Do peers influence children’s skill development in preschool?

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Received 9 April 2005; accepted 20 September 2005

Abstract

Currently, a disjuncture exists between the economic literature on young children’s outcomes from early education or child care and the literature on schooling outcomes of older children and adolescents. Peer effects have been found to be both theoretically important and empirically significant in school settings, yet the effects of peers have not been incorporated into research estimating the child development production function. In this study, we estimate the value-added effects of peer abilities on the educational outcomes of a probability sample of four year olds who attended Head Start, publicly subsidized pre-kindergarten, or private preschool in Georgia. We use a longitudinal data set that includes measures of preschool quality, child and family characteristics, peer abilities, and assessments of the skills of pre-kindergarteners both before and after attending preschool. The ability level of the peers in a child’s classroom has direct and positive effects on the child’s cognitive skills, pre-reading skills, and expressive language skills after controlling for preschool resources, family characteristics, and the child’s skills at the beginning of preschool. Neither time spent on discipline, nor contextual effects of classroom composition, nor teachers’ motivation appear to be the mechanisms that explain the influences of peers on children’s skill development.

Keywords: Human capital

1. Introduction

An obvious disjuncture exists in the economic research literature on the development of young children and the educational outcomes of older, school-age children and adolescents. The outcomes of schooling are held to be a function of the ability of the student, the family and home influences on the child, the school inputs, and peers in the classroom (Hanushek, 1979; Hanushek, Kain, Markman, & Rivkin, 2003; Wolfe & Summers, 1977; Zimmer & Toma, 2002). Moreover, some theoretical work on the education market argues that the effects of schooling are principally derived from peer effects and efficient sorting of children (Epple & Romano, 1998). In contrast, the early education and child care literature has largely omitted the effects of peers on the developmental outcomes of the young children in these environments. For example, in a recent study of the effect sizes attributable to the quality of child care environments, the NICHD Early Childcare Research Network and Duncan (2003) posit four factors that influence children’s development status:

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quantity and quality of care, resources available in the child’s home, child characteristics, and family attributes.

The omission of peer influences from estimates of the child development production function appears to be particularly consequential in that it inhibits a complete understanding of how the developmental skills of the children are produced and may lead to omitted variable bias which may exaggerate the estimates of other coefficients in the model. It is entirely plausible that the effects of peers may be particularly large in early education and care environments where more interaction between peers occurs throughout the day and instructional methods deemphasize whole group activities and teacher-directed instruction. For example, extant research suggests that child development is enhanced by teachers who believe in and use child-initiated instruction within their classrooms (Marcon, 1999). Child-initiated instruction allows the children to choose their own activities and the other children with whom they will participate for large parts of the day. Frequent interactions between children can stimulate development, not only for language and communications skills but also for social and problem-solving skills. In addition, preschool quality is judged to be higher when children can access classroom instructional resources for large periods of the day, under the theory that children will visit centers within the classroom and develop skills through their interactions with the other children and center resources (Harms, Clifford, & Cryer, 1998). However, we currently have no direct tests of the extent to which the quality of the environment or the influence of peers within that environment yield greater skill development.

In early educational environments where teacher-directed activities are often kept to a minimum, the skill development of children may directly relate to the skills of their peers. Higher skilled peers who have a larger vocabulary, ability to express themselves, greater familiarity with print materials, and well-developed social skills could stimulate skill development among the other children within their preschool environment, primarily within their classrooms. But peer effects can arise from sources other than direct transmission from one’s peers (Betts & Shkolnic, 1999). For example, peers with more highly developed behavioral skills may cause less disruption of the class and allow teachers to focus their attention on stimulating the children’s development. In addition, peers with higher levels of skills could allow teachers to increase the pace and level of content that they introduce during their interactions with the children. Teachers who introduce content just at the point when the children are capable of assimilating it or encourage the children to practice skills they have just acquired may enhance the cognitive and language skills of the children within their classrooms. Further, teachers may become more motivated when they perceive that the children in their class have higher abilities and may change their instruction in ways that produce the benefits. These hypotheses that set forth plausible explanations of ways that peer abilities may affect children’s development motivate the inclusion of peer effects in evaluations of the child development production function. Moreover, including peer effects may serve as a check on the potential for omitted variable bias in the estimates of the effects of preschool inputs, such as the quality of preschool or center-based child care. When the abilities of peers are omitted from the models, it is possible that the effects of quality are biased upwards and the effects magnified due to misspecification.

Moreover, peer influences bear implications for early education policies. If peer effects are shown to influence children’s development at an early age, policies that raise the average ability level of child’s peers may produce incremental improvements to children’s development. Research on peer effects for school-age children has shown that disadvantaged children benefit most from peers with higher ability levels (Summers & Wolfe, 1977; Zimmer & Toma, 2000). Currently, Head Start, the largest early education program with appropriations of approximately $6.7 billion nationally (Butler & Gish, 2003), targets children from economically disadvantaged families whose development is significantly behind that of other children (US Department of Health and Human Services, 2002; Henry et al., 2004). For example, Henry et al. report that four year olds entering Head Start were over 10 points (0.68 standard deviation units) behind other children entering private preschool in terms of pre-reading skills (2004). If the ability level of peers have positive effects on the development of children with initial skill deficits, it may be advantageous to develop policies with greater mixing of children with different abilities than can be achieved in early education programs targeted exclusively toward disadvantaged children.
However, if highly skilled peers do not affect the skill development of children, the mixing of children with different abilities may assume less importance in policy decisions.

In this study, for what is (to our knowledge) the first time, the effects of peer abilities on the development of children in preschool are estimated. We use data gathered on a probability sample of children attending preschool in Georgia, including children in private preschool, publicly subsidized pre-kindergarten, and Head Start. We develop estimates of the abilities of the children in each child's preschool classroom, which include measures of cognitive skills, pre-reading skills, and expressive language skills. We test the effects of peer abilities on children's skills at the beginning of preschool and after the end of preschool using value-added models that control for family characteristics and preschool inputs. In addition, we test some alternative specifications to assess the robustness of the estimates and the mechanisms through which peer effects register their effects. In the next section, we present the theory underlying the production of skills in early education settings—the production function. In Section 3, we describe the sample, measures, and analysis techniques. In Section 4, the findings are presented. Finally, we draw some conclusions.

2. A theory of early childhood development

A body of evidence relying on randomized experiments has substantiated that high quality early education programs can be both successful in improving children's developmental status (Consortium for Longitudinal Studies, 1983; Schweinhart & Weikart, 1997) and cost-effective (Barnett, 1992). Studies of large-scale public preschool programs indicate that they can contribute to more rapid skill development, increased school readiness, and future school success of the children who participate in them (Gormley & Gayer, 2003; Gormley, Gayer, Phillips, & Dawson, 2004; Henry et al., 2004; Renyolds, 2000; Renyolds, Temple, Robertson, & Mann, 2001). In addition, the quality of classrooms and skills of the teachers are associated with improved student success (NICHD Early Childcare Research Network, 2002; NICHD Early Childcare Research Network & Duncan, 2003; Peisner–Feinberg & Burchinal, 1997). Absent from the current research literature is the estimation of value-added specifications of the child development production function, which test the effects of peer abilities on the development of skills by their preschool classmates.

2.1. The child development production function

Following Boardman and Murnane (1979), Summers and Wolfe (1977), Hanushek (1979), and Zimmer and Toma (2002), we use a value-added specification of the school production function, which because of the early education setting, we term the child development production function:

\[ Y_{t,j} = B_0 + B_1 F_{t,j} + B_1 S_{t,j} + B_1 P_{t,j} + B_1 Y_{t-1,j} + e \]

