

## Nature–Nurture in the Classroom: Entrance Age, School Readiness, and Learning in Children

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The impact of entrance age on reading and mathematics achievement in 1st grade was examined. Methodological problems with past research were identified, including small size of achievement differences, failure to take background variables into account, and confusion of achievement levels with degree of learning. Using a pre–post design, growth of reading and mathematics was examined in younger 1st graders, older 1st graders, and older kindergarteners. Comparisons of background information on these groups with children who were either held out prior to or retained an extra year in kindergarten, produced minimal background differences. Results revealed that younger 1st graders made as much progress over the school year as did older 1st graders and made far more progress than older kindergarteners. Overall, findings demonstrated that, in itself, entrance age was not a good predictor of learning or academic risk.

The role of genetic or maturational versus experiential influences on psychological development surfaces regularly in efforts to explain important psychological phenomena. In recent years, the intensity of the “nature–nurture” debate has heated up in both academic and applied settings. Findings from work in quantitative behavior genetics (Plomin, 1995; Rowe, 1994) have revealed substantial genetic influences across a range of intellectual and personality dimensions, including IQ, introversion–extraversion, depression, and aggression (Plomin, 1990; Scarr, 1992). Moreover, the unique impact of environmental influences has also been highlighted recently, including schooling effects on memory and language skills (Ferreira & Morrison, 1994; Morrison, Smith, & Dow-Ehrensberger, 1995) as well as on selected narrative and quantitative problem-solving skills (Bisanz, Morrison, & Dunn, 1995; Varnhagen, Morrison, & Everall, 1994). As a consequence of these advances, debate has been reawakened among basic developmental scientists on the unique and interactive effects of genetic and environmental influences (Wahlsten, 1996) as well as on the most fruitful theoretical

conceptualization of their impact on psychological development (Bronfenbrenner, Ceci, & Lenzenweger, in press).

In reality, the nature–nurture debate is by no means limited to academic circles. Important social problems have also generated controversy over the roles of genetic versus environmental factors. Recent examples include the debates over the success or failure of compensatory education (Jensen, 1969), over genetic versus social factors underlying criminal behavior (Wilson & Herrnstein, 1985), and over the bases for cross-cultural differences in academic achievement (Stevenson & Lee, 1990). This classic dichotomy has surfaced again in recent years in educational circles, surrounding the question of school readiness and entrance age. Specifically, concerns have been expressed in the scientific and popular literature that children who are young when they enter Grade 1 (effectively, 5 years old) may be at risk for academic underachievement, lowered self-esteem, and later adaptation problems. Yet, research findings in this area have not uniformly supported this claim, leading to a confusing and contradictory picture.

On one side, a number of reports have claimed that the youngest children in a class are more likely to perform less well academically (Breznitz & Teltsch, 1989; Davis, Trimble, & Vincent, 1980), to repeat a grade (Langer, Kalk, & Searls, 1984), to be referred to special education (Di Pasquale, Moule, & Flewelling, 1980; Maddux, 1980), and to be labeled as learning disabled (Maddux, 1980). The maturationalist theme underlying such claims is that young children entering Grade 1 are not developmentally ready to benefit from formal schooling (Gesell, 1940). Consequently, researchers have argued that these children progress little academically, their poorer performance compared with older classmates results in feelings of anxiety and lowered self-esteem, and subsequent emotional and motivational difficulties produce a spiralling circle of increasing academic and social failure throughout elementary and junior high school.

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On the other side, careful review reveals a number of logical and methodological problems with these studies (Shepard & Smith, 1986, 1988). In addition, not all studies found age to be a major, independent predictor of early school success (Alexander & Entwistle, 1988; Gredler, 1980; Jones & Mandeville, 1990; Shepard & Smith, 1986). Still, in other studies with cross-sectional designs, researchers have noted that age differences in achievement in the early grades diminish or disappear in later grades (Langer, Kalk, & Searls, 1984; Miller & Norris, 1967; Shepard & Smith, 1986; but see Breznitz & Teltsch, 1989).

Examination of the rather extensive and contradictory literature on this question reveals at least three major problems with existing research that could contribute to the currently confused picture.

### Magnitude of Age Differences

First, the size of the achievement differences found in many studies comparing younger with older first graders, although statistically significant, is seldom very large and, hence, of dubious educational significance (Shepard & Smith, 1986). For example, using sample sizes of over 8,000 children per grade, Davis et al. (1980) found that, at the end of first grade, children who were fully 6 years old at the beginning of the year were only 9 percentile points ahead of children who were 5 years old at the beginning of the year. Similarly, Shepard and Smith (1985), examining data from 700 first graders in 10 separate schools, found an average of only a 9 and a 6 percentile point difference in reading and math, respectively, between youngest and oldest first graders. In a recent investigation of factors contributing to the risk of reading failure in elementary school children, Jones and Mandeville (1990) found that the proportion of total risk attributed to socioeconomic and racial factors was 13 times larger than that contributed by chronological age. These findings reinforce the view that achievement differences between younger and older children are small in absolute magnitude and in educational relevance compared with other factors.

### Assessment of Background Characteristics

Second, few studies have attempted to systematically control for potentially biasing background variables (e.g., IQ, day-care experience, and parental education and occupation). There are several potentially important problems in this area. Differential rates of participation in research studies as a function of socioeconomic, racial, or other factors may yield group differences in background characteristics for younger versus older entrants, which could in turn influence the direction and magnitude of the achievement differences observed. Depending on the nature and sources of the bias, real group differences may be eliminated, or nonexistent group differences may be artifactually created.

In addition, differential rates of holding out and retaining younger rather than older students could produce different background characteristics in the two samples that might yield a biased picture. Younger children are held out for a year prior to kindergarten and retained an extra year in kindergarten to a greater degree than are older children (Shepard & Smith, 1985). Consequently, depending on the policies of local school

boards and the existing stereotypes in communities about the importance of entrance age on development, background characteristics of younger versus older children entering school may differ substantially sometimes in counterintuitive ways. Certainly, in some cases, children deemed to be cognitively, academically, or socially at risk may be held out or retained. Such practices could yield residual samples of younger school entrants with more favorable background characteristics on average (like IQ or socioeconomic status [SES]) than older entrants (Cahan & Cohen, 1989), thereby reducing the magnitude of the age effect. In some communities, however, substantial numbers of relatively affluent, educated parents of comparatively bright, mature children opt to hold them out prior to kindergarten or have them repeat kindergarten simply to avoid any possible disadvantage to their child. This removal of young, high SES children serves to lower the background characteristics of the residual group of younger age entrants as compared with older children, thereby magnifying the size of the age differences.

Finally, although some studies claimed that achievement differences diminished in later grades (Langer, Kalk, & Searls, 1984), higher retention rates over the elementary school years for younger versus older entrants could systematically eliminate the poorest performing younger entrants from the later comparisons, thereby minimizing the true size of the age effect on growth of academic achievement. Overall, without gathering systematic information on younger versus older entrants, one cannot be certain to what degree and in what direction potential group differences in background characteristics might be produced nor can their subsequent impact on academic achievement be predicted beforehand.

### Measuring Degree of Progress

Third, by focusing attention on age differences in absolute levels of academic achievement, most research has systematically overlooked the more central question, namely, are relatively young children learning? It is entirely possible that younger entrants, being in some cases almost a full year younger than older entrants, start out first grade slightly behind their older classmates but make as much (or more) progress during the course of the school year, concluding first grade only a few percentile points lower. Without some way to assess degree of progress in children (e.g., with a pre-post design), one cannot draw valid conclusions about whether younger children are learning as well as older children.

Taking into account these methodological issues, in this study, we attempted to reexamine the influence of entrance age on academic achievement. To compare degree of learning, three groups of children were chosen for study: younger Grade 1 children (those with birthdates within 2 months prior to the official cutoff date for school entry); older Grade 1 children (those with birthdates falling 2 months after the official cutoff date for school entry); and older kindergarten children (those with birthdates falling 2 months after the official cutoff date for entry into kindergarten). This latter group comprise children who just missed the cutoff for Grade 1 but were very close in age to the younger Grade 1 children (in this study, they averaged 58 days apart in age). Children were tested in reading and

mathematics performance in the early fall and late spring of the school year.

This pre-post design with three groups of children permitted two fundamental questions to be asked. First, do younger Grade 1 children make as much progress in reading and math as do older Grade 1 children? Second, do younger first graders make any more progress in reading and math than a closely age-matched group of kindergarten children who just missed the cutoff for Grade 1? Put another way, the latter question asks whether younger Grade 1 children make any more progress than they would have if they had been in kindergarten. On the surface, the comparison between younger first graders and older kindergarteners may seem unfair, because kindergarteners really do not receive the same degree of formal schooling in reading and math as do first graders. Yet the strong form of the claim that younger first graders are not ready for formal schooling would necessarily predict that the degree of learning exhibited by younger first graders should be no greater than that exhibited by an age-matched group of children not exposed to the formal schooling experience (i.e., older kindergarteners who just missed the cutoff date).

In one final question addressed in this study, we examined the magnitude of predicted schooling effects in reading versus mathematics. Accumulating evidence (Stevenson & Lee, 1990) suggests that American schools and families place more emphasis and spend more instructional time on reading and related activities than on mathematics in the elementary grades. Consequently, we anticipated that schooling effects for reading achievement would be more pronounced than on mathematics achievement.

To assess potential differences in background characteristics, we gathered data on children's IQ, amount of day-care experience, and parental occupation and education. These data were crucial for examining whether differential rates of holding out or retaining younger age entrants might produce group differences in important background characteristics that could influence academic performance.

Because of the potential importance of these types of subject selection biases with the present research design (Bentin, Hammer, & Cahan, 1991; Cahan & Cohen, 1989), we directly compared the background characteristics of the group of younger first graders with two other groups of children. The first was a *held-out* group, composed of children identical in age to younger first graders and therefore eligible for school entry but who had been held out for a year prior to entry into kindergarten. The second was a *retained* group, composed of children identical in age to younger first graders but who had spent an additional year in kindergarten. Unfortunately, limitations on the number of testers available did not permit collection of comparable achievement data on the samples of held-out and retained groups in this study.

It is worth noting that the first graders in this study represent the youngest group of children in North America receiving formal Grade 1 schooling (as far as we can ascertain). The cutoff date for school entry in the locale under study is March 1 (i.e., they must have turned 5 years of age by this date to be allowed entry to kindergarten the previous September). Therefore, young school entrants could have started kindergarten as young as 4 years 6 months of age. Hence, to the degree that being

relatively young is a major hindrance, this group of younger first graders should be more at risk than any other children on the continent receiving Grade 1 instruction.

## Method

### Participants

A total of 539 children participated in the study: 152 young Grade 1 children (87 girls and 65 boys), 114 old Grade 1 children (66 girls and 48 boys), 126 old kindergarten children (60 girls and 66 boys), 103 held-out children (40 girls and 63 boys), and 44 retained children (17 girls and 27 boys). Children were recruited into the study over a 3-year period from 26 public elementary schools in a moderately large city in western Canada. Participating schools represented a broad spectrum of socioeconomic levels and geographic areas within the city. All participating children spoke fluent English and were judged by teachers to be free of serious medical, neurological, behavioral, and emotional problems.

Young first-grade children were defined as those whose birthdates fell within 2 months prior to the official March 1 cutoff date for school entry. Old kindergarten children's birthdates fell within 2 months following the official cutoff date. Old first-grade children were identical to old kindergarten children, but were a year older. Held-out children included those with birthdates 2 months prior to the official cutoff (and hence eligible the year before for school entry) but who had been held out of kindergarten for a year. Retained children were those with birthdates 2 months prior to the official cutoff date, who had entered kindergarten at the appropriate time but had been retained an extra year in kindergarten. The latter two groups, then, were identical in age to the young first-grade group but had not proceeded to first grade according to an age-appropriate schedule.

### Educational Setting

Examination of the curriculum guidelines and discussions with teachers and administration officials revealed that the instructional environment in kindergarten was grounded in a philosophy featuring *learning through play* activities, in which teachers emphasized developmentally appropriate practices to promote children's learning and development. Although the definition of *developmentally appropriate* was not entirely clear or consistent across teachers, in practice, instruction in kindergarten emphasized informal student arrangements coupled with individual choice by students of the activity on which they would focus. Teachers attempted to facilitate children's learning within the context of these child-initiated activities. As a consequence, