benefits for young people (see Reynolds et al., 2010 for a review). Nevertheless, the degree to which selection—how characteristics of schools implementing sustainability practices and characteristics of families exposed to these practices explain or condition observed effects—plays a part in these findings has not been adequately assessed. Selection can take two forms. Active selection encompasses parents making conscious choices about neighborhoods and schools, whereas passive selection encompasses how the characteristics and circumstances of families affect the odds that they will live in an area that has certain types of schools, regardless of the extent that they had any active choice in their neighborhood selection. Exploring selection processes is important in terms of strengthening causal inference in this policy relevant model (Duncan, Magnuson, & Ludwig, 2004; Winship & Morgan, 1999).

These selection mechanisms suggest that differences between those who are and are not exposed to sustainability practices may be due to two sources of variation. The first is that the same family and school characteristics that select children into educational contexts with more sustainability features may also be related to children's developmental outcomes. For example, to the extent that more socioeconomically advantaged families recognize the benefits of sustainability practices and enroll their children in programs with such practices, this family advantage could underlie the positive association observed between sustainability practices and child outcomes. To account for this source of variation, we examine how

robust the links between sustainability practices and children's well-being are once we take into account how a host of school and family assets and constraints are related to both sustainability practices and children's well-being. The second source of variation related to selection, described previously, is the fact that schools may differentially elect to implement sustainability practices while families may differentially choose educational alternatives that guarantee greater exposure to these practices, and certain children in these families and schools may gain particular benefit from the sustainability practices. To address this source of variation, we investigate the degree to which family assets and constraints moderate observed benefits of sustainability practices for the academic and socioemotional functioning of children transitioning into formal schooling. Careful attention to these selection mechanisms is a key contribution of the current study.

## Conceptual model and study aims

Our conceptual model is presented in Figure 1. It takes many of the sustainability practices promoted by the PK-3 model—the explicit and implicit practices that smooth the transition into formal schooling, thus promoting positive outcomes for children—and incorporates selection mechanisms using data from the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B). Our focus on children who have recently transitioned into elementary school (kindergarten students) is purposeful. Entry into formal schooling can be a challenging transition, and what happens during this transition sets the stage for children's subsequent educational experiences that exert lasting effects on their life course trajectories (Alexander, Entwisle, & Olson, 2014; Pianta & Cox, 1998). ECLS-B is a unique dataset that offers detailed information about children's preschool and kindergarten educational experiences and is thus ideal for investigating our three research questions.

Our first research question asks whether children's exposure to sustainability practices is linked to their academic and socioemotional outcomes following entry into formal schooling. Testing this path (Path A in Figure 1) is intended to validate prior work on PK-3 sustainability practices. This scholarship has consistently shown benefits for children's academic and social development in later elementary school (Miles & Stipek, 2006; Reynolds et al., 2010). We direct our attention instead on the transition to elementary school, and we specifically focus on the total number of practices identified as critical by past research that children are exposed to during their early education (i.e., from preschool to kindergarten) (Bogard & Takanishi, 2005; Reynolds et al., 2010).

Our second and third research aims takes up the issue of selection mechanisms. To begin, school assets and constraints refer to the features of schools that make the transition to formal schooling easier or more difficult for children in general, such as school size and diversity (Benner, 2011; Leithwood & Jantzi, 2009), or that make it easier or more difficult to implement sustainability practices, such as funding and sector (Coleman & Hoffer, 1987; Kozol, 2005). Next, family assets and constraints are family characteristics that make children more vulnerable to differential treatment (e.g., race/ethnicity, nativity; Taylor, 2002), mean that they will have fewer resources facilitating access to sustainability practices (e.g., family structure; Duncan, Yeung, Brooks-Gunn, & Smith, 1998), or suggest that their

parents will be more or less likely to efficaciously seek out opportunities for them (e.g., residential instability, inconsistent routines; Gershoff, Aber, Raver, & Lennon, 2007).

The second research aim addresses the fact that school and family selection mechanisms could be spurious factors, simultaneously predicting sustainability practices (Path B1 in Figure 1) and children's outcomes (Path B2) in ways that create the appearance of a link between the two even when none exists or exists in a weaker form. For this research aim, we are investigating whether we still observe benefits of sustainability practices after taking into account the family and school mechanisms that affect the likelihood that children will be exposed to such practices. To the extent that any observed effects of sustainability practices persist beyond this spuriousness, the case for the importance of sustainability practices for children's academic success and socioemotional well-being will be stronger.

Our third research aim focuses on addressing selection mechanisms via moderation, asking whether the links between sustainability practices and children's outcomes vary as a function of family and school selection forces (Path C in Figure 1). We posit competing hypotheses about moderation. The compensatory hypothesis suggests that high-risk children (e.g., those from low-income families, those attending schools serving predominantly low-income children) have more vulnerabilities and would thus benefit most from quality educational supports consistent with the PK-3 framework (Sameroff & Chandler, 1975). In contrast, the accumulated advantage hypothesis suggests that children with more advantages at entry will benefit most from quality educational supports consistent with the PK-3 framework because they have stronger existing skills and more family-related resources that help them capitalize on any new resources (Cunha, Heckman, Lochner, & Masterov, 2006).

## Method

### Data and sample

The current study draws on the ECLS-B, a nationally representative probability sample of infants born in 2001. The study, conducted by the National Center for Education Statistics (NCES), uses a multistage sampling design. The resulting sample is racially/ethnically diverse and includes an over-sample for American Indian, Asian, low birth-weight infants, and twins. It includes longitudinal assessments, interviews, and questionnaires conducted when children were 9 and 24 months and four (preschool) and 5 years old (kindergarten). In total, 83% of the 9-month sample (Wave 1; $N = 10{,}700$) participated in the preschool wave (Wave 3), and 92% of those eligible participated in data collection when they were in kindergarten in either 2006 or 2007 (Wave 4; $N = 8{,}850$; $M_{\text{child age}} = 74.47$ months). Given our focus on sustainability practices consistent with the PK-3 model and how they relate to children's outcomes, we included only those children with both teacher and child assessment data when students were in kindergarten ($N = 5{,}050$). Here and throughout the manuscript, *n*'*s* are rounded to the nearest 50, in accordance with NCES requirements for restricted-use data.

In total, 50% of the analytical sample was female, and the sample was racially/ethnically diverse (43% white, 20% Latino, 14% African American, 12% Asian American, and 12% other/multiracial). Those included versus excluded from the analytical sample did not

significantly differ on gender (X(1) = 2.79), mother nativity (X(1) = 0.81), father nativity (X(1) = 2.88), maternal English fluency ($t$(10,700) = −0.04), child age at Wave 1 ($t$(10,250) = 1.58), or child temperament at Wave 1 ($t$(10,700) = 0.53). We did observe significant differences in child low birth weight status ($t$(10,650) = 32.7, $p < .01$), but the differences were not substantively meaningful (27% low birth weight for excluded participants versus 25% low birth weight in analytic sample). Similarly, we observed a significant difference in the race/ethnic distributions across the excluded versus included participants (X(4) = 52.20), but for each racial/ethnic group, there was a 3% difference (or less) in the group's representation in the excluded versus included groups (e.g., 17.3% of the excluded sample was African American versus 14.4% in the analytic sample). As described in the following section, we employed missing data techniques to avoid any further loss of cases and sample weighting to account for differential attrition across waves.

## Measures

Descriptive statistics for all study measures appear in Table 1.

## Sustainability practices

ECLS-B allowed for the measurement of seven sustainability practices that have been previously linked to the PK-3 model. Each individual measure was dichotomized, based on thresholds from prior studies (Mead, 2009; Reynolds, Magnuson, & Ou, 2006), to indicate whether it was consistent with PK-3 practices (1) or not (0). For each practice, the percentage of children exposed is presented in brackets. Of the seven practices, one was reported by parents, five by teachers, and one by school administrators.

In Wave 3, parents reported whether their child was enrolled in center-based care (i.e., nursery school, preschool, or prekindergarten) at age four (1 = *enrollment* [48%], 0 = *no enrollment).* Teachers indicated whether the school offered full-day kindergarten (1 = *yes* [75%], 0 = *no*), the total number of minutes of reading instruction per day (1 = *90 minutes or more daily* [60%], 0 = *less than 90 minutes daily)*, and the size of their kindergarten class (1 = *20 children or less* [62%], 0 = *more than 20 children).* Teachers also reported whether seven different activities supporting the transition to elementary school were offered in their schools (e.g., have preschoolers visit kindergarten class, provide parent orientation at the beginning of kindergarten). The total number of kindergarten transition activities was summed (range: 0–7); we identified those schools offering four or more activities (coded as one (1) [41%]) versus those offering three or fewer activities, which were coded as zero (0). Teachers also were asked about the type of teaching certification they had. Those reporting regular/standard certification or the highest certification available were coded as one (1) [88%]; no certification, temporary/ probational, emergency, and alternative certification were coded as zero (0). Finally, administrators reported whether the elementary school served preschool students (1 = *yes* [52%], 0 = *no*). After all sustainability factors were dichotomized, we summed them to create a count of the practices experienced by each child ($M$ = 4.25, $SD$ = 1.38).

### Children's developmental outcomes

In the spring of kindergarten, teachers completed the Social Rating Scale (SRS), adapted from Gresham and Elliott (1990). We chose the externalizing behavior subscale based on previous developmental research that suggests externalizing symptoms (e.g., aggression, opposition) are highest in early childhood and are also associated with lower levels of later academic competence (Bongers, Koot, van der Ende, & Verhulst, 2004; Masten et al., 2005). We chose the interpersonal skills subscale because it reflects children's ability to forge personal connections, a critical aspect of belongingness at school (Ready, LoGerfo, Burkam, & Lee, 2005). All SRS items were rated on a 5-point scale ranging from 1 *(never*) to 5 *(very often).* For externalizing behaviors, teachers evaluated children on eight different acting out behaviors, such as restlessness, aggression, and impulsivity. Higher mean scores reflect more externalizing behaviors ($\alpha$ = .93). Teachers also provided ratings of children's interpersonal skills (e.g., sharing, providing comfort). Higher mean scores indicate more positive interpersonal skills ($\alpha$ = .87).

Two measures from child assessments conducted in the spring of kindergarten tapped academic achievement. Children completed untimed, individually administered, two-stage standardized assessments in mathematics (e.g., numbers, shapes, arithmetic) and reading (e.g., letter recognition, sight words, literal inference) designed specifically for the ECLS-B data collection. Children's performance on the uniform first stage determined whether they took the low-, medium-, or high-difficulty version of the second stage. Item response theory was used to develop single proficiency scores for each assessment (i.e., mathematics, reading).

### Family assets and constraints

To determine the potential characteristics of the families selecting into schools with more sustainability practices, we measured constraints in three sets of factors assessed at the final preschool wave, unless otherwise noted. These selection factors drive, both actively and passively, parents' choice of neighborhood and parents' choice of school. For *demographic factors*, mothers reported their race/ethnicity (dummy variables for African American, Asian American, Latino/a, Other; White as the reference group). We also include nativity of both parents (1 = *foreign born*, 0 = *born in U.S.*).

Six variables captured socioeconomic factors—mother's marital status (1 = *not married*, 0 = *married)*, total number of children under 18 in the household, highest level of parent education across parents (ranging from 1 = 8th *grade or less* to 9 = *Ph.D. or professional degree)*, mothers' and fathers' employment status (2 = *not employed*, 1 = *employed part-time*, 0 = *employed full-time)*, family poverty status (1 = *family at or below 185% of the federal poverty line*, the threshold for receipt of federal lunch assistance, 0 = *family above 185% of the federal poverty line*), and receipt of public assistance (mean of receipt of Women, Infants, and Children (WIC) support, food stamps, Medicaid, Temporary Assistance to Needy Families (TANF) support, and public housing).

Six measures tapped family processes/circumstances. Mothers reported whether they had a residential move between child age 24 months and the preschool wave. Mothers indicated

whether their child participated in seven different activities outside of school (e.g., drama, music); the dichotomous items were summed to determine the total number of extracurricular activities. They also reported the presence or absence of five family routines (e.g., eat dinner as a family, child has a designated bedtime). The binary items were summed into the total number of family routine activities. Mothers also reported their ability to speak, read, write, and understand English, each coded on a 4-point scale (1 = *not well at all*, 4 = *very well*); higher mean scores reflected greater fluency. Finally, they reported on their children's low birth weight status and rated their children's health using a 5-point scale, from 1 (*poor*) to 5 (*excellent*).

## School assets and constraints

Measures of the characteristics of each child's elementary school were drawn primarily from the Common Core of Data (CCD), an NCES program that collects school-level data on both fiscal and non-fiscal characteristics on all public schools. We used data on the racial/ethnic composition of schools' student bodies to determine each school's race/ethnic diversity based on Simpson's (1949) index of diversity:

$$D_C = 1 - \sum_{i=1}^{g} p_i^2$$

In this formula, racial/ethnic diversity ($D_c$) depends on the proportion ($p$) of students in the school from each race/ethnicity ($i$). The proportions are squared and summed across the total number of racial/ethnic groups in the school ($g$). Possible scores range from zero to approximately one. This index accounts for both the relative proportion of each racial/ethnic group and the number of groups represented. Higher scores reflect greater racial/ethnic diversity. We also included a measure of school size. Three other school factors were sector (1 = *public*, 0 = *private*) and the percentage of students qualifying for the federal Free- or Reduced-price Lunch (FRPL) program, both drawn from the CCD. We also included teacher reports of the percentage of English language learners in their kindergarten classrooms.

## Control variables

To account for potential spurious associations between sustainability practices and student outcomes due to children's social locations, analyses controlled for child age, gender, child temperament, and early cognitive scores. Child temperament was measured using the Infant Toddler Symptom Checklist (ITSC) from Wave 1, in which seven variables are averaged to create a temperament score. This checklist screens child behavior for emotional functioning, learning difficulties, and behavioral problems (DeGangi, Poisson, Sickel, & Wiener, 1995). Early cognitive scores were measured with a modified version of the Bayley Short Form-Research Edition (BSF-R), administered at age two; we include scaled scores for the mental scale (see Mulligan & Flanagan, 2006). To control for any spuriousness due to place of residence and to account for the role of residence in the ECLS-B sampling frame, region (dummy variables for northeast, midwest, west; south as the reference category) and urbanicity (dummy variables for urban, rural; suburban as the reference category) were also incorporated as controls in our multivariate models. Finally, because the ECLS-B sample

entered kindergarten either in the 2006–2007 school year (75% of the sample) or the 2007–2008 school year (25% of the sample), we controlled for the year the child entered kindergarten.