where, \( Y_{t,j} \) is measure of skills at time \( t \) for the \( j \)th child, \( B_0 \) is a constant, \( F_{t,j} \) is a vector of family background influences from time \( t-1 \) to time \( t \) for the \( j \)th child, \( S_{t,j} \) is a vector of school inputs from time \( t-1 \) to time \( t \) for the \( j \)th child, \( P_{t,j} \) is a vector of peer influences from time \( t-1 \) to time \( t \) for the \( j \)th child, \( Y_{t-1,j} \) is a measure of child skills at time \( t-1 \) for the \( j \)th child and \( e \) is the error term. Innate ability is included in conceptual models that have been developed for estimating the school production function, but it has been routinely omitted from the reduced form equations that have been estimated largely because of the lack of clarity in defining the term and, therefore, in developing measures for it. Here-to-fore, innate ability has primarily played a theoretical role in the school production function. We do not purport to have solved its omission from the estimates of the child development production function presented in this study. Hanushek (1979) argues that including a prior measure of achievement, or in our case a measure of the child’s skills prior to entering pre-kindergarten, does presumably reduce the specification bias since only the growth effects of innate abilities are omitted. The practice of using a single test score from a prior period raises the potential for measurement error (Hanushek et al., 2003; Hoffer, 1992). However, in the case of four-year-olds, who must be directly assessed rather than relying on pencil and paper tests, the lack of available instruments for assessing younger children, the difficulty in assessing young children before they enroll in pre-kindergarten, and cost of direct assessment will likely inhibit obtaining skill assessments from earlier periods, as is the case in this study. Having an estimate of the children’s skills at the beginning of preschool allows us to use a value-
ability of peers. Peer effects have been defined as the effects of the ability of peers (\(P_{1,j}\)) on an individual child (Hanushek et al., 2003; Zimmer & Toma, 2000). Ability is a measure of what a child knows and can do that may influence her peers. The ability of peers may influence the development of other children in the classroom through interactions that occur frequently throughout the day. As we have previously stated, skills may be directly transmitted from one child to another through play or teacher-directed activities, but direct transmission is not the only means by which the skills of peers may influence. Peer effects may arise from a number of different pathways (Betts & Shkolnic, 1999). Better-behaved children in the classroom may avoid distracting the teacher from more effective instruction. Children with higher abilities may allow teachers to introduce more content and encourage the development of higher order skills than she could do with children of lower abilities. Teachers who perceive that they have a class filled with very capable students may be motivated to provide better instruction.

Problems stemming from measurement error are no less of an issue with peer ability than ability of the individual child. In the direct transmission of skills from peers, it is likely that the ability of peers to influence a particular skill may not be solely attributable to the peers’ level of that one particular skill. For example, four-year-olds who communicate well may be able to stimulate the development of counting or cognitive skills on the part of other children in their classroom. In this study, we include a composite measure of the skills of the other children in the classroom to provide a closer approximate for the measure of ability than can be achieved by averaging a single test score across a child’s classmates or a measure of the classroom composition. The composite peer ability measure included measures of the children’s vocabulary, ability to express themselves, problem-solving skills, mastery of basic skills such as counting and color identification, and familiarity with print material.

Other studies of peer effects have included contextual measures as well, primarily measures of classroom composition to assess the alternatives means through which peer effects could occur. While Hanushek et al. (2003) found no significant contextual effects, Summers and Wolfe (1977) did. We also estimated models with contextual measures of peers, specifically racial composition of the classroom and percentage of boys in the classroom. In addition, to test one of the alternative pathways for transmission of peer effects, we also estimated models which include the amount of time which the teacher spent on discipline. Adding this variable to the specification will offer a direct assessment of the cost that disruptive students impose on the development of skills within an early childhood classroom.
The inclusion of a peer ability measure and use of a value-added specification seem likely to reduce specification bias which may have occurred in current estimates of the child development production function. The argument that peers can influence the development of the other children within early elementary classrooms seems particularly strong. Therefore, we estimate the effects of peers, including their ability level, using a value-added specification for the child development production function. These models may also reduce the omitted variable bias which may have inflated estimates of the effects of preschool inputs such as quality of care. While the inclusion of peer effects in the child development production function is a clear improvement over models without measures of peer abilities, other sources of bias are still potentially present. Others have pointed out the potential for endogeneity problems associated with motivated parents seeking out higher quality child care (see NICHD Early Child Care Research Network & Duncan, 2003). In a parallel fashion, we recognize that motivated parents may seek out preschools where their children’s peers will be more able. We do not suggest that this problem has been solved in this paper; however, we do find it heartening that attempts to deal with the problem of endogeneity and measurement error have shown that measurement error is the greater source of bias in estimating peer effects (Roberson & Symons, 2003) and that controls for endogeneity seemed to have little impact on the estimates of peer effects (Hanushek et al., 2003).

3. Sample, measures, and analysis

3.1. Sample

The data used for this study were drawn from the Early Childhood Study (ECS) in Georgia, which began in 2001. The population for this longitudinal study included children who lived in Georgia, who were born between the dates of September 2, 1996 and September 1, 1997, and who attended fulltime preschool in 2001–2002. Approximately 120,000 children in Georgia met the age criteria and were thereby eligible to participate in the ECS. A probability sample which included three groups of children attending preschool was drawn for the study: (1) children enrolled in Georgia’s Pre-K Program; (2) children attending Head Start as four year olds; and (3) children attending private preschools or child care centers who were four years old and, therefore, eligible for the Georgia Pre-K Program. The three groups of children are described briefly in the following paragraphs.

**Georgia Pre-K:** In 1995–1996, Georgia became the first state in the nation to offer tuition-free pre-kindergarten for all four year olds whose parents chose to enroll them, regardless of their household means. In 2001–2002, the program served 63,613 children, 25,711 of whom were classified as economically at risk (Georgia Office of Educational Accountability, 2003). The state expended approximately $216.3 M to operate the program during the study year.

**Head Start in Georgia:** Head Start is a national program that provides comprehensive developmental services for low-income preschool children and their families. Funded at approximately $6.7 billion nationally, Head Start serves over 900,000 children and their families each year (Congressional Research Service, 2003). In Georgia, Head Start programs serve nearly 20,000 children ranging from three to five years old in 33 different programs covering 157 of Georgia’s 159 counties (Georgia Head Start Collaboration Office, 2003). For the 2001–2002 school year, Georgia Head Start provided spaces for 10,976 four year olds (Georgia Office of School Readiness, 2003).

**Private preschools:** For the purpose of this study, private preschools are schools or child care centers that offer educational and developmental programs for four year olds in exchange for tuition or fees for these services. The families of the children receiving the services usually pay the school or center directly. These preschools include private-not-for-profit programs, such as church-based schools, and private-for-profit programs, such as child care facilities or private college-preparatory day schools. All of the preschools included as private preschools in this study are licensed by the state. However, the preschools vary in a number of significant ways, including the population of four year olds served, the credentials and skills of teachers employed, and their approach to child development.

A stratified random sampling approach was used to select the children included in the study. First, counties were stratified into five groups according to their population of four year olds and 21 counties were selected at random. The agencies administering the programs provided lists of all schools and centers meeting the study criteria in the 21 counties selected in the first stage. Using a random selection
test of the Oral and Written Language Scales (OWLS), which was administered at the beginning of preschool and end of preschool (Carrow–Wolffolk, 1995). The OWLS was not administered at the beginning of kindergarten. All assessments were administered by trained staff who had achieved reliable scores in practice rounds before assessing children in the study. These measures provide reliable and valid estimates of the individual skills and are in many ways similar to standardized test scores that are used as measures of student performance. Prior research has indicated that skill advantages represented by measures such as these are an important intermediate outcome that is associated with positive social outcomes in later years. These include avoiding retention, avoiding special education, high school graduation, and avoiding being held within the criminal justice system (Renyolds, 2000; Renyolds et al., 2002).

In Table 1, the descriptive statistics for the developmental skills at the beginning of preschool and after preschool are presented. Except for the measure of familiarity with printed material and listening comprehension (Story and Print), the raw scores for each of the skills are converted to age-adjusted standardized scores according to the test developers specifications, such that a mean of 100 and standard deviation of 15 are expected if the skills among the sampled group are equivalent to the norming population. At the beginning of preschool only the children’s scores in terms of letter and word recognition exceeded the expected norms. Expressive language skills and vocabulary fell considerably below expectations. By the beginning of the kindergarten year, averages exceeded expectations for letter and word recognition and cognitive skills. At the end of preschool, expressive language skills remained well below the national norm. For the purpose of estimating the size of the effects, the measures of developmental skills were all transformed to standardized scores with a mean of 0 and standard deviation of 1.

Family characteristics: Family characteristics that are included in this study are family income, receipt of Temporary Assistance for Needy Families (TANF), whether both parents had lived continuously with the child since birth and mother’s education level. Mother’s education is measured by two dichotomous variables, the first indicating that the mother had not earned a high school degree, and a second indicting that the mother had only received a high school degree but no further
education. Family income was reported by the parents on a survey using a continuous 10 point scale which topped out at $100,000 or above per year. An indicator variable was used for receipt of TANF was drawn from two sources: the parent survey and a search of the state TANF roles at two points in time since the birth of the child. If either source indicated receipt of TANF, the dichotomous variable was coded one. The parent survey also supplied the data for a dichotomous variable coded one if the parents indicated they had both lived with the child since birth. Table 2 presents the descriptive information for these variables.

School inputs: For this study, the definition of school inputs was broadly construed and the measures of school inputs were comprehensive to reduce the potential for positive bias in the peer effects variables. We include resource and process measures for this reason, including eight school- and teacher-related variables. A directly observed, standard measure of quality that has been frequently used in other studies of the effects of center-based child care and preschool, the Early Childhood Environmental Rating Scale–Revised (ECERS-R) was used to rate quality in each of the study classrooms. Ratings were conducted by trained observers who spent at least one day in each classroom. Three teacher characteristics were included: a dichotomous variable indicating that the teacher had an associate’s degree; a dichotomous variable indicating the teacher had a bachelor’s degree, and the number of years each teacher had experience in teaching preschool through third grade in years. Also, included was the total number of students in the class. The teacher’s were asked to estimate how much time per day that they spent on discipline in the class on a teacher’s survey. Time spent on discipline is often hypothesized to be both a cause of effects associated with class size differences and a source of bias when omitted from education production function estimates, especially for groups that are believed to present more disciplinary problems.1 Finally, two variables measuring program type, Head Start and private preschool were included, making the reference group children attending Georgia’s Pre-K program to control for systematic differences in the effectiveness of the programs. The school inputs are described in Table 2, also.

Peer effects: Following Zimmer and Toma (2000), we are primarily interested in the ability level of a child’s peers in the estimation of the child development production function. Children’s development is likely to be affected by the general abilities of their peers not just their ability in a specific skill being evaluated, especially at four years old. For example, the communication skills of peers including vocabulary and listening comprehension as well as their cognitive skills, may affect other children’s cognitive development. We constructed a composite measure of peer ability that represents what peers were able to do from across the range of all skills that were directly assessed in the study. We combined all of the assessment scores taken at the beginning of

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1The models were estimated with and without time on discipline as part of classroom effects. Results on the former are included in the robustness of estimates section.
preschool for the random sample of peers in the class in which each child was enrolled. We only included children in the study when at least four peers had valid measures on all assessments. It is important to note that the peer effects are measured at the classroom level, not the school level. In theory, the effects of peers within a preschool classroom are more closely linked to the skill development of the children within that classroom. School level peer characteristics were not observed in this study. Scores included in the peer ability construct were: cognitive skills (WJ-AP), three measures of pre-reading skills (PPVT, Story and Print Concepts assessment, and WJ-LW), the expressive language sub-test of the OWLS, and the number of basic skills that the child had mastered (counting, number naming, and color naming). The scores for each skill measure were converted to standardized scores ($z$ scores) and averaged for each child. The average score for each child’s peers within the classroom were averaged and included as the measure of peer ability. The peer ability scale is highly reliable as indicated by a Cronbach’s alpha of 0.896. The conversion to standardized scores allows us to interpret the coefficient on the peer ability measure in a way that allows comparison to other estimates of peer effects.

In addition, we included several other measures of the characteristics of children in the classroom to assess the possibility of omitted variable bias and examine the mechanism by which peer ability effects may be transmitted. The percentage of boys in the class, percentage of African-American children in the class, and percentage of Hispanic children in the class were included in subsequent models. These measures were collected from rosters that included all of the children in each of the sample classrooms. As Table 2 shows, the sample classrooms ranged from 0% to 100% African-American and averaged about 38.2% African-American children. The race of the individual child was also included in two dichotomous variables, one indicating an African-American child and one indicating a Hispanic child.

### 3.3. Analysis

Our primary hypothesis is that the ability level of a child’s peers in preschool will produce positive, additive effects on the growth of the child’s skills. Estimates of the child development production...
function were generated using OLS. Standard errors were corrected for stratification and cluster effects due to the sampling design. Five sets of models were estimated to assess the effects of peers on the development of skills during preschool.

The main results are from the five alternative models, all of which use the child development production function specification, each estimated for five different skills. For each of the alternative models the individual and family characteristics and school inputs remain the same—including the child’s baseline test score from the beginning of preschool as a test of innate ability. The main findings present estimates of the peer ability measure constructed from the $z$ scores. The four equations alternative specifications were used to test the robustness of the peer effects estimates and the potential pathways through the peer effects may occur. Equation two used an alternative measure of peer abilities using only the standardized assessments. Those assessments were averaged across each child’s peers in their preschool classroom and converted to standardized scores (mean = 0 and $s = 1$). The third equation included a measure of teacher’s assessment of kindergarten readiness to assess the impact of teachers’ motivation. The third equation was used to assess the extent to which classroom disruption could be considered a mechanism through which peer effects are transmitted to skill acquisition. Finally, the fourth alternative models included contextual variables of the classroom composition in the model for each of the five skill variables.

4. Findings

4.1. Direct assessments including baseline scores

The effects of peers on the pre-reading scores of the children in the study were positive, but not always significant (Table 3). Higher peer abilities are associated with significantly more receptive vocabulary (PPVT) in the fall of kindergarten and with significantly greater familiarity with print materials and listening comprehension skills (Story and Print concepts). Increasing peer abilities by one standard deviation increases children’s receptive vocabulary by more than one-quarter standard deviation on average. Similarly, increasing peer abilities by one standard deviation increases print familiarity and listening comprehension by approximately one-third standard deviation. In contrast, the effect of peers on letter and word recognition was insignificant. In terms of school inputs, class size was significantly and positively related to receptive vocabulary. The children’s skills at the beginning of preschool scores for all tests were significantly and positively related to the subsequent scores for the same test, except for Story and Print. Boys appear to do better on the PPVT but worse on the story and print assessment, after the other variables are controlled. African-Americans scored lower than White children on the pre-reading skills during fall, but the differences were insignificant after controlling for the other variables in the model. Income is associated with better letter and word recognition.

Increasing children’s cognitive skills at kindergarten entry is particularly important. Cognitive skills may play a role in grouping children for instructional purposes and may be a key determinant of retention and assignments to special education and remedial education. At least one study indicates that a cognitive advantage at school entry is a mechanism through which early education programs translate into longer term social benefits (Renyolds, 2000). Ability level of peers in preschool classrooms was associated with increased cognitive skills at the beginning of kindergarten, as shown in Table 3. A one standard deviation increase in peer abilities increased cognitive scores by slightly more than one-third standard deviation at the beginning of kindergarten. Using the children’s cognitive scores at the end of kindergarten, this effect is shown to persist through the kindergarten year and although it is somewhat smaller, about one quarter standard deviation (results not shown). African-American children average cognitive scores over one quarter standard deviation below White children, but other minorities do not differ from White children on this measure. As expected, children’s cognitive skills at the beginning of preschool are strongly and significantly related to their skills at the beginning of kindergarten.

