Effectiveness of Preschool and Kindergarten in Promoting and Maintaining Early Literacy Skills[1]

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Introduction

Decades of research indicate that high quality early childhood programs can result in sizeable short-term benefits in young children's skills in the areas of language, phonological awareness, and print knowledge—skills that are predictive of how well children will learn to read once they are exposed to formal reading instruction in kindergarten (e.g., Lonigan, Burgess, & Anthony, 2000; Phillips, Gormley, & Anderson, 2016). A meta-analysis by Li et al. (2016, for example, found the average effect size of preschool for print concepts to be .54 and for early reading skills to be .44, with somewhat smaller effect sizes found for more broadband skills such as vocabulary (cited in Yoshikawa, Weiland, & Brooks-Gunn, 2016).

While there is empirical evidence that some benefits from preschool can persist into adulthood (e.g., Campbell et al., 2012; Schweinhart, 2005), there is marked variation in findings of lasting effects of preschool. This is particularly the case with respect to initial academic benefits. A robust body of research shows that initial gains in academic skills tend to **dissipate** as children progress through the primary grades, with the decline steepest in the first two years after a preschool program ends (Jenkins et al., 2011; Phillips et al., 2017; Yoshikawa et al., 2016).

Recent research has focused on the importance of subsequent educational environments in sustaining the positive preschool effects (e.g., Bailey, Duncan, Odgers, & Yu, 2017; Phillips et al., 2017). Kindergarten, for example, can play a **complementary** role in enhancing the benefits of preschool and/or a **compensatory** role in enriching the skills of children most at risk.

The purpose of this study was to examine the child variation and programmatic differences in the growth of early literacy skills for preschool children and how these literacy skills were maintained through kindergarten.

Research questions were:

1. What is the linkage between children's early literacy skills at the end of preschool and their performance on early literacy skills at the beginning of kindergarten?
2. Are there programmatic differences in growth of early literacy skills during preschool?
3. Are there programmatic differences in the degree to which kindergarten programs (i.e., kindergarten context) maintain and increase early literacy skills acquired in preschool?

Method

Participants

Participants were 604 preschool children in their pre-kindergarten year who were selected from a pre-existing data set of children who had preschool and kindergarten data entered into Dynamic Measurement Group's data management system for the 2015–2016 and 2016–2017 school years. Children were selected who had complete data at the beginning, middle, and end of the year in both preschool and kindergarten.

Children were from 50 preschool classrooms in 26 schools from 8 different states representing 3 census regions of the United States (West, Midwest, and South). The schools were located in rural, suburban, midsize, and large cities. Demographic data from the National Center for Education Statistics (NCES) was available for 23 of the 26 schools. Based on available NCES data from the 2015–2016 school year, 67% of the children attending these schools qualified for free/reduced lunch. With respect to race, 32% of the school children were White, 55% Hispanic, 5% Black, 3% Asian, 1% American Indian/Alaskan Native, less than 1% Native Hawaiian/Pacific Islander, and 3% Multiracial. From preschool, the children dispersed into 105 kindergarten classrooms in 42 schools. Based on available NCES data, 62% of the children attending these schools qualified for free/reduced lunch. With respect to race, 44% of the children were White, 42% Hispanic, 6% Black, 3% Asian, 1% American Indian/Native Alaskan, less than 1% Native Hawaiian/Pacific Islander, and 4% Multiracial.

Measures

Preschool Early Literacy Indicators (PELI®, Kaminski, Abbott, Bravo-Aquayo, & Good, 2018). The PELI is a screening and progress monitoring assessment of early literacy and language skills for preschool children. The PELI Composite Score is based

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on activities assessing phonological awareness, alphabet knowledge, vocabulary and oral language, and comprehension within a storybook format. A series of studies on the PELI conducted since 2009-10 provides strong evidence of its reliability and validity. Inter-rater reliability of various PELI forms ranges from .90 to .98. Alternate-form reliability of the PELI Composite score ranges from .85 to .92. Criterion-related validity of the PELI Composite Score with early literacy composites consisting of DIBELS Next, the CELF, and the PPVT range from .65 to .85. The PELI has empirically-derived, criterion-referenced benchmark goals that provide guidance about expected levels of performance and progress. PELI benchmark goals can be used both for identifying children who may need additional instructional support and as a frame of reference for evaluating the adequacy of a child's progress (Kaminski, Abbott, Aguayo, Latimer, & Good, 2014).