### Plan of analysis

We conducted hierarchical regression analyses to examine our three research questions. The first step of the hierarchical analyses examined the relations between sustainability practices and children's outcomes. These analyses included only basic covariates (i.e., child gender, age, temperament, early cognitive scores, region, urbanicity, year child entered kindergarten). Here, we were interested in establishing whether greater exposure to sustainability practices promoted children's academic and socioemotional well-being (research question one). The second step integrated the family and school factors that we hypothesized might select children into schools with more PK-3 sustainability practices and be simultaneously related to children's outcomes. Herein, we were addressing selection mechanisms that could manifest as spurious relations, and we were thus interested in whether the base relations between exposure to sustainability practices and children's outcomes documented in the first step would hold once we took into these family and school factors into account (research question two). These analyses more comprehensively document the robustness of the findings around sustainability practices' influence. In the final step, we integrated interactions between school/family factors and sustainability practices to determine whether the links between exposure to sustainability and children's outcomes varied as a function of any of the family or school assets or constraints (research question three). All continuous variables used in the interaction terms were centered prior to computing the interaction. Due to the large number of interactions tested and the sample size, we used a Bonferroni family-wise $p < .002$ as our threshold for establishing significance ($p < .05$ divided by 21 interaction analyses).

All analyses were conducted in M*plus* v7.1 (Muthen & Muthen, 1998–2011) and included the sample weight (WKR0) to account for the complex sampling design and differential attrition. Although the current dataset included some missing data, the full-information maximum likelihood (FIML) method in M*plus* allowed data for all cases to be estimated in modeling. FIML is a preferred method for generalizing results to the population and using all available data (Arbuckle, 1996). It does not estimate the missing data, as is the case with mean- or regression-based imputation techniques; rather, it fits the covariance structure model directly to the observed (and available) raw data for each participant (Enders, 2010).

## Results

### Relations between sustainability practices and children's outcomes

The first research question examined whether children's exposure to sustainability practices was linked to their academic performance or socioemotional well-being. As shown in Table 2, children who were exposed to more sustainability practices performed better on the reading achievement test but not the mathematics test following the transition to elementary school. They were also rated by their teachers as having better interpersonal skills but not as exhibiting more or less externalizing behaviors. These analyses controlled for a small set of

key covariates, and the effect sizes of sustainability practices were of similar magnitude for reading achievement ($\beta$ = .07) and interpersonal skills ($\beta$ = .06).

## Selection mechanisms: Robustness of the relations between sustainability practices and children's outcomes

In examining possible selection mechanisms, we first examined direct relations between family and school factors and both sustainability practices and children's outcomes. We then determined whether the observed relations between sustainability factors and children's well-being persisted when these family and school factors were taking into account, to verify the observed effects found in the first step of our analyses were not spurious in nature. As seen in Table 3 (standardized coefficients presented to show effect sizes), we observed that both family and school factors were associated with children's exposure to sustainability practices. For family demographics, Latino children had less exposure to PK-3 sustainability practices than their White peers. For family processes and circumstances, exposure to sustainability practices was higher, on average, for children whose mothers had greater English proficiency. Regarding school factors, children in smaller schools and schools with more students qualifying for FRPL were exposed to more sustainability practices, on average, than their counterparts in larger and more socioeconomically advantaged schools. Family and school factors also were associated with children's competencies in ways that were generally consistent with prior literature. For family demographics, we observed the well-documented race/ethnic disparities, particularly in mathematics achievement. Similarly, children from more socioeconomically advantaged families and families making more educational investments tended to perform more strongly across achievement domains and were rated as having fewer behavioral difficulties. At the school level, students in private schools and schools with fewer students qualifying for FRPL generally performed better academically than their counterparts in public schools and in schools with more students qualifying for FRPL.

After taking into account these selection mechanisms, the previously observed association between sustainability practices and children's reading at the end of kindergarten persisted, and this coefficient was stable across the steps of the stepwise model ($\beta$ = .07). Similar stability was observed for children's interpersonal skills at the end of kindergarten ($\beta$ = .06 in step one and $\beta$ = .07 in step 2).

## Selection mechanisms: Potential variation in the relation between sustainability practices and children's outcomes

Our final research question examined whether the relations between exposure to sustainability practices and children's academic, social, and emotional outcomes varied according to family/school assets and constraints that could potentially influence that exposure. Our results identified no such conditional effects, suggesting the benefits of sustainability practices were consistent across diverse family and school settings that made some children more likely to experience those practices than others.

## Discussion

For decades, educators and policymakers have sought to address the persistent achievement gaps tied to larger social stratification—differences across race/ethnic and SES lines emerge early in children's educational careers and only widen over time (Hallinan, 2001; KewalRamani, Gilbertson, Fox, & Provasnik, 2007). Strategies to combat these disparities have shifted from adolescence and dropout prevention to promoting access to and enrollment in early childhood education programs, based in part on economic models that highlight the particular return on investment at this time in the life course (Heckman, 2006). Evidence of fade-out effects of preschool attendance has instigated renewed efforts to better align the educational experiences of young children as they move from preschool into early elementary school, the primary goal of the PK-3 model. Existing studies have linked PK-3 exposure to better academic performance and socioemotional well-being in later elementary school (Reynolds et al., 2006, 2010; Reynolds & Temple, 2008), and in the current study, we more rigorously tested this relationship by taking into account, in multiple ways, the possible selection mechanisms tied to family and school constraints. We also focused on the transition to formal schooling, as this transition is particularly critical for children's educational trajectories (Entwisle et al., 2005).

First, we examined the baseline relations between PK-3 sustainability practices and children's academic performance and socioemotional well-being following the transition to kindergarten. PK-3 sustainability practices were associated with reading (but not math) gains and better interpersonal skills (but not fewer externalizing behaviors). We then examined selection mechanisms tied both to which schools implemented more PK-3 practices and to which families had greater exposure to PK-3 practices. Here, we observed that schools serving more disadvantaged student populations generally implemented more PK-3 practices, suggesting that PK-3 programming may be one policy enacted by schools to decrease academic disparities (Bogard & Takanishi, 2005). The investment in PK-3 that these schools appeared to make was particularly noteworthy given that schools enrolling students from more disadvantaged backgrounds confront a host of challenges related to resource availability and educator retention (Rothstein, 2004). Why and how these schools chose to implement PK-3 practices in the face of such obstacles is an important area of future inquiry. We also found more PK-3 practices in smaller schools, which indicates that, not surprisingly, coordination and alignment across schooling levels is easier in smaller educational systems that involve fewer key personnel (Lee, 2000). In recent years, educational systems have pushed to create smaller learning communities, based on extensive research that generally favors smaller schools for young people's academic achievement and school engagement (see Leithwood & Jantzi, 2009 for a review), and such efforts may facilitate implementation of PK-3 practices.

At the family level, no clear profile emerged of who was more likely to take advantage of or actively seek out PK-3 options. Interestingly, exposure to PK-3 sustainability practices was lower for Latino children but greater for children whose mothers had greater English fluency. Language and cultural barriers can make interactions with school personnel challenging, and this may be a particular struggle for the Latino families in our sample, 56% of whom include at least one foreign-born parent (Crosnoe, 2006; Suarez-Orozco, 2001). It

may be that Latino parents with greater English fluency are better able to work within the educational system to identify the resources, such as PK-3 practices, that could benefit their children. Given that immigrant children and children from immigrant families are a demographic targeted by the PK-3 model (Sadowsky, 2006), such programs may need to implement strategies that explicitly promote the inclusion of Latino families facing greater language barriers, through having bilingual program staff or provision of recruitment materials in multiple languages.

Despite variation in who is exposed to PK-3 sustainability practices, we found that children who experienced more PK-3 sustainability practices had higher reading achievement at the end of kindergarten, even after controlling for school and family selection factors. That reading achievement was particularly influenced by PK-3 exposure is not surprising, given that several practices of PK-3 included in our sustainability measure—time spent on reading (Guthrie, Schafer, & Huang, 2001), small class sizes (Nye, Hedges, & Konstantopoulos, 2000), and highly-certified teachers (Chatterji, 2006)—are independently linked to children's literacy skills. Such links are a purposeful piece of the PK-3 model, as they are viewed as integral to a systematic model that promotes early school success during a critical time of development (Reynolds et al., 2010). Why PK-3 exposure was unrelated to children's math achievement is unclear, given that PK-3 sustainability practices such as class size and teacher certification are also related to children's mathematics performance (Finn, Gerber, Achilles, & Boyd-Zaharias, 2001; Kim, Chang, & Kim, 2011). Previous research on children's early numeracy skills has identified benefits of cooperative learning strategies and greater time on mathematics instruction (Georges, 2009; Slavin & Lake, 2008), both of which are consistent with the principles of PK-3. As such, the PK-3 model may benefit from more explicitly integrating these into its framework.

In the socioemotional domain, exposure to PK-3 sustainability practices also was significantly linked to children's interpersonal skills, even after selection factors were integrated into the model. However, similar effects were not observed for children's externalizing behaviors, less surprising given the limited evidence that having a highly educated teacher—one practice promoted by the PK-3 model—is associated with social competence but not problem behaviors (Mashburn et al., 2008). That greater exposure to PK-3 practices was linked to stronger interpersonal skills is promising in that interpersonal skills are more strongly associated with young people's later academic performance (Arnold, Kupersmidt, Voegler-Lee, & Marshall, 2012; Hindman, Skibbe, Miller, & Zimmerman, 2010), but, future research should delve further into the socioemotional consequences of PK-3 sustainability practices.

Finally, the current study found that the benefits of PK-3 sustainability practices did not vary by family or school assets or constraints. In essence, all children, regardless of family background or school characteristics, tended to benefit both academically and socioemotionally from greater exposure to PK-3 practices. This is contrary to both of our competing hypotheses; the compensatory hypothesis posited that the most vulnerable students would benefit most, as they had the greatest ground to make up (Sameroff & Chandler, 1975; Weiland & Yoshikawa, 2013), whereas the accumulated advantage hypothesis suggested that students with more family and school assets would benefit more,

as they were best positioned to take advantage of the benefits of PK-3 sustainability practices (e.g., Ceci & Papierno, 2005; Lareau, 2004). The universal benefits of PK-3 practices however, are consistent with evaluations of universal pre-K and some state-funded preschools that show consistent benefits for students regardless of race/ethnicity or SES (Gormley, Gayer, Phillips, & Dawson, 2005; Howes et al., 2008). Thus, although PK-3 typically targets children and families in greatest need, our work provides support for the implementation of universal PK-3 efforts.