After controlling for the other variables in the model, peer abilities are significantly associated with higher expressive language scores at the end of the preschool year (Table 3). Increasing peer abilities by one standard deviation raises children’s scores by 0.02 standard deviations. As is the case with cognitive skills, a significant and sizable gap (nearly one-third standard deviation) in expressive language skills exists between African-American kindergarteners.
We used four alternative specifications of the child development production function to assess the robustness of the estimates of peer effects presented in the previous three sections and to shed light on three of the pathways through which peer effects are hypothesized to work. First, we used an alternative measure of the peer abilities within the classroom. For the primary test, we transformed six assessments obtained at the beginning of preschool to standardized scores and averaged the assessments for each child’s peers in the classroom. Although the reliability of the six baseline scores was quite high (Cronbach’s alpha = 0.896), the composite measure included two frequently used tests that do not have a norm-referenced score. To provide a check on the robustness of the measure, we constrained the peer ability measure to include only the four tests with norm-referenced scores. The results for the coefficients on the peer ability measures are included in Table 4. The coefficients for this measure of peer abilities are all larger than was the case for the broader measure of peer abilities. The lone insignificant coefficient on peer abilities in the original specification (letter and work recognition equation) is significant in this specification. An increase of one standard deviation in peer abilities increases children’s skills in recognizing letters and words by over one-quarter standard deviation.

A second alternative specification investigates the potential for teachers to become more motivated or change their behaviors in the classroom when they...
believe that they have a more able class. In this case, the effects of the ability of peers may represent a signal while the real effect comes from the teachers’ interaction with the children. To assess the extent to which the ability of peer effects remained after controlling for the teachers’ ratings of the abilities of children in their classroom, we added teachers’ readiness ratings to the models. Readiness ratings may be a more direct reflection of the teachers’ attitudes about the ability levels of the class than the directly assessed measures (Mashburn & Henry, 2004). Teachers were surveyed in the spring of the preschool year and asked to rate the overall readiness of the study children in their classroom for kindergarten. The rating was collected on a seven-point scale. The ratings for the children in the class were averaged for each class and that variable was included in the model. None of the coefficients on peer abilities were affected significantly by including the teachers’ ratings of the readiness of children in her class in the equations. This does not support the hypothesis that teacher motivation is responsible for the relationship between peer abilities and skill acquisition in preschool.

A third alternative specification was used to assess the extent to which classroom disruption could be considered a mechanism through which peer effects are transmitted to skill acquisition. For these models, teachers’ reports of the time spent on discipline were included. In no case were the coefficients on peer abilities changed significantly and in no case was the coefficient on time spent on discipline significant. Finally, we included contextual variables in the model for each of the five skill variables. The percentage of boys in the classroom positively and significantly affected the development of expressive language skills, but without substantively affecting the coefficient on peer abilities. In no case were the coefficients on the racial composition of the class significant and for no other skill was the percentage of boys in the classroom significant.

### Table 4

<table>
<thead>
<tr>
<th>Cognitive</th>
<th>Pre-reading</th>
<th>WJ-LW</th>
<th>Story and Print</th>
<th>Expressive language</th>
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<td>WJ-AP</td>
<td>PPVT</td>
<td></td>
<td>OWLS</td>
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<td><strong>Peer abilities (std)</strong></td>
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<td>0.42***</td>
<td>0.29*</td>
<td>0.72***</td>
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<td><strong>Teacher motivation</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Peer ability (std)</td>
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<td>0.04***</td>
<td>0.08</td>
<td>0.33*</td>
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<tr>
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<td><strong>Discipline</strong></td>
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<td></td>
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<tr>
<td>Peer abilities (std)</td>
<td>0.38** (0.13)</td>
<td>0.28** (0.11)</td>
<td>0.05 (0.14)</td>
<td>0.37** (0.15)</td>
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<td>-0.01 (0.04)</td>
<td>-0.02 (0.05)</td>
<td>0.03 (0.06)</td>
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<td><strong>Class composition</strong></td>
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<tr>
<td>Peer abilities (std)</td>
<td>0.39** (0.13)</td>
<td>0.32** (0.13)</td>
<td>0.03 (0.12)</td>
<td>0.33** (0.15)</td>
</tr>
<tr>
<td>% Boys</td>
<td>0.29 (0.42)</td>
<td>-0.09 (0.35)</td>
<td>-0.13 (0.40)</td>
<td>0.09 (0.44)</td>
</tr>
<tr>
<td>% African-American</td>
<td>0.12 (0.24)</td>
<td>0.30 (0.27)</td>
<td>0.02 (0.19)</td>
<td>0.07 (0.28)</td>
</tr>
<tr>
<td>% Hispanic</td>
<td>0.30 (0.47)</td>
<td>0.14 (0.43)</td>
<td>-0.84* (0.19)</td>
<td>0.56 (0.63)</td>
</tr>
<tr>
<td>N</td>
<td>242</td>
<td>238</td>
<td>243</td>
<td>241</td>
</tr>
</tbody>
</table>

**Notes:** The expressive language assessment (OWLS) was administered at the end of the Pre-K year. That assessment was not conducted at the beginning of the kindergarten year.

* *p < 0.10 level.
** **p < 0.05 level.
*** ***p < 0.01 level.
5. Conclusions

A positive relationship exists between peer abilities and the development of cognitive, pre-reading, and expressive language skills for children in preschools and child care settings. The finding of positive peer effects using the value-added specification of the child development production function is a unique contribution of this study. The effects of the peers in a child’s classroom are sufficiently substantial to deserve routine inclusion in studies estimating the child development production function in formal settings. Since the estimates of peer abilities were based on a sample of the other children in a class, it might be expected that these estimates would be attenuated. Further research based on all of a child’s classmates may yield more precise effect size estimates but the estimates in this study are not affected by sampling bias, since the children were chosen at random from the classroom. If the hypothesis that cognitive advantages at school entry gains further support as a mechanism through which early education translates into later social and educational benefits, the importance of early education peer effects may be increased.

The magnitude of the effects of peer abilities on individual student performance appears to be somewhat larger in this study of early education than in studies of peer effects in latter schooling. For example, Hanushek et al. (2003) report effects for math achievement ranging between 0.15 and 0.24 standard deviation units (p. 540). The effects of peer abilities in our study of preschool children range between 0.02 for expressive language skills and 0.36 for cognitive skills. While it is difficult to make direct comparisons because of the differences in the outcomes measured in these two studies, it is possible that the effects of peer abilities may be as large or larger in preschools as in K-12 schools.

The effects of preschool inputs are reminiscent of the patterns found for K-12 school inputs. None of the inputs showed a consistent pattern of effects. In some cases, such as class size, when effects did register, they were in the opposite direction of conventional wisdom. It is easy to imagine that the best teachers created the most demand and that these classes were filled to capacity as a result. The results appear to be consistent with this, although disentangling the direction of the relationships would require a different research design. The lack of a relationship between classroom quality and children’s skill development when peer effects were included in the equations may raise questions about the attribution of school input effects from some earlier studies in which the abilities of peers were omitted.

By no means do we purport that these results of associations between peer abilities and skill development have definitively established that peer effects in preschool cause higher levels of skill development. Methodological limitations due to potential endogeneity of peer abilities and issues related to the distribution of peer abilities (Glewwe, 1997), while they have been discounted in other studies of peer effects in K-12 schools, should make us cautious about the estimates of peer effects in this study. However, the magnitude and strength of the associations make a compelling case that estimates of the effects of inputs in preschool are likely to suffer from omitted variable bias unless peer abilities have been included in the model specification. In addition, future studies should include estimates of the effects of peer abilities on children with both high and low initial levels of skills. We were unable to obtain reliable estimates, due to the limited number of children within the classes on whom the peer skills were estimated. It is very important to have estimates of the effects on children at both ends of the skills continua to inform policy deliberations related to mixing of students at the time when publicly subsidized pre-kindergartens and preschools are rapidly developing across the US.

6. Uncited references

Dunn and Dunn (1997); Foster (2003); Light and Littleton (1999); Moffitt (2001); Wagner, Torgesen, and Rashotte (1999); Woodcock, McGrew, and Mayer (2001).

Acknowledgments

This research was funded in part by the UPS Foundation, National Institute for Early Education Research, which is generously funded by the Pew Charitable Trust, and Bright From the Start: Georgia Department of Early Care and Learning. The content of the manuscript and the interpretations of the findings are the responsibility of the authors.
References