Dynamic Indicators of Basic Early Literacy Skills Next Edition (DIBELS Next®, Good & Kaminski, 2011). The Dynamic Indicators of Basic Early Literacy Skills (DIBELS Next) are a set of assessments used for universal screening and progress monitoring of literacy skills. DIBELS Next assessments are brief, repeatable measures with multiple alternate forms available for grades K–6. Across the kindergarten year there are four one-minute DIBELS Next measures: First Sound Fluency, Letter Naming Fluency, Phoneme Segmentation Fluency, and Nonsense Word Fluency. Each skill indicator is predictive of future reading success and provides a target for intervention or instruction. DIBELS Next measures are valid and reliable (for details see Good, Kaminski, Dewey, Wallin, Powell-Smith, & Latimer, 2013).

Data Collection

The data is a preexisting set of PELI and DIBELS Next data entered into the Dynamic Measurement Group data management system. Data for the preschool sample include children who had complete data at the beginning, middle, and end of the year in both preschool and kindergarten.

Data Analysis

The first research question was addressed with correlation and multiple regression analyses predicting kindergarten early literacy skills on DIBELS Next from preschool early literacy skills on PELI. With this analysis we were able to identify the magnitude of the relationship and specify a regression equation predicting early literacy skills at kindergarten entry.

The second research question was addressed with hierarchical linear modeling (HLM) analysis (preschool model). HLM was used to fit a child-level growth trajectory representing each child's progress during their preschool year. The PELI intercept and slope were computed with ordinary least squares regression with beginning of year coded as 1, middle of year as 2, and end of year as 3. The level 2 predictor was the child's preschool program. In this way we were able to examine typical early literacy progress in preschool and evaluate the extent to which the child's preschool program enhanced or suppressed that progress.

The third research question also was examined with HLM (kindergarten model) with individual child progress on the DIBELS Next Research Lexile as the level 1 model, and with three predictor variables in the level 2 model: (a) the child's intercept (initial preschool skill level) from the preschool model of PELI progress, and (b) the child's slope of progress from the preschool model, and (c) the child's kindergarten classroom context. The slope and intercept from the preschool model were used to predict the child's initial skills at the beginning of kindergarten, and their kindergarten context was used as a predictor of their progress in kindergarten. Research Lexile is a transformation of the DIBELS® Composite Score for each time of year that places all measures on the same scale (Metametrics, 2014).

Kindergarten context was computed using DIBELS Next Pathways of Progress™ (Good, Powell-Smith, & Dewey, 2015). An indication of the kindergarten instructional context was obtained by examining the progress of other children in the kindergarten classroom who were not being followed from preschool (i.e., context children). The 604 preschool children in 50 preschool classrooms who were followed into kindergarten dispersed to 105 classrooms with 86 of those classrooms having at least 10 context children with complete data to provide an indicator of kindergarten instructional context. Kindergarten context was then computed as the proportion of context children who made typical progress or better using the DIBELS Next Pathways of Progress. A classroom was considered a high performing kindergarten context if 77 percent of context children were making typical progress or better. A classroom was an average kindergarten context if 57 percent of context children made typical progress or better. A classroom was a low performing kindergarten context if 37 percent of context children were making typical progress or better.

In this way we were able to examine the extent to which preschool early literacy skills predicted a child's skills entering kindergarten and examine their progress when they are exposed to formal reading instruction in kindergarten. We also were able to examine the impact of kindergarten classroom context in maintaining adequate reading progress.

Results

Descriptive statistics for analyses are provided in Table 1. Children began preschool with language and early literacy skills in the average range (38th to 45th percentile) as measured by the Preschool Early Literacy Indicators (PELI). Their skills on the PELI continued to be in the average range at the end of preschool compared to a national sample of over 5,500 preschool children with complete data in the Dynamic Measurement Group data system for the 2013–2015 school years. At the beginning of the kindergarten year, their early literacy skills as measured by DIBELS Next were in the high average range–at the 75th percentile–compared to national norms for over 52,000 children with data in the Dynamic Measurement Group data system.

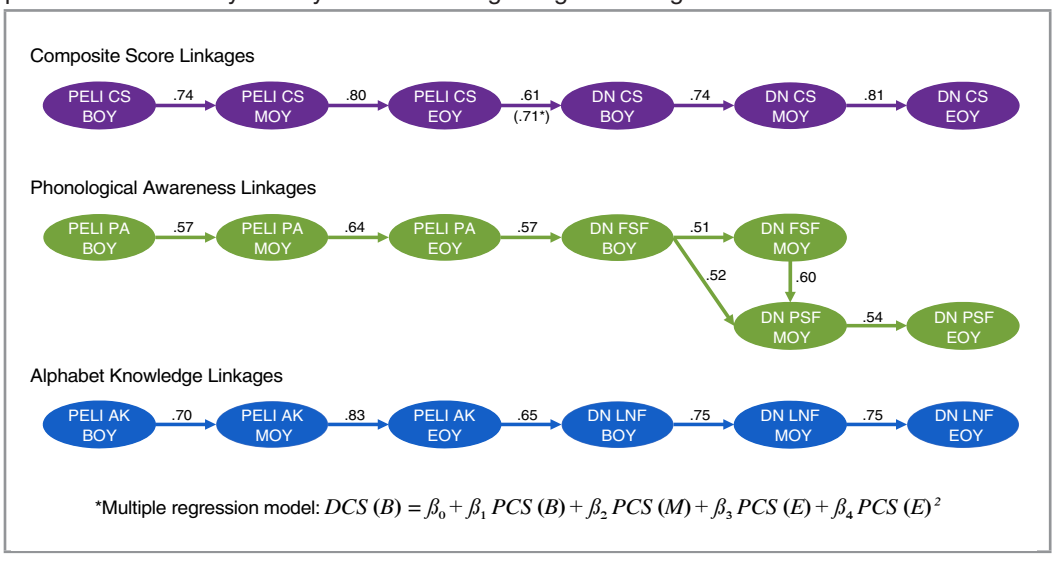
Table 1. Descriptive Statistics for Preschool PELI and Kindergarten DIBELS Measures

Measure	*N*	*Mean*	*SD*	*Percentile*
BOY PELI Composite Score	604	172.79	71.11	45th
MOY PELI Composite Score	604	218.37	50.22	47th
EOY PELI Composite Score	604	246.81	42.32	50th
PELI Composite Intercept	604	138.64	89.78	
PELI Composite Slope	604	37.01	26.49	
BOY DIBELS Composite Score	604	53.11	28.46	75th
BOY DIBELS Research Lexile	604	-805.53	342.15	
MOY DIBELS Composite Score	604	168.29	54.56	70th
MOY DIBELS Research Lexile	604	-329.05	323.35	
EOY DIBELS Composite Score	604	159.49	47.28	67th
EOY DIBELS Research Lexile	604	-99.67	324.85	
Kindergarten context	427	0.57	0.20	

Note. BOY is beginning of year, MOY is middle of year, and EOY is end of year. Data represents kindergarten students form the 2016–2017 school year. Kindergarten context is the proportion of classmates with typical Pathway of Progress or better.

Research Question 1. Results of the correlation and multiple regression analyses for the PELI Composite Score (PCS), the PELI Alphabet Knowledge subtest, and the PELI Phonological Awareness subtest predicting to children's kindergarten DIBELS Next are shown in Figure 1. For each time period across preschool and kindergarten, the earlier skill was correlated with the later skill. For the composite scores, correlations generally ranged from .70 to .80 with the exception of an end-of-preschool to beginning-of-kindergarten correlation of .61. A multiple regression analysis was also used to predict the beginning-of-kindergarten composite score based on all of the preschool composite scores, plus a quadratic term for the end-of-preschool measure due to ceiling effects.

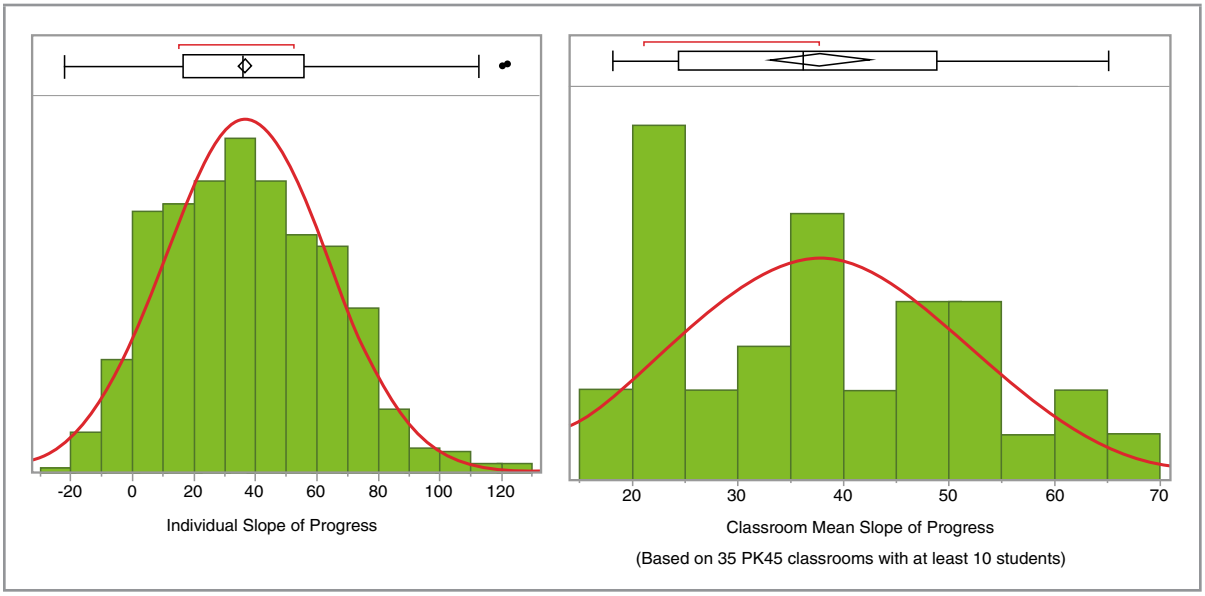
Figure 1. Linkage between children's early literacy skills at the end of preschool and their performance on early literacy skills at the beginning of kindergarten



Note. PELI CS = PELI Composite Score; DN CS = DIBELS Next Composite Score; PELI PA = PELI Phonologial Awareness; DN FSF = DIBELS Next First Sound Fluency; DN PSF = DIBELS Next Phoneme Segmentation Fluency; PELI AK = PELI Alphabet Knowledge; DN LNF = DIBELS Next Letter Naming Fluency

Research Question 2. Individual and programmatic differences in growth of early literacy skills in preschool are presented in Figure 2. Individual differences in growth in preschool were substantial with some children displaying minimal or even negative growth, and other children growing by 100 points or more between beginning and middle and between middle and end of preschool. Programmatic effects were also substantial. In some classrooms with at least 10 children for comparison, children progressed only at about 20 points per time period. In other classrooms, the mean growth was 60 or 70 points.

Figure 2. Individual and Programmatic Differences in Growth of Early Literacy Skills in Preschool



Research Question 3. The HLM kindergarten model is specified in Equation 1. The results of the HLM analysis are summarized in Tables 2 and 3. The preschool intercept and slope were significant predictors of a child's initial skills in kindergarten. The child's kindergarten context was a significant predictor of their kindergarten progress.

Equation 1

Kindergarten HLM Model

Level 1, individual student progress model

$$RLexile_{ti} = \pi_{0i} + \pi_{1i}*TOY_{ti} + \pi_{2i}*TOY^2_{ti} + e_{ti}$$

Where:

$RLexile_{ti}$ = Research Lexile for student *i* at time *t*

TOY_{ti} = time of year (1 = beginning, 2 = middle, 3 = end)

Level 2, between student model of progress

$$\pi_{0i} = \beta_{00} + \beta_{01}*PK45INT_i + \beta_{02}*PK45SLP_i + r_{0i}$$

$$\pi_{1i} = \beta_{10} + \beta_{11}*PATH345C_i + r_{1i}$$

$$\pi_{2i} = \beta_{20} + \beta_{21}*PATH345C_i + r_{2i}$$

Where:

$PK45INT_i$ = Preschool intercept (initial skills) for student *i* from the preschool model of growth.

$PK45SLP_i$ = Preschool slope (rate of progress) for student *i* from the preschool model of growth.

$PATH345C_i$ = Proportion of kindergarten context students making at least typical progress on DIBELS Next.

Equation 1. Kindergarten hierarchical linear model of kindergarten progress based on (a) preschool intercept, (b) preschool slope of progress, and (c) kindergarten instructional context.

Table 2. Hierarchical Linear Model Estimates of Fixed Effects for the Kindergarten Model					
HLM fixed effect	Coefficient	Standard error	*t*-ratio	*df*	*p*
For intercept, π_0					
β_{00}	-1,933.13	68.14	-28.37	424	< .001
β_{01} (PK45INT)	4.19	0.25	16.52	424	< .001
β_{02} (PK45SLP)	8.50	0.86	9.87	424	< .001
For TOY slope, π_1					
β_{10}	275.14	15.51	17.74	425	< .001
β_{11} (Path345C)	149.09	24.63	6.05	425	< .001
For TOY^2 slope, π_2					
β_{20}	-71.28	25.86	-2.76	425	.006
β_{21} (Path345C)	-98.96	42.90	-2.31	425	.022

Table 3. Hierarchical Linear Model Estimates of Variance Components for the Kindergarten Model					
Random effect	Standard deviation	Variance component	*df*	χ^2	*p*
r_0	225.77	50,972.76	424	841.61	< .001
TOY slope, r_1	100.83	10,167.58	425	923.70	< .001
TOY^2 slope, r_2	69.82	4,874.18	425	503.74	.005
level-1, *e*	131.88	17,391.86			

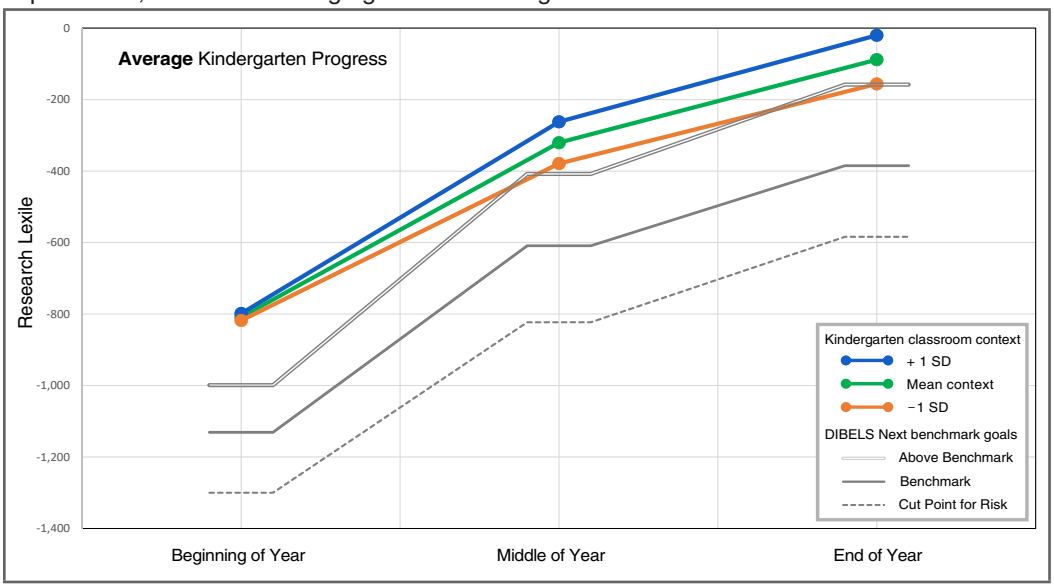
Figures 3 to 6 present 4 scenarios of this HLM kindergarten model illustrating different patterns of preschool and kindergarten progress. The blue line on the graph represent the progress of students in classrooms considered a high performing kindergarten context. The green line represents an average performing kindergarten context, and the orange is a low performing kindergarten context.