Although the current study provides insights into the benefits of PK-3 using a more comprehensive methodology that takes into account a host of family and school selection factors, the study is not without limitations. First, one concern about our models is that the effect sizes for the effects of PK-3 sustainability practices on reading achievement and interpersonal skills were relatively small. In comparing effect sizes, however, we draw the reader's attention to Table 3 and the effects of sustainability practices as compared with parent education, a robust predictor of children's educational success and, to a lesser extent, socioemotional well-being (Bradley & Corwyn, 2002). We found that PK-3 sustainability practices had about half the association of that for parent education for reading achievement ($\beta$ = .07 versus .15), and the effect size of sustainability practices was double that of parent education for interpersonal skills ($\beta$ = .07 versus .03). Moreover, in comparing the effect sizes for PK-3 sustainability practices to the other family and school assets and constraints, the effect sizes were almost uniformly comparable. These comparisons highlight the nonnegligible associations between PK-3 sustainability practices and children's academic performance and socioemotional well-being.

Second, ECLS-B data do not provide information regarding the quality of PK-3 implementation, which adds variability to our PK-3 exposure measure that we cannot model out. Along similar lines, we could not determine with the current data whether there are discernible differences in children's developmental outcomes in schools that explicitly used the PK-3 model versus those that simply implemented sustainability practices consistent with PK-3. Fidelity of PK-3 implementation and explicit adoption of the PK-3 model could plausibly better support the development of young children, but this hypothesis needs to be tested with data not available in ECLS-B. In addition, although we took advantage of the longitudinal nature of ECLS-B, some measures were included at the same wave, potentially contributing to simultaneity bias. Relatedly, although our models implemented temporal sequencing and controlled for a host of potential family and school confounds that were theoretically relevant and could be measured in ECLS-B, potential threats to causal attribution posed by unknown or unobservable confounds do exist. As such, we cannot make definitive conclusions about causal relationships. Our contribution lies in highlighting the promising nature of sustainability practices for children's academic performance and socioemotional well-being. More work, both observational and experimental, is needed to verify the benefits of PK-3 for children's growth and development.

Finally, the results reported here pertain to the developmental outcomes of children in kindergarten who had been exposed to PK-3 sustainability practices for two years at most. Although understanding factors that promote children's transition to formal schooling are key given the effects of this critical transition throughout the early life course (Entwisle et

al., 2005), whether this exposure (or continued exposure) yielded benefits that persisted as children moved through the K-12 educational system is unknown and untestable with ECLS-B data. We know that fade-out effects are common for many PK-only interventions (Kauertz, 2006), but lasting benefits for more intensive PK programs (Nores, Belfield, Barnett, & Schweinhart, 2005; Ramey et al., 2000) suggest that PK-3 benefits may similarly persist across the life course. Whether this is true is something that only time and more rigorous experimental studies will tell.

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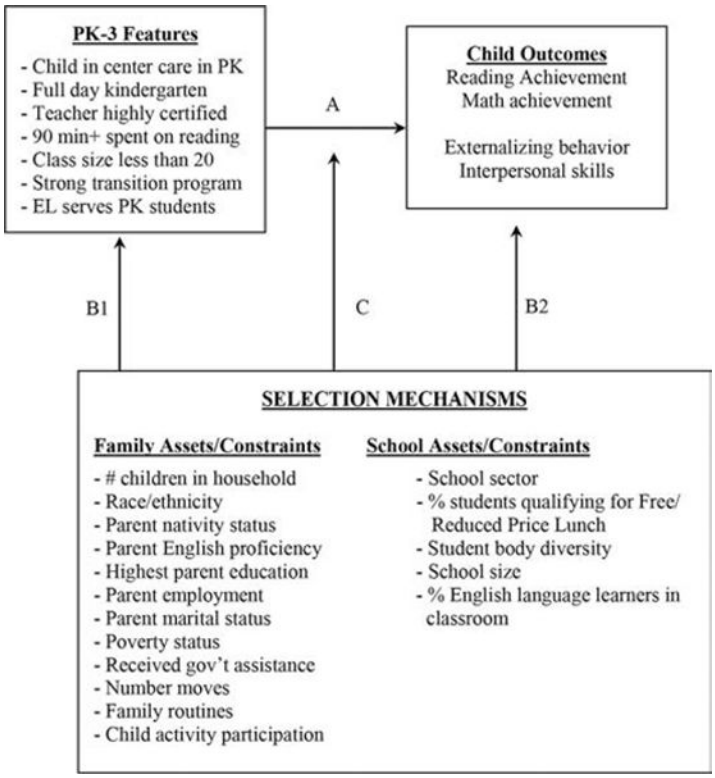


**Figure 1.**

Conceptual model for exploring effects of PK-3 for children's outcomes, taking into account issues of selection factors related to family and school assets and constraints.

**Table 1**

Descriptive statistics for study variables.

| Variable | *N* | % | *M* | *SD* | Range |
|---|---|---|---|---|---|
| PK-3 sustainability practices[a] | | | | | |
| Child enrolled in center care at age 4 | 5050 | 27.0 | | | |
| Child enrolled in full-day K program | 5000 | 75.1 | | | |
| K teacher has highest level of certification | 5050 | 88.0 | | | |
| # of reading instruction minutes/day in K | 4500 | | 94.34 | 50.84 | 0–600 |
| K class size | 4950 | | 19.79 | 4.37 | 2–49 |
| Number K transition activities | 4900 | | 3.21 | 1.11 | 0–7 |
| Child's elementary school includes PK | 4500 | 52.1 | | | |
| Total number of PK-3 practices | 5050 | | 4.25 | 1.38 | 1–7 |
| Child outcomes | | | | | |
| Reading achievement | 5050 | | 39.51 | 15.48 | 12.39–82.48 |
| Mathematics achievement | 5050 | | 40.70 | 10.95 | 11.10–69.69 |
| Externalizing behaviors | 5050 | | 1.97 | 0.81 | 1–5 |
| Interpersonal skills | 5050 | | 3.82 | 0.71 | 1–5 |
| Family assets/constraints—demographic factors | | | | | |
| White | 5050 | 42.7 | | | |
| African American | 5050 | 14.4 | | | |
| Latino/a | 5050 | 19.6 | | | |
| Asian American | 5050 | 11.5 | | | |
| Other | 5050 | 11.9 | | | |
| Mother foreign born | 5050 | 24.3 | | | |
| Father foreign born | 3850 | 30.0 | | | |
| Family assets/constraints—socioeconomic factors | | | | | |
| Not a two-parent family | 4800 | 28.5 | | | |
| Number children in household | 5050 | | 2.52 | 1.16 | 1–10 |
| Highest parent education | 5050 | | 5.05 | 2.05 | 1–9 |
| Mother not employed full-time | 5000 | 57.5 | | | |
| Father not employed full-time | 4000 | 12.3 | | | |

| Variable | *N* | % | *M* | *SD* | Range |
|---|---|---|---|---|---|
| Family poverty status | 5050 | 45.0 | | | |
| Family receives government assistance | 5050 | 46.8 | | | |
| Family assets/constraints—processes/circumstances | | | | | |
| Had residential move in past 2 years | 5050 | 45.2 | | | |
| Child involvement in out-of-school activities | 5050 | | 0.83 | 1.16 | 0–7 |
| Family routine | 5050 | | 4.24 | 0.97 | 0–5 |
| Mother English proficiency | 4400 | | 3.72 | 0.71 | 1–4 |
| Child low birth weight | 5050 | 25.2 | | | |
| Child health | 5050 | | 4.35 | 0.80 | 1–5 |
| School assets/constraints in transition experiences [a] | | | | | |
| Student body race/ethnic diversity | 4450 | | 0.38 | 0.21 | 0–1 |
| School size | 4450 | | 545.65 | 243.00 | 12–2080 |
| School assets/constraints in PK-3 adoption | | | | | |
| School sector (public) | 5050 | 88.0 | | | |
| Percent students receiving FRPL | 4350 | | 46.78 | 28.95 | 0–99.70 |
| Percent ELL students in K classroom | 4750 | | 10.56 | 17.94 | 0–96.67 |

*Note.* Total possible $n = 5{,}050$. All *Ns* rounded to the nearest 50 per NCES requirements. All child/family characteristics measured at last child preschool age. All other variables measured when the child was in kindergarten. FRPL = Free- or Reduced-Price Lunch; ELL = English language learner.

[a] Descriptive statistics for PK-3 practices and school characteristics reported at the individual (child) level.

**Table 2**

Relations between PK-3 sustainability practices exposure and children's developmental outcomes.

| | PK-3 Practices | | Reading Achievement | | Math Achievement | | Externalizing Behaviors | | Interpersonal Skills | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Measure** | ***β*** | ***SE*** | ***β*** | ***SE*** | ***β*** | ***SE*** | ***β*** | ***SE*** | ***β*** | ***SE*** |
| Total number PK-3 practices | – | – | .07** | .02 | .02 | .02 | .04† | .02 | .06* | .02 |
| | | | | Covariates | | | | | | |
| Child is female | −.01 | .02 | .04* | .02 | −.02 | .02 | −.25*** | .02 | .16*** | .02 |
| Child age | −.00 | .03 | .01 | .02 | .02 | .02 | −.00 | .02 | −.02 | .02 |
| Child temperament | −.02 | .02 | −.02 | .02 | −.05** | .02 | .00 | .02 | −.02 | .01 |
| Child early cognitive score | .00 | .02 | .29*** | .02 | .38*** | .02 | −.14*** | .02 | .19*** | .02 |
| Residence in urban area | −.05 | .03 | .06** | .02 | .08*** | .02 | −.02 | .03 | .01 | .03 |
| Residence in rural area | .01 | .03 | −.03 | .02 | −.00 | .02 | .00 | .03 | .01 | .03 |
| Residence in Northeast | −.15*** | .03 | −.01 | .02 | .03 | .02 | −.03 | .02 | .01 | .02 |
| Residence in West | −.41*** | .02 | −.03 | .02 | −.00 | .02 | −.04† | .02 | .01 | .03 |
| Residence in Midwest | −.24*** | .02 | −.01 | .02 | .05** | .02 | −.02 | .02 | .02 | .02 |
| Year attended kindergarten (2006) | −.01 | .02 | .37*** | .02 | .31*** | .02 | .09*** | .02 | −.10*** | .02 |

*Note.* All covariates measured when the child was in kindergarten except child temperament (age 9 months) and early cognitive scores (age 2). The standardized coefficients (*β*) are adjusted for sample weight (WKR0). *N* = 5,050.

† $p < .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

**Table 3**

Relations between PK-3 exposure and children's developmental outcomes, accounting for selection mechanisms (spuriousness).

| | PK-3 Practices | | Reading Achievement | | Math Achievement | | Externalizing Behaviors | | Interpersonal Skills | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Measure** | ***β*** | ***SE*** | ***β*** | ***SE*** | ***β*** | ***SE*** | ***β*** | ***SE*** | ***β*** | ***SE*** |
| Total number PK-3 practices | – | – | .07** | .02 | .02 | .02 | .03 | .02 | .07** | .02 |
| Family assets/constraints—demographics | | | | | | | | | | |
| African American | −.03 | .03 | .01 | .02 | −.03† | .02 | .00 | .02 | .03 | .02 |
| Latino/a | −.07* | .03 | −.01 | .03 | −.05* | .03 | −.05† | .03 | .04 | .03 |
| Asian American | −.01 | .02 | .08*** | .01 | .06*** | .01 | −.05*** | .01 | .00 | .02 |
| Other | .01 | .02 | .01 | .02 | −.01 | .01 | .01 | .02 | −.01 | .02 |
| Mother born outside U.S. | .06† | .04 | −.03 | .03 | −.02 | .03 | .00 | .03 | .00 | .03 |
| Father born outside U.S. | .03 | .04 | .03 | .03 | .03 | .03 | −.02 | .03 | .02 | .03 |
| Family assets/constraints—socioeconomic circumstances | | | | | | | | | | |
| Non-two-parent family | .03 | .03 | −.03 | .02 | −.01 | .02 | .07** | .03 | −.05* | .03 |
| Number children in household | −.00 | .02 | −.06*** | .02 | −.03* | .02 | −.04* | .02 | −.01 | .02 |
| Highest parent education | .01 | .03 | .16*** | .02 | .14*** | .02 | −.05* | .03 | .03 | .03 |
| Mother unemployed | −.02 | .02 | −.02 | .02 | −.02 | .02 | −.08*** | .02 | .04† | .02 |
| Father unemployed | .01 | .02 | −.03† | .02 | −.04* | .02 | .01 | .02 | −.00 | .02 |
| Family poverty | −.02 | .03 | .00 | .03 | −.02 | .03 | .01 | .03 | −.01 | .03 |
| Receive government assistance | −.01 | .03 | −.09*** | .03 | −.10*** | .03 | .12*** | .03 | −.12*** | .03 |
| Family assets/constraints—processes/circumstances | | | | | | | | | | |
| Residential move | −.01 | .02 | .02 | .02 | .04* | .02 | .02 | .02 | .03 | .02 |
| Out-of-school activities | −.02 | .02 | .05** | .02 | .07*** | .02 | −.02 | .02 | .03 | .02 |
| Family routine | .03 | .02 | .05*** | .02 | .06*** | .02 | −.03 | .02 | .04* | .02 |
| Mother English proficiency | .13*** | .03 | .03 | .03 | .01 | .03 | .08* | .03 | −.04 | .03 |
| Child low birth weight | .01 | .01 | −.01 | .01 | −.03* | .01 | .01 | .01 | .00 | .01 |
| Child health | −.02 | .02 | .04* | .02 | .04* | .02 | −.03 | .02 | .04† | .02 |
| School assets/constraints in transition experiences | | | | | | | | | | |

| | PK-3 Practices | | Reading Achievement | | Math Achievement | | Externalizing Behaviors | | Interpersonal Skills | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Measure** | ***β*** | ***SE*** | ***β*** | ***SE*** | ***β*** | ***SE*** | ***β*** | ***SE*** | ***β*** | ***SE*** |
| Student race/ethnic diversity | .02 | .02 | −.01 | .02 | −.02 | .02 | .02 | .02 | −.05 * | .02 |
| School size | −.08 *** | .02 | .05 ** | .01 | .03 † | .02 | −.01 | .02 | .02 | .02 |
| School assets/constraints in PK-3 adoption | | | | | | | | | | |
| School sector (public) | −.03 | .04 | −.04 * | .02 | −.04 * | .02 | .01 | .02 | −.04 * | .02 |
| % students receiving FRPL | .10 ** | .03 | −.05 * | .02 | −.07 ** | .02 | −.10 *** | .03 | .12 *** | .03 |
| % ELLs in K classroom | .02 | .03 | .03 | .02 | .02 | .02 | .05 † | .03 | −.03 | .03 |

*Note.* All family assets/constraints measured at the preschool wave (i.e., prior to kindergarten). All school assets/constraints measured when the child was in kindergarten. Results control for all covariates, and the standardized coefficients (*β*) are adjusted for sample weight (WKR0). FRPL = Free- or Reduced-Price Lunch; ELL = English language learner. All models control for the full set of covariates. $N$ = 5,050.

† $p < .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.