Kindergartners' Approaches to Learning, Family Socioeconomic Status, and Early Academic Gains

First-time kindergartners who demonstrated positive approaches to learning behaviors more frequently in the fall of kindergarten tended to make greater gains in reading, mathematics, and science between kindergarten and second grade. For each additional point in students' fall kindergarten approaches to learning score, average gains from kindergarten to second grade were 3.4 points higher for reading, 1.9 points higher for mathematics, and 1.3 points higher for science. The positive relationships between initial approaches to learning behaviors and academic gains in reading, mathematics, and science were larger for students from lower socioeconomic status (SES) households than for students from higher SES households.

At kindergarten entry, children differ not only in their cognitive knowledge and skills but also in their approaches to learning behaviors, such as their ability to pay attention in class, follow classroom rules, complete tasks independently, and show eagerness to learn.[1] In the early years, even before formal schooling begins, children from socioeconomically disadvantaged households typically have less access to resources that have been associated with learning, such as books and educational toys in their homes and quality preschool settings, than do students from more socioeconomically advantaged households.[2] As these children enter school, they tend to exhibit positive approaches to learning behaviors less often than students from more socioeconomically advantaged households.[3] Research suggests that children who demonstrate positive approaches to learning behaviors more frequently perform better academically, on average, in the early grades than students who demonstrate these behaviors less frequently.[4] This Spotlight analysis extends findings from *The Condition of Education 2015* Spotlight <u>Kindergartners' Approaches to Learning Behaviors and Academic Outcomes</u> to describe associations between the approaches to learning behaviors of first-time kindergartners in the fall of kindergarten and their academic gains in reading, mathematics, and science from kindergarten through the spring of second grade for students from different family socioeconomic status (SES) backgrounds.[5]

In the Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011), teachers of kindergarten students rated their students on seven approaches to learning behaviors: paying attention in class, persisting in completing tasks, showing eagerness to learn new things, working independently, adapting easily to changes in routine, keeping belongings organized, and following classroom rules. Teachers assigned a rating of 1 (never), 2 (sometimes), 3 (often), or 4 (very often) for each of the seven items during the fall kindergarten round of the ECLS-K:2011. Following data collection, an average of the seven ratings was calculated to represent a composite score for each child's fall kindergarten approaches to learning behaviors.[6]

Information on family SES was collected through parental reports of parent/guardian educational attainment, occupations, and household income in the kindergarten year. In addition, trained ECLS-K:2011 assessors conducted one-on-one adaptive testing through computer-assisted personal interviews with children in reading and mathematics in the fall and spring of kindergarten,[7] first grade, and second grade. Science was assessed in the spring of kindergarten and in the fall and spring of first grade and second grade. More details on the family SES and academic assessment components included in the analysis can be found in the Technical Notes section of this Spotlight.

Figure 1. Average approaches to learning scores of first-time kindergartners, by family socioeconomic status (SES): Fall 2010
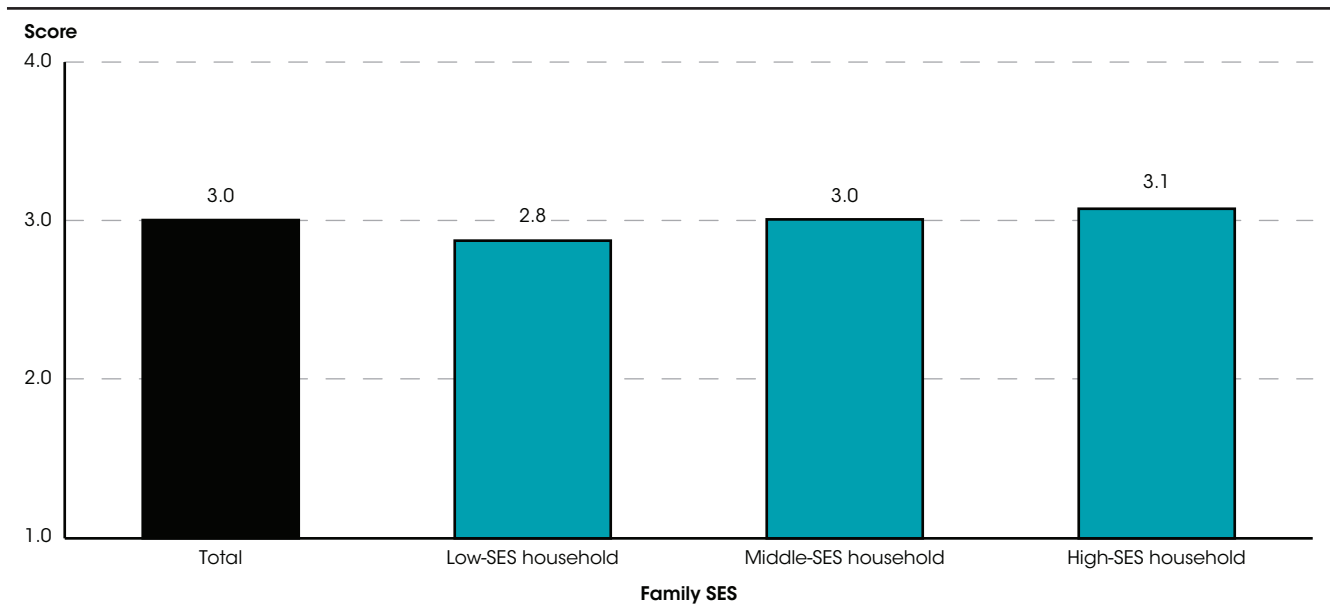

NOTE: The approaches to learning scale is based on teachers' reports on how often students exhibit positive learning behaviors in seven areas: attentiveness, task persistence, eagerness to learn, learning independence, ability to adapt easily to changes in routine, organization, and ability to follow classroom rules. Possible scores on the scale range from 1 to 4, with higher scores indicating that a child exhibits positive learning behaviors more often. Socioeconomic status (SES) was measured by a composite score based on parental education and occupations and household income in the child's kindergarten year. Kindergartners living in households in the highest 20 percent of the SES scale were identified as kindergartners from high-SES households, those living in households in the middle 60 percent of the SES scale were identified as kindergartners from middle-SES households, and those living in households in the lowest 20 percent of the SES scale were identified as kindergartners from low-SES households. Estimates weighted by W6C6P_6T0. Estimates pertain to a sample of children who were enrolled in kindergarten for the first time in the 2010–11 school year. Most of the children were in second grade in 2012–13, but 6 percent were in first grade or other grades (e.g., third grade, ungraded classrooms).
SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011), Kindergarten–Second Grade Restricted-Use Data File. See *Digest of Education Statistics 2015*, table 220.45.

In the fall 2010 kindergarten data collection, the average approaches to learning score for first-time kindergartners was 3.0, indicating that they "often" demonstrated positive approaches to learning behaviors. Overall, 26 percent of first-time kindergartners were rated by their teachers in the fall of kindergarten as demonstrating positive approaches to learning behaviors "very often" (average rating of 4), 49 percent were rated as demonstrating them "often" (average rating of 3), 24 percent were rated as demonstrating them "sometimes" (average rating of 2), and 1 percent were rated as "never" demonstrating them (average rating of 1).[8] Students from low-SES households tended to have lower fall kindergarten approaches to learning scores (2.8) than students from middle-SES (3.0) and high-SES households (3.1).

Figure 2. Average reading scale scores of fall 2010 first-time kindergartners, by frequency of positive approaches to learning behaviors in fall of kindergarten and time of assessment: Fall 2010 through spring 2013
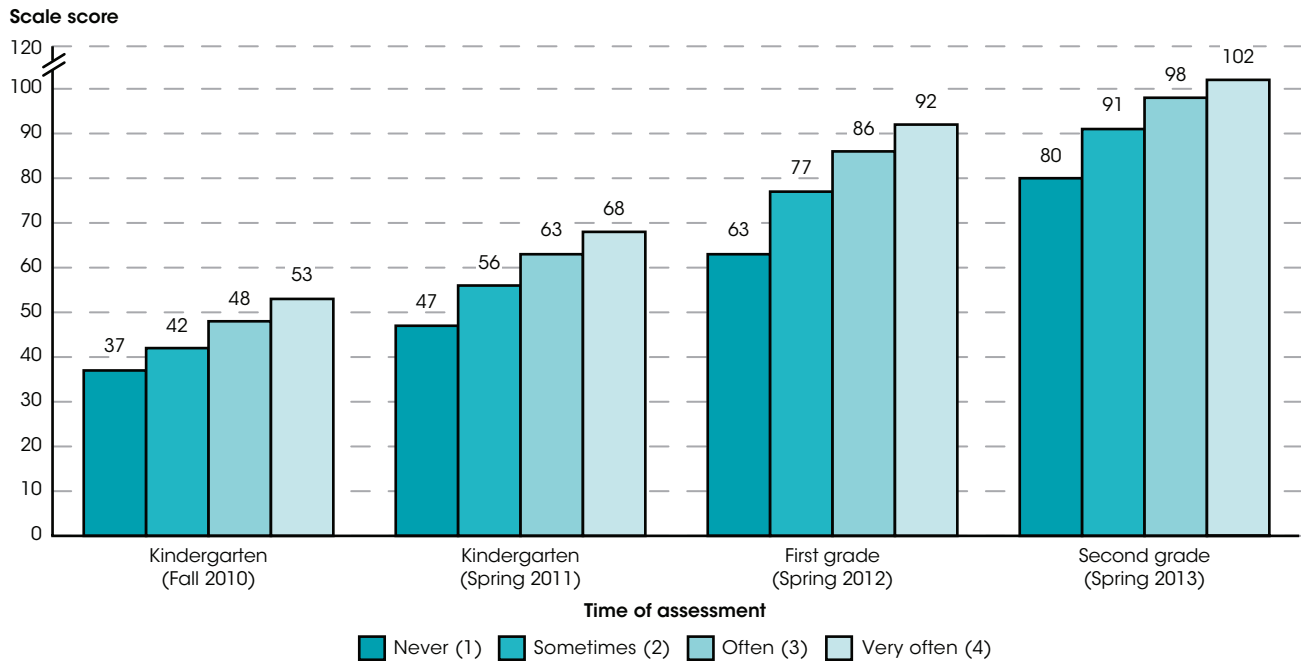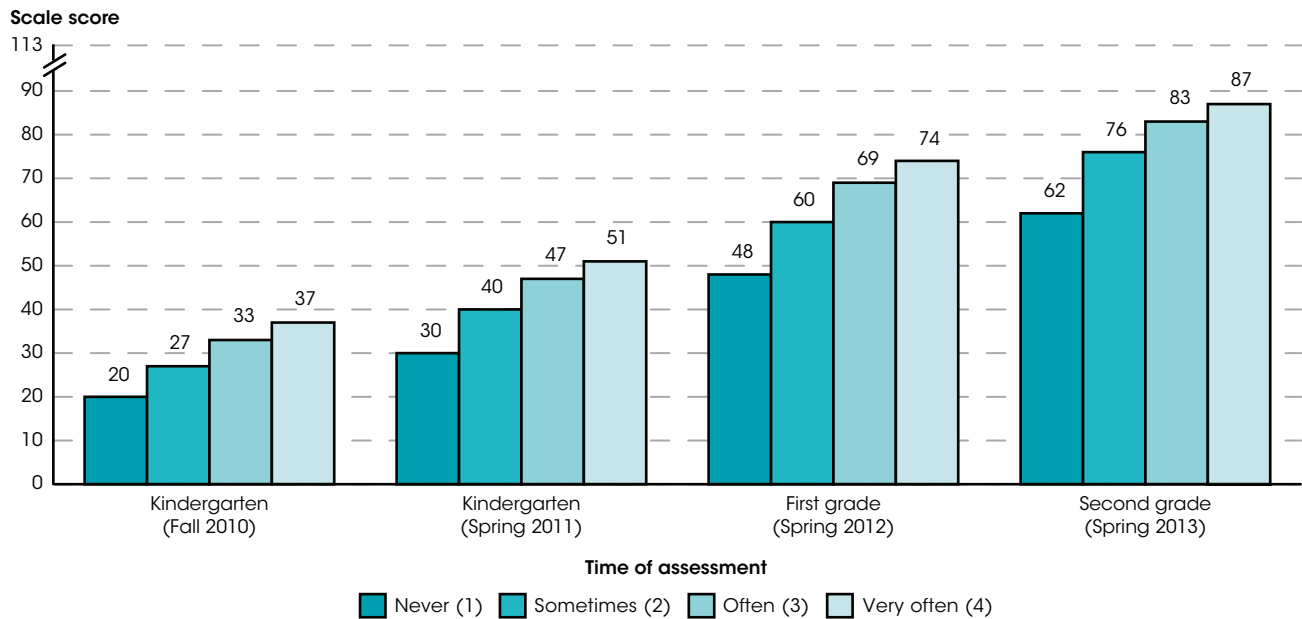

NOTE: Scores on the reading assessments reflect performance on questions measuring basic skills (print familiarity, letter recognition, beginning and ending sounds, rhyming words, and word recognition); vocabulary knowledge; and reading comprehension, including identifying information specifically stated in text (e.g., definitions, facts, and supporting details), making complex inferences from texts, and considering the text objectively and judging its appropriateness and quality. Possible scores for the reading assessment range from 0 to 120. Frequency of positive approaches to learning behaviors is derived from kindergartners' fall 2010 approaches to learning scores. The approaches to learning scale is based on teachers' reports on how often students exhibit positive learning behaviors in seven areas: attentiveness, task persistence, eagerness to learn, learning independence, ability to adapt easily to changes in routine, organization, and ability to follow classroom rules. Possible scores on the scale range from 1 to 4, with higher scores indicating that a child exhibits positive learning behaviors more often. Fall 2010 approaches to learning scores were categorized into the anchor points on the original scale by rounding the average score to the nearest whole number. Estimates differ from previously published figures because reading scale scores were recalculated to represent the kindergarten through second-grade assessment item pools, and weights were adjusted to account for survey nonresponse at each data collection wave. Estimates weighted by W6C6P_6T0. Estimates pertain to a sample of children who were enrolled in kindergarten for the first time in the 2010–11 school year. Most of the children were in second grade in 2012–13, but 6 percent were in first grade or other grades (e.g., third grade, ungraded classrooms).
SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011), Kindergarten–Second Grade Restricted-Use Data File. See *Digest of Education Statistics 2015*, table 220.40.