The gray lines represent the DIBELS Next cut point for risk (dashed line), benchmark goal (solid line), and above-benchmark scores (double line) for each time of year. DIBELS Next goals and cut points are based on research that examined the predictive utility of a score on a measure at a particular point in time, with respect to later DIBELS measures and external measures of reading proficiency and achievement. (Additional information about the benchmark goals research is included in the *DIBELS Next Technical Manual*, available from http://dibels.org/.) The dashed gray line represents the cut point for risk. For students who score below the cut point for risk, the overall likelihood of achieving subsequent early literacy/reading goals is low, approximately 10% to 20%. The solid gray line represents the benchmark goal. For students who score at the benchmark goal, the overall likelihood of achieving subsequent reading goals and scoring at or above the 40th percentile on any high-quality reading outcome measures is approximately 70% to 85%. The double gray line (top) represents the DIBELS Next Above Benchmark level. In the Above Benchmark range, the overall likelihood of achieving subsequent early literacy and/or reading goals is 90% to 99%.

Scenario 1: ***Average*** *Kindergarten Progress.* Figure 3 portrays the expected progress in kindergarten for children who: (a) entered preschool with average skills (i.e., at the mean for this sample), (b) made average progress in preschool, and (c) continued to make average progress in kindergarten. The average progress scenario provides a baseline or reference to facilitate interpretation of other scenarios. Preschool children making average progress in preschool and kindergarten would be expected to enter kindergarten with scores in the Above Benchmark range (above the 60th percentile on DIBELS Next) and would be expected to maintain skills above the 60th percentile throughout kindergarten.

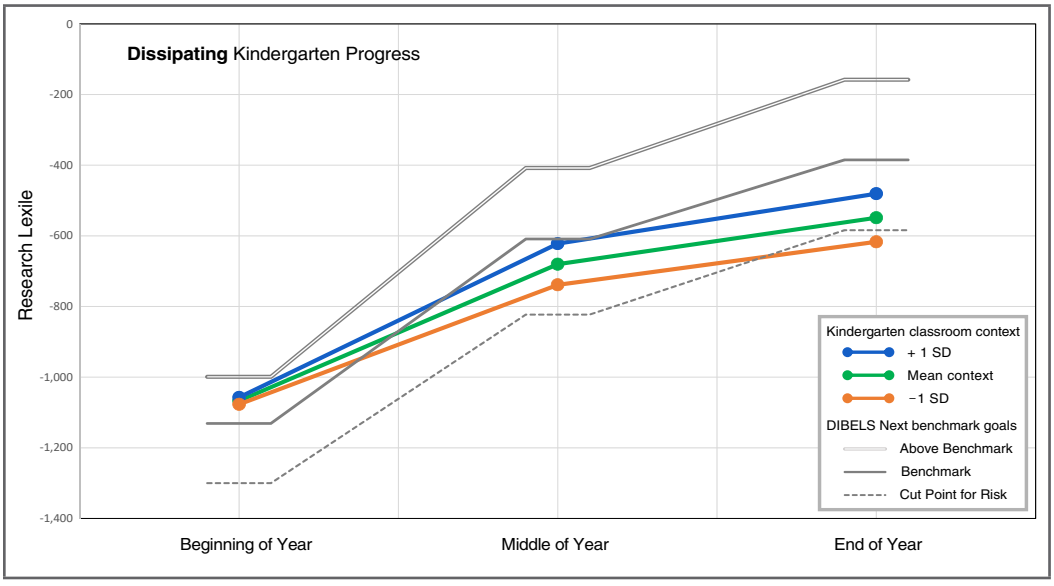
Figure 3 also illustrates the effects of kindergarten context. Children in a high performing kindergarten context (blue line) generally maintained their Above Benchmark status with little loss in standing. Children in an average kindergarten context (green line) experienced some loss in standing but were still above benchmark. Children in a low performing kindergarten context experienced substantial loss in standing and were barely at the Above Benchmark level.

Figure 3. Scenario 1: Children who enter preschool with average skills, make average growth in preschool, and make average growth in kindergarten.



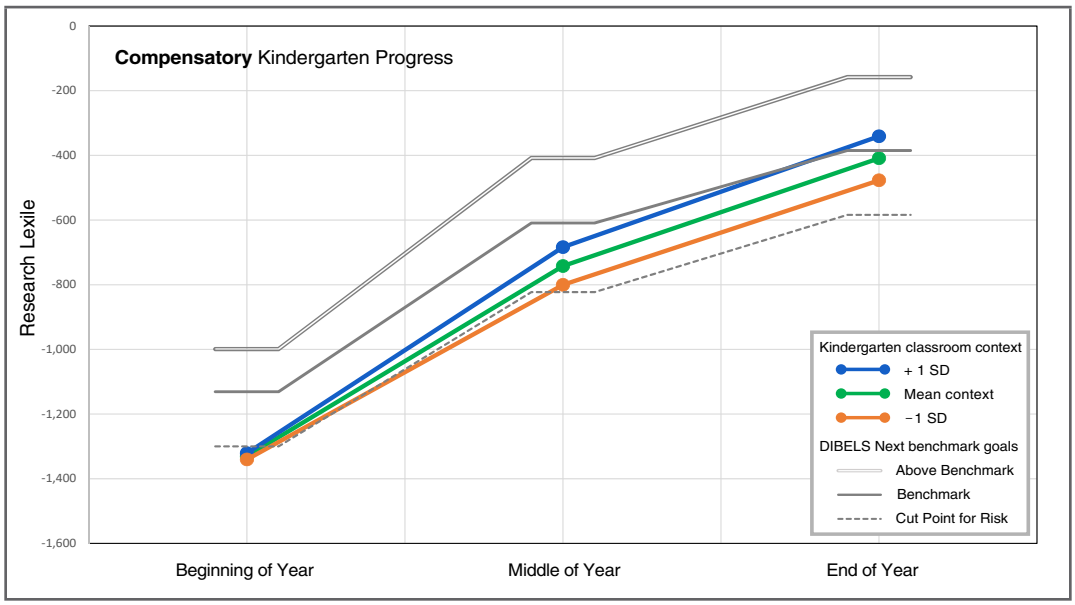
Scenario 2: ***Dissipating*** *Kindergarten Progress.* Figure 4 shows the predicted progress for children who enter preschool with very low skills (below the 17th percentile for this sample) and who make good progress in preschool but who make low progress in kindergarten. These children enter kindergarten with skills in the at the benchmark goal. However, by the end of the year their skills are below the benchmark goal. Children in the low performing kindergarten contexts would be expected to end the year with skills below the cut point for risk. This pattern corresponds to dissipating or "fadeout" effects from preschool to the end of kindergarten.

Figure 4. Scenario 2: Expected progress of children who entered preschool with low skills, made high growth in preschool, but made low growth in kindergarten.



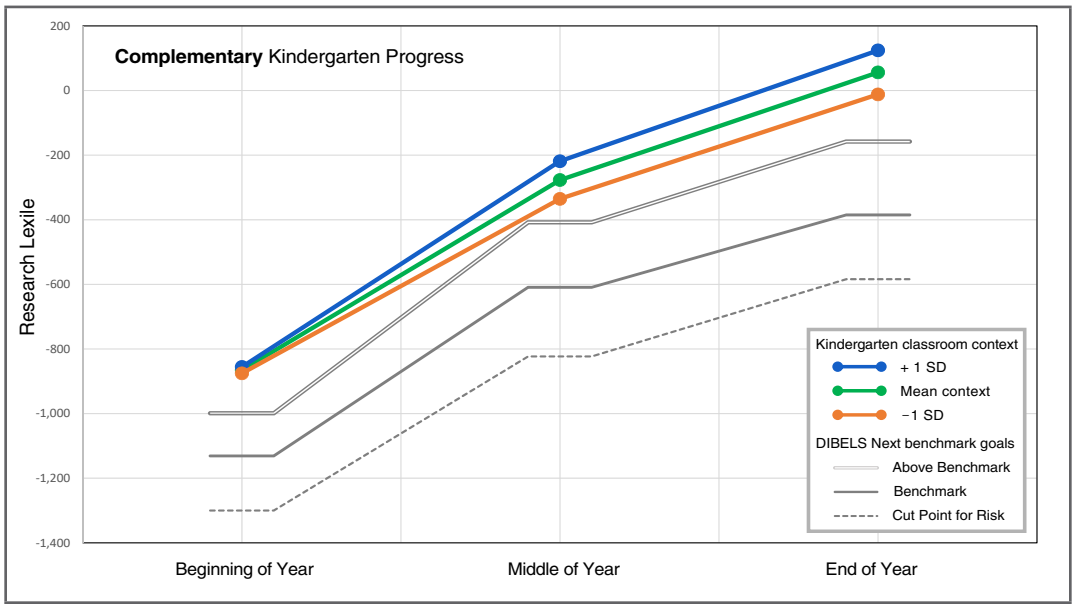
Scenario 3: ***Compensatory*** *Kindergarten Progress.* Figure 5 illustrates the potential compensatory effects of kindergarten. In this scenario, children enter preschool with low skills (below the 17th percentile) and make low progress in preschool. These children would be expected to enter kindergarten with scores below the cut point for risk. If they make high growth in kindergarten and are in a high performing kindergarten context, they would be expected to achieve scores above the benchmark goal by the end of the year. Children in an average performing kindergarten context would achieve scores close to the benchmark goal, and even the children in a low performing kindergarten context would have scores approaching the benchmark goal.

Figure 5. Scenario 3: Fitted pattern for children entering preschool with low skills, who make low growth in preschool, and who makes high, **compensatory** growth in kindergarten.



Scenario 4: ***Complementary*** *Kindergarten Progress.* Figure 6 depicts the complementary role of kindergarten in sustaining the benefits of effective preschool. In this model, children may enter preschool with low skills (below the 17th percentile) but make good progress in preschool and continue to make good progress in kindergarten. In this scenario, all children, even those in low performing kindergarten contexts, end the year with skills well above the 60th percentile. These children are positioned well to excel in their elementary education and beyond.

Figure 6. Scenario 4: Expected progress for children who enter preschool with low skills, make high growth in preschool, and continue to make high growth in kindergarten.



Discussion

The results of the HLM models and scenarios demonstrate the variation in effects of preschool and of the subsequent kindergarten environment in sustaining or dissipating the benefits of preschool. What is clear is the importance not only of getting children on track in preschool, but of keeping them on track in kindergarten. When children with low skills receive effective preschool instruction, they enter kindergarten on track. If kindergarten can keep them on track, they end up with skills similar to children who have typical skills and make typical progress. Even when children enter kindergarten with low skills, kindergarten can compensate, so that many children achieve end of year benchmark goals. However, when children enter kindergarten on track but kindergarten does not keep them on track, their skills dissipate or "fadeout."

A number of hypotheses have been proposed for how to sustain preschool effects, including increases in: (a) focused curricula teaching advanced content, (b) alignment of instructional content between preschool and kindergarten, (c) onsite support for teachers, (d) summer school opportunities, and (e) family involvement (e.g., Entwisle, Alexander, & Olson, 2001; Galindo & Sheldon, 2012; Yoshikowa et al., 2016). Given the diversity of educational settings in which children receive kindergarten instruction, there may not be a single factor that works equally well across all settings. Whatever strategies are used, it is paramount to get children to the benchmark goal or above at the end of preschool and at the end of kindergarten.

One feature that is missing from the discussion of strategies to sustain preschool effects is formative assessment. In a major review of the research on assessment, Black and William (1998) concluded that formative assessment improves learning and results in considerable gains in achievement. More recently, Hattie (2009) evaluated more than 800 meta-analyses of 138 influences on student achievement and found formative assessment including progress monitoring to be the third largest effect. Thus, a critical component of an effective system-wide model for getting and keeping children on track is a data-based decision-making process utilizing ongoing assessment and continuous progress monitoring for all children.

One such model is an Outcomes-Driven Model (Kaminski, Cummings, Powell-Smith, & Good, 2008) in which general outcome measures such as PELI and DIBELS Next are used formatively to (a) identify children who need support, (b) guide intervention, and (c) monitor ongoing progress to evaluate the effectiveness of intervention and inform modifications. Within this model, empirically-derived benchmark goals provide guidance about expected levels of performance and progress. While such assessment data is increasingly being collected in educational settings, to positively effect outcomes, the data needs to be used formatively to modify instruction in an ongoing manner to get and keep all children on track.

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