Results from the previous Spotlight on kindergartners' approaches to learning behaviors and academic outcomes indicated that the frequency of positive approaches to learning behaviors for first-time kindergartners (or their average approaches to learning rating) in the fall of kindergarten was positively associated with their reading, mathematics, and science scores in the spring of kindergarten and the spring of first grade. The same pattern was observed in the spring of 2013, when most of the ECLS-K:2011 students were enrolled in second grade. Students who had an average rating of "never" on the approaches to learning scale in the fall of kindergarten had the lowest reading, mathematics, and science scores in the spring of second grade, and students who had an average rating of "very often" in the fall of kindergarten had the highest scores in these subjects in the spring of second grade. For example, students who were rated by teachers as "never" demonstrating positive approaches to learning behaviors in the fall of kindergarten had an average spring second-grade reading score of 80 points, compared with an average score of 91 points for those with a rating of "sometimes," 98 points for those with a rating of "often," and 102 points for those with a rating of "very often."

Figure 3. Average mathematics scale scores of fall 2010 first-time kindergartners, by frequency of positive approaches to learning behaviors in fall of kindergarten and time of assessment: Fall 2010 through spring 2013

Scale score

Never (1) Sometimes (2) Often (3) Very often (4)

Time of assessment

NOTE: Scores on the mathematics assessments reflect performance on questions on number sense, properties, and operations; measurement; geometry and spatial sense; data analysis, statistics, and probability; and prealgebra skills such as identification of patterns. Possible scores for the mathematics assessment range from 0 to 113. Frequency of positive approaches to learning behaviors is derived from kindergartners' fall 2010 approaches to learning scores. The approaches to learning scale is based on teachers' reports on how often students exhibit positive learning behaviors in seven areas: attentiveness, task persistence, eagerness to learn, learning independence, ability to adapt easily to changes in routine, organization, and ability to follow classroom rules. Possible scores on the scale range from 1 to 4, with higher scores indicating that a child exhibits positive learning behaviors more often. Fall 2010 approaches to learning scores were categorized into the anchor points on the original scale by rounding the average score to the nearest whole number. Estimates differ from previously published figures because mathematics scale scores were recalculated to represent the kindergarten through second-grade assessment item pools, and weights were adjusted to account for survey nonresponse at each data collection wave. Estimates weighted by W6C6P_6T0. Estimates pertain to a sample of children who were enrolled in kindergarten for the first time in the 2010–11 school year. Most of the children were in second grade in 2012–13, but 6 percent were in first grade or other grades (e.g., third grade, ungraded classrooms).
SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011), Kindergarten–Second Grade Restricted-Use Data File. See *Digest of Education Statistics 2015*, table 220.40.

As in the previous Spotlight, first-time kindergartners who received an average approaches to learning rating of "never" in the fall of kindergarten not only scored the lowest on the reading, mathematics, and science assessments at each assessment time point, but their scores at subsequent assessment time points did not catch up to the previous assessment time point scores of peers who had received an approaches to learning rating of "very often" in the fall of kindergarten. For example, in mathematics, students with an approaches to learning rating of "very often" in the fall of kindergarten had an average score of 74 points in the spring of first grade, whereas students with an approaches to learning rating of "never" in the fall of kindergarten had an average score of 62 points in the spring of second grade.

Figure 4. Average science scale scores of fall 2010 first-time kindergartners, by family socioeconomic status (SES) and time of assessment: Spring 2011 through spring 2013
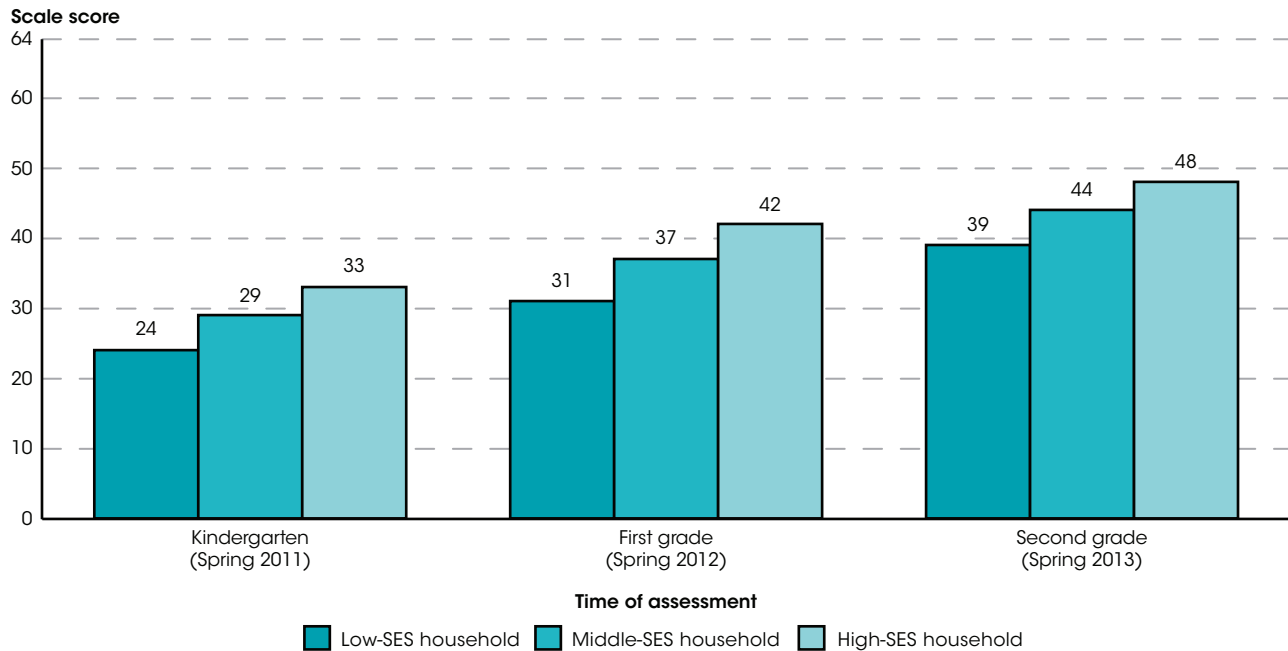
NOTE: Scores on the science assessments reflect performance on questions on physical sciences, life sciences, environmental sciences, and scientific inquiry. Possible scores for the science assessment range from 0 to 64. Science was first assessed in the spring of kindergarten. Socioeconomic status (SES) was measured by a composite score based on parental education and occupations and household income in the child's kindergarten year. Kindergartners living in households in the highest 20 percent of the SES scale were identified as kindergartners from high-SES households, those living in households in the middle 60 percent of the SES scale were identified as kindergartners from middle-SES households, and those living in households in the lowest 20 percent of the SES scale were identified as kindergartners from low-SES households. Estimates differ from previously published figures because science scale scores were recalculated to represent the kindergarten through second-grade assessment item pools, and weights were adjusted to account for survey nonresponse at each data collection wave. Estimates weighted by W6C6P_6T0. Estimates pertain to a sample of children who were enrolled in kindergarten for the first time in the 2010–11 school year. Most of the children were in second grade in 2012–13, but 6 percent were in first grade or other grades (e.g., third grade, ungraded classrooms).
SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011), Kindergarten–Second Grade Restricted-Use Data File. See *Digest of Education Statistics 2015*, table 220.40.

With respect to family SES, students from households with the lowest SES in the fall of kindergarten had the lowest reading, mathematics, and science scores in kindergarten through second grade, while those from households with the highest SES had the highest scores in all three subjects during this period. For example, in the spring of kindergarten students from low-SES households had an average science score of 24 points, compared with average science scores of 29 points for students from middle-SES households and 33 points for students from high-SES households. In the spring of second grade, students from low-SES households still had the lowest average science score (39 points) when compared with students from middle-SES households (44 points) and high-SES households (48 points).

Given that reading, mathematics, and science scores varied at different assessment time points both for students with different fall kindergarten approaches

to learning scores and for students from different SES households, multivariate analyses were conducted to explore students' academic gains from kindergarten to second grade in relation to their initial approaches to learning scores and family SES. Two sets of ordinary least squares (OLS) regression analyses were conducted. For both sets, gains in children's reading, mathematics, and science scores from the initial kindergarten assessment to the spring second-grade assessment were the outcome measures. The gains scores were calculated as the difference between the spring second-grade score and the initial kindergarten score (fall for reading and mathematics; spring for science). All regression analyses of gain scores also controlled for children's initial assessment scores because gains made at different points on the Item Response Theory (IRT) scale score have qualitatively different interpretations.[9] More details on the regression methodology and IRT scale interpretation can be found in the Technical Notes section of this Spotlight.

Table 1. Estimated coefficients from ordinary least squares (OLS) regressions of reading, mathematics, and science kindergarten through second-grade gains, by fall kindergarten approaches to learning scores and family socioeconomic status (SES): Fall 2010 through spring 2013

	Kindergarten through second-grade gain scores					
	Reading[1]		Mathematics[2]		Science[3]	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Variable	Coefficient (s.e.)	Coefficient (s.e.)	Coefficient (s.e.)	Coefficient (s.e.)	Coefficient (s.e.)	Coefficient (s.e.)
Intercept	60.99* (0.877)	56.43* (1.358)	50.52* (1.104)	45.63* (2.305)	18.57* (0.640)	17.28* (0.964)
Initial kindergarten score[4]	-0.53* (0.015)	-0.53* (0.015)	-0.28* (0.016)	-0.28* (0.016)	-0.30* (0.016)	-0.30* (0.016)
Fall kindergarten approaches to learning score[5]	3.39* (0.268)	5.01* (0.434)	1.92* (0.247)	3.66* (0.702)	1.34* (0.123)	1.80* (0.284)
Family SES[6]						
Middle-SES household	4.04* (0.420)	8.98* (1.619)	2.56* (0.481)	7.92* (2.393)	1.22* (0.241)	2.55* (0.968)
High-SES household	5.78* (0.496)	14.81* (1.873)	3.63* (0.551)	13.28* (2.802)	2.43* (0.284)	5.27* (1.102)
Interaction of SES and approaches to learning score						
Middle-SES household		-1.76* (0.506)		-1.91* (0.760)		-0.47 (0.326)
High-SES household		-3.05* (0.558)		-3.26* (0.857)		-0.95* (0.342)

* p < 0.05.

[1] Reflects performance on questions measuring basic skills (print familiarity, letter recognition, beginning and ending sounds, rhyming words, and word recognition); vocabulary knowledge; and reading comprehension, including identifying information specifically stated in text (e.g., definitions, facts, and supporting details), making complex inferences from texts, and considering the text objectively and judging its appropriateness and quality. Possible scores for the reading assessment range from 0 to 120.

[2] Reflects performance on questions on number sense, properties, and operations; measurement; geometry and spatial sense; data analysis, statistics, and probability (measured with a set of simple questions assessing children's ability to read a graph); and prealgebra skills such as identification of patterns. Possible scores for the mathematics assessment range from 0 to 113.

[3] Science was not assessed in the fall of kindergarten. Reflects performance on questions on physical sciences, life sciences, environmental sciences, and scientific inquiry. Possible scores for the science assessment range from 0 to 64.

[4] Initial reading and mathematics scores are from fall kindergarten; initial science scores are from spring kindergarten.

[5] The approaches to learning scale is based on teachers' reports on how often students exhibit positive learning behaviors in seven areas: attentiveness, task persistence, eagerness to learn, learning independence, ability to adapt easily to changes in routine, organization, and ability to follow classroom rules. Possible scores on the scale range from 1 to 4, with higher scores indicating that a child exhibits positive learning behaviors more often.

[6] Socioeconomic status (SES) was measured by a composite score based on parental education and occupations and household income in the child's kindergarten year. The reference category for the regression model is the low-SES household group. Kindergartners living in households in the highest 20 percent of the SES scale were identified as kindergartners from high-SES households, those living in households in the middle 60 percent of the SES scale were identified as kindergartners from middle-SES households, and those living in households in the lowest 20 percent of the SES scale were identified as kindergartners from low-SES households.

NOTE: Estimates weighted by W6C6P_6T0. Estimates pertain to a sample of children who were enrolled in kindergarten for the first time in the 2010–11 school year. Most of the children were in second grade in 2012–13, but 6 percent were in first grade or other grades (e.g., third grade, ungraded classrooms).

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011), Kindergarten–Second Grade Restricted-Use Data File.

The first set of regression analyses (table 1, model 1) included the fall kindergarten approaches to learning scores and kindergarten family SES as independent predictors of children's academic gains. Regressions of students' gains in reading, mathematics, and science from kindergarten to the spring of second grade indicated that students who demonstrated positive approaches to learning behaviors more frequently in the fall of kindergarten tended to make greater gains in all three subjects in their first three years of school after accounting for initial assessment scores and family SES. For each additional point in students' fall kindergarten approaches to learning scores, average gains from kindergarten to second grade were 3.4 points higher for reading, 1.9 points higher for mathematics, and 1.3 points higher for science. For example, on average a student with a fall kindergarten approaches to learning score of 4 (very often) would gain 10.2 points[10] more in reading than a similar student with a fall kindergarten approaches to learning score of 1 (never).

Results from this regression set also indicated that family SES in kindergarten was positively associated with

students' gains between kindergarten and second grade in reading, mathematics, and science. For example, for students with the same fall kindergarten approaches to learning score, those from high-SES households would gain on average 5.8 points more in reading, 3.6 points more in mathematics, and 2.4 points more in science than students from low-SES households.

The second set of regression analyses (table 1, model 2) included an interaction variable of family SES and the fall kindergarten approaches to learning score, in addition to the variables included in the first set of regressions. Interaction variables are used to explore whether the relationship between two variables, such as the approaches to learning score and reading gains, differ across levels of a third variable, such as family SES. Significant interaction coefficients indicate that the relationships between initial approaches to learning scores and gains in reading, mathematics, and science from kindergarten to second grade differed for students from different family SES backgrounds.

Figure 5. Average fall kindergarten to spring second-grade reading gain scores associated with fall kindergarten approaches to learning scores, by family socioeconomic status (SES): Fall 2010 through spring 2013
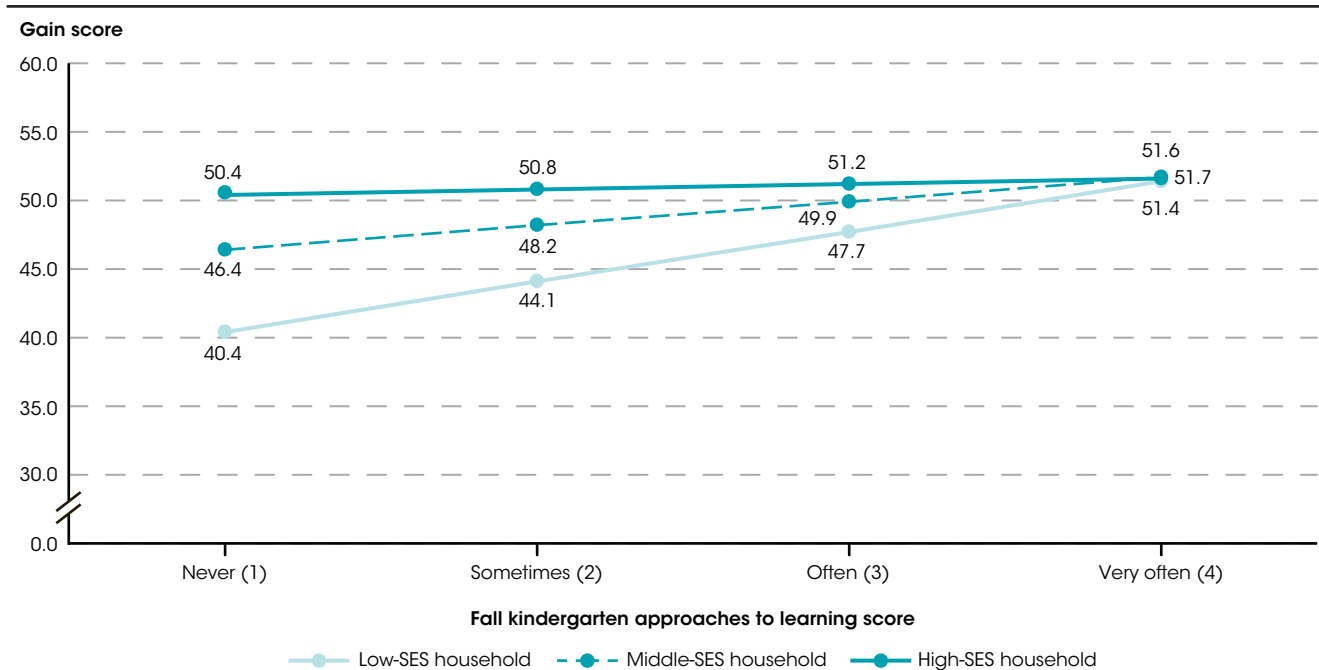

Gain score
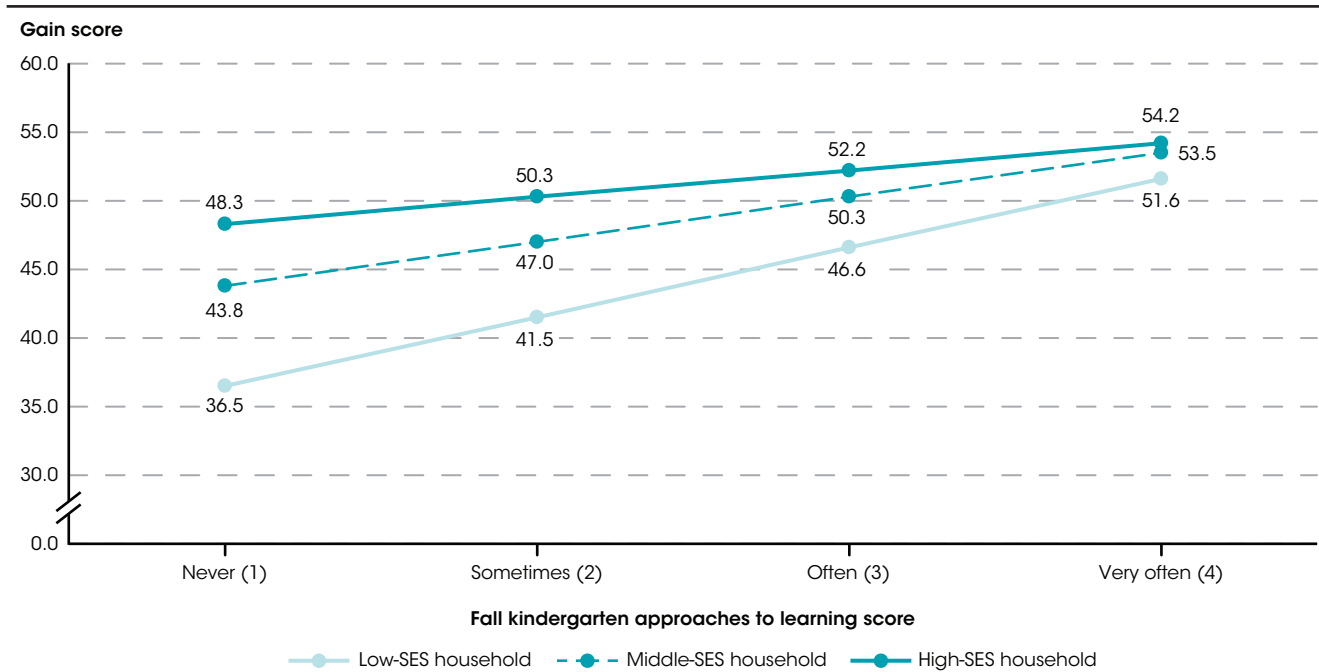
NOTE: Figure estimates are based on the average fall kindergarten reading score of 47.4. The approaches to learning scale is based on teachers' reports on how often students exhibit positive learning behaviors in seven areas: attentiveness, task persistence, eagerness to learn, learning independence, ability to adapt easily to changes in routine, organization, and ability to follow classroom rules. Possible scores on the scale range from 1 to 4, with higher scores indicating that a child exhibits positive learning behaviors more often. Scores on the reading assessment reflect performance on questions measuring basic skills (print familiarity, letter recognition, beginning and ending sounds, rhyming words, and word recognition); vocabulary knowledge; and reading comprehension, including identifying information specifically stated in text (e.g., definitions, facts, and supporting details), making complex inferences from texts, and considering the text objectively and judging its appropriateness and quality. Possible scores for the reading assessment range from 0 to 120. Socioeconomic status (SES) was measured by a composite score based on parental education and occupations and household income in the child's kindergarten year. Kindergartners living in households in the highest 20 percent of the SES scale were identified as kindergartners from high-SES households, those living in households in the middle 60 percent of the SES scale were identified as kindergartners from middle-SES households, and those living in households in the lowest 20 percent of the SES scale were identified as kindergartners from low-SES households. Estimates weighted by W6C6P_6T0. Estimates pertain to a sample of children who were enrolled in kindergarten for the first time in the 2010–11 school year. Most of the children were in second grade in 2012–13, but 6 percent were in first grade or other grades (e.g., third grade, ungraded classrooms).
SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011), Kindergarten–Second Grade Restricted-Use Data File.

Findings from the second set of regression analyses showed negative interaction effects between fall kindergarten approaches to learning scores and family SES (table 1, model 2). A negative interaction means that the academic gains associated with fall kindergarten approaches to learning scores in reading, mathematics, and (to an extent) science are largest for children from low-SES households and smaller for children from middle- and high-SES households. In reading, for example, each additional point on the fall kindergarten approaches to learning score is associated with a 5.0-point gain increase, on average, for students from low-SES households, while it is associated with a 3.2-point gain increase for students from middle-SES households and a 2.0-point gain increase for students from high-SES households.[11] The larger gain increase associated with the fall kindergarten approaches to learning score for students from low-SES households decreases the gap in the reading gains between students from households with different SES levels.

Among students whose average rating was "never (1)" on the fall kindergarten approaches to learning scale and who had the average fall kindergarten reading score of 47.4 points, for example, students from low-SES households would have an average reading gain of 36.5 points, students from middle-SES households would have an average gain of 43.8 points, and students from high-SES households would have an average gain of 48.3 points.[12] In contrast, among students with an average score of "very often (4)" on the fall kindergarten approaches to learning scale and the average fall kindergarten reading score (47.4 points), students from low-SES households would have an average reading gain of 51.6 points, students from middle-SES households would have an average gain of 53.5 points, and students from high-SES households would have an average gain of 54.2 points. The gap in reading gain scores between students from high-SES and low-SES households who had the same fall kindergarten reading score decreases from 11.8 points for students with the lowest fall kindergarten approaches to learning score to 2.6 points for students with the highest approaches to learning score.

Figure 6. Average fall kindergarten to spring second-grade mathematics gain scores associated with fall kindergarten approaches to learning scores, by family socioeconomic status (SES): Fall 2010 through spring 2013

NOTE: Figure estimates are based on the average fall kindergarten mathematics score of 32.3. The approaches to learning scale is based on teachers' reports on how often students exhibit positive learning behaviors in seven areas: attentiveness, task persistence, eagerness to learn, learning independence, ability to adapt easily to changes in routine, organization, and ability to follow classroom rules. Possible scores on the scale range from 1 to 4, with higher scores indicating that a child exhibits positive learning behaviors more often. Scores on the mathematics assessments reflect performance on questions on number sense, properties, and operations; measurement; geometry and spatial sense; data analysis, statistics, and probability; and prealgebra skills such as identification of patterns. Possible scores for the mathematics assessment range from 0 to 113. Socioeconomic status (SES) was measured by a composite score based on parental education and occupations and household income in the child's kindergarten year. Kindergartners living in households in the highest 20 percent of the SES scale were identified as kindergartners from high-SES households, those living in households in the middle 60 percent of the SES scale were identified as kindergartners from middle-SES households, and those living in households in the lowest 20 percent of the SES scale were identified as kindergartners from low-SES households. Estimates weighted by W6C6P_6T0. Estimates pertain to a sample of children who were enrolled in kindergarten for the first time in the 2010–11 school year. Most of the children were in second grade in 2012–13, but 6 percent were in first grade or other grades (e.g., third grade, ungraded classrooms).
SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011), Kindergarten–Second Grade Restricted-Use Data File.

In mathematics, the positive relationship between approaches to learning behaviors and gains was also largest for children from low-SES households. Each additional point on the fall kindergarten approaches to learning score results in a 3.7-point mathematics gain increase for students from low-SES households, while it results in a 1.8-point gain increase for kindergartners from middle-SES households and a 0.4-point gain increase for students from high-SES households.

Among students whose average rating was "never (1)" on the fall kindergarten approaches to learning scale and who had the average fall kindergarten mathematics score of 32.3 points, for example, students from low-SES households would have an average mathematics gain of 40.4 points, students from middle-SES households would have an average gain of 46.4 points, and students

from high-SES households would have an average gain of 50.4 points. In contrast, among students with an average score of "very often (4)" on the fall kindergarten approaches to learning scale and the average fall kindergarten mathematics score (32.3 points), students from low-SES households would have an average mathematics gain of 51.4 points, students from middle-SES households would have an average gain of 51.7 points, and students from high-SES households would have an average gain of 51.6 points. The gap in mathematics gain scores between students from high-SES and low-SES households who had the same fall kindergarten mathematics score decreases from 10.0 points for students with the lowest fall kindergarten approaches to learning score to 0.2 points for students with the highest approaches to learning score.

Figure 7. Average spring kindergarten to spring second-grade science gain scores associated with fall kindergarten approaches to learning scores, by family socioeconomic status (SES): Spring 2011 through spring 2013
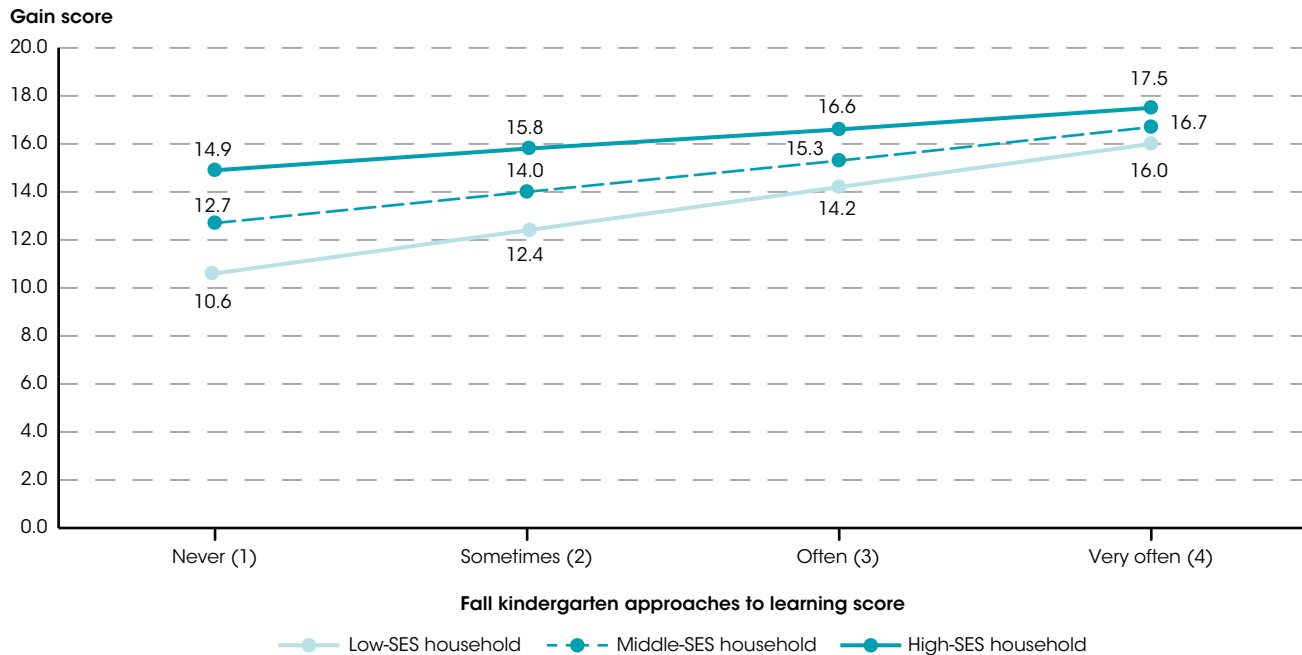
NOTE: Figure estimates are based on the average spring kindergarten science score of 28.6. The approaches to learning scale is based on teachers' reports on how often students exhibit positive learning behaviors in seven areas: attentiveness, task persistence, eagerness to learn, learning independence, ability to adapt easily to changes in routine, organization, and ability to follow classroom rules. Possible scores on the scale range from 1 to 4, with higher scores indicating that a child exhibits positive learning behaviors more often. Scores on the science assessments reflect performance on questions on physical sciences, life sciences, environmental sciences, and scientific inquiry. Possible scores for the science assessment range from 0 to 64. Socioeconomic status (SES) was measured by a composite score based on parental education and occupations and household income in the child's kindergarten year. Kindergartners living in households in the highest 20 percent of the SES scale were identified as kindergartners from high-SES households, those living in households in the middle 60 percent of the SES scale were identified as kindergartners from middle-SES households, and those living in households in the lowest 20 percent of the SES scale were identified as kindergartners from low-SES households. Estimates pertain to a sample of children who were enrolled in kindergarten for the first time in the 2010–11 school year. Most of the children were in second grade in 2012–13, but 6 percent were in first grade or other grades (e.g., third grade, ungraded classrooms).
SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011), Kindergarten–Second Grade Restricted-Use Data File.

In science, the positive relationship between fall kindergarten approaches to learning scores and gains was larger for students from low-SES households than for students from high-SES households; however, no significant interaction was found for students from middle-SES households, indicating that the relationships between approaches to learning scores and science gains were not measurably different for children from low- and middle-SES backgrounds. Each additional point on the fall kindergarten approaches to learning score results in a 1.8-point science gain increase for students from low-SES households and a 0.8-point science gain increase for students from high-SES households.

Among students whose average rating was "never (1)" on the fall kindergarten approaches to learning scale and who had the average spring kindergarten science score of 28.6 points, for example, students from low-SES households would have an average science gain of 10.6 points and students from high-SES households would have an average science gain of 14.9 points. In contrast, among students with an average score of "very often (4)" on the fall kindergarten approaches to learning scale and the average spring kindergarten science score (28.6 points), students from low-SES households would have an average science gain of 16.0 points and students from high-SES households would have an average gain of 17.5 points. The gap in science gain scores between students from high-SES and low-SES households who had the same spring kindergarten science score decreases from 4.3 points for students with the lowest fall kindergarten approaches to learning score to 1.5 points for students with the highest approaches to learning score.

Technical Notes

This Spotlight uses bivariate and multivariate analyses of data from the Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011) to explore relationships between approaches to learning behaviors, academic gains, and family SES. For the first section of the Spotlight, average reading, mathematics, and science second-grade scores are compared by fall kindergarten approaches to learning categories using analysis of variance (ANOVA) procedures and post hoc t test comparisons, tested for statistical significance at the .05 level with False Discovery Rate (FDR) adjustment. For the second section, two sets of ordinary least squares (OLS) regression analyses were conducted. For both sets of regression analyses, gains in children's reading, mathematics, and science scores from the initial kindergarten assessment to the spring second-grade assessment are the outcome measures. The reading and mathematics gain scores were calculated as the difference between the spring second-grade score and the fall kindergarten score, while the science gain score was calculated as the difference between the spring second-grade score and the spring kindergarten score. Following the recommendation outlined in the ECLS-K:2011 Kindergarten–Second Grade Data File user's manual, both sets of regression analyses of gain scores controlled for children's initial assessment scores (i.e., fall kindergarten scores for reading and mathematics, and spring kindergarten scores for science) because gains made at different points on the item response theory (IRT) scale score have qualitatively different interpretations.[13] Children who made gains toward the lower end of the scale, for example in skills such as identifying letters and associating letters with sounds, are learning different skills than children who made gains at the higher end of the scale, for example those who have gone from reading single words to reading sentences, although their gains in number of scale score points may be the same. Comparison of gains in scale score points is most meaningful for groups that started with similar initial status. One way to account for children's initial status is to include a prior round assessment score as a control variable in an analytic model.

In addition to initial assessment scores as controls, the first set of regression analyses includes the continuous measure of fall kindergarten approaches to learning scores and the three-category kindergarten family SES variable as the independent variables. Built on the first set of models, the second set of analyses includes the interaction variables of family SES categories and the continuous fall kindergarten approaches to learning score. Interaction variables are used to explore whether the relationship between two variables, such as approaches to learning score and reading gains, differs across levels of a third variable, such as family SES. To test for interactions, new terms are added to the regression in which the approaches to learning and family SES group designation are multiplied. Significant interaction coefficients in the second set of models would indicate that the relationships

between initial approaches to learning scores and gains in reading, mathematics, and science from kindergarten to second grade differed for students from different family SES backgrounds. For all regression analyses, the low-SES household group is the reference category.

The reading assessment included questions measuring basic skills (print familiarity, letter recognition, beginning and ending sounds, rhyming words, and word recognition), vocabulary knowledge, and reading comprehension. The reading comprehension questions asked the child to identify information specifically stated in the text (e.g., definitions, facts, supporting details) and to make inferences about the text. The math assessment was designed to measure skills in conceptual knowledge, procedural knowledge, and problem solving. The assessment consisted of questions on number sense, properties, and operations; measurement; geometry and spatial sense; data analysis, statistics, and probability; and patterns, algebra, and functions. The science assessment included questions on physical sciences, life sciences, environmental sciences, and scientific inquiry.

Broad-based scores using the full set of items administered in the kindergarten through second-grade assessments in reading, math, and science were calculated using IRT procedures. The IRT-based overall scale score for each content domain is an estimate of the number of items a child would have answered correctly in each data collection round if he or she had been administered all of the questions that had been included in the assessments for that domain in kindergarten, first grade, and second grade. The ECLS-K:2011 employed a two-stage adaptive assessment (in reading and mathematics in kindergarten and in reading, mathematics, and science in first and second grade) in which children were individually administered a set of items appropriate to their demonstrated ability level rather than all of the items in the assessment. Although this procedure resulted in children being administered different sets of items, there was a subset of items that all children received (the items in the routing tests, plus a set of items common across the different second-stage forms). These common items were used to calculate scores for all children on the same scale. IRT also was used to calculate scores for all children on the same scale for the science assessment fielded in the spring of kindergarten even though that assessment was not two-stage. In that assessment, the assortment of items a child received was not dependent upon routing to a second stage, but instead on omissions by the child or the discontinuation of the administration of the assessment. In those cases, IRT was used to estimate the probability that a child would have provided a correct response when no response was available.

Information on family SES was collected through parental reports of parent/guardian educational attainment, occupational prestige levels, and household income in the kindergarten year. Occupational prestige level was based on information collected about the type of business or industry in which the parent worked, the parent's job title, and the most important activities or duties the parent

did for the job. For this Spotlight, kindergartners living in households in the highest 20 percent of the SES scale were identified as being from high-SES households, those in households in the middle 60 percent of the SES scale were identified as being from middle-SES households, and those in households in the lowest 20 percent of the SES scale were identified as being from low-SES households.

More information about the ECLS-K:2011 is available at http://nces.ed.gov/ecls/kindergarten2011.asp.

Endnotes:

[1] See *The Condition of Education 2015* Spotlight indicator Kindergartners' Approaches to Learning Behaviors and Academic Outcomes and Zill, N., and West, J. (2001). *Entering Kindergarten: A Portrait of American Children When They Begin School: Findings From The Condition of Education 2000* (NCES 2001-035). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

[2] Arnold, D.H., and Doctoroff, G.L. (2003). The Early Education of Socioeconomically Disadvantaged Children. *Annual Review of Psychology, 54*: 517–545.

[3] Ladd, G.W., Birch, S.H., and Buhs, E.S. (1999). Children's Social and Scholastic Lives in Kindergarten: Related Spheres of Influence? *Child Development, 70*(6): 1373–1400. Zill, N., and West, J. (2001). *Entering Kindergarten: A Portrait of American Children When They Begin School: Findings From The Condition of Education 2000* (NCES 2001-035). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

[4] See *The Condition of Education 2015* Spotlight indicator Kindergartners' Approaches to Learning Behaviors and Academic Outcomes and Entwisle, D.R., and Alexander, K.L. (1998). Facilitating the Transition to First Grade: The Nature of Transition and Research on Factors Affecting It. *The Elementary School Journal, 98*(4): 351–364.

[5] Fall 2011 first-grade and fall 2012 second-grade scores are excluded from the discussion because data were collected from a representative subsample (and not the full sample) of ECLS-K:2011 students at those time periods.

[6] The reliability coefficient for the approaches to learning scale was 0.91 in the fall of kindergarten (Tourangeau et al. 2015); this coefficient is a measure of the internal consistency of the scale.

[7] This Spotlight builds on an analysis of children who were first-time kindergartners in the fall of 2010. Although the discussion makes reference to later rounds of data collection by the grade the majority of children are expected to be in (that is, the modal grade for children who were first-time kindergartners in the fall 2010–11 school year), children are included in subsequent data collections regardless of their actual grade level.

[8] For average reading, mathematics, and science score comparisons across approaches to learning categories in this Spotlight, kindergartners' average scores on the approaches to learning scale in the fall of kindergarten were rounded to the nearest whole number (following the initial calculations with unrounded numbers) so that students could be grouped into the original categories represented by the four-point scale. For example, a student with an average score of 2.4 would be categorized into the "sometimes" (value of 2) group.

[9] Tourangeau, K., Nord, C., Lê, T., Wallner-Allen, K., Vaden-Kiernan, N., Blaker, L., and Najarian, M. (2015). *Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011) User's Manual for the ECLS-K:2011 Kindergarten–Second Grade Data File and Electronic Codebook, Restricted Version* (NCES 2015-049). U.S. Department of Education. Washington, DC: National Center for Education Statistics.

[10] To calculate the change in gain score associated with the fall kindergarten approaches to learning rating, a student's approaches to learning score is multiplied by the unstandardized regression coefficient for fall kindergarten approaches to learning. For instance, the change in reading gain score for a student with a fall kindergarten approaches to learning score of 4 would be calculated as 4 x 3.39 = 13.56 point increase in gain score, while the change in gain score for a student with an approaches to learning score of 1 would be 1 x 3.39 = 3.39 point increase. The difference in the gain score increase would equal 10.17 (i.e., 13.56 points - 3.39 points), or 10.2 points.

[11] Students from low-SES households had an average increase in their reading gain score of 5.0 points, based on the 5.01 coefficient for the fall kindergarten approaches to learning score, while students from middle-SES households had an average gain increase of 3.2 points (5.01 - 1.76 interaction effect) and students from high-SES households had an average gain increase of 2.0 points (5.01 - 3.05 interaction effect) (based on unrounded numbers in formula).

[12] Estimated gain scores are calculated as the sum of five components: (1) the intercept coefficient, (2) the average initial kindergarten score multiplied by the initial kindergarten score coefficient, (3) the student's approaches to learning score multiplied by the fall kindergarten approaches to learning rating coefficient, (4) the student's family SES coefficient, and (5) the student's approaches to learning score multiplied by the interaction coefficient that corresponds to the student's family SES. For instance, the kindergarten through second-grade reading gain score for a student with the initial reading score of 47.4 points and a fall kindergarten approaches to learning score of 1 from a high-SES household would be: 56.43 + [(47.42 x (-0.53)] + (1 x 5.01) + (14.81) + [(1 x (-3.05)] = 48.30 (based on unrounded numbers in formula).

[13] Tourangeau, K., Nord, C., Lê, T., Wallner-Allen, K., Vaden-Kiernan, N., Blaker, L., and Najarian, M. (2015). *Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011) User's Manual for the ECLS-K:2011 Kindergarten–Second Grade Data File and Electronic Codebook, Restricted Version* (NCES 2015-049). U.S. Department of Education. Washington, DC: National Center for Education Statistics.

Reference tables: *Digest of Education Statistics 2015,* tables 220.40 and 220.45

Related indicators: Preschool and Kindergarten Enrollment, Kindergarten Entry Status: On-Time, Delayed-Entry, and Repeating Kindergartners [*The Condition of Education 2013 Spotlight*], Kindergartners' Approaches to Learning Behaviors and Academic Outcomes [*The Condition of Education 2015 Spotlight*]

Glossary: Household, Socioeconomic status (SES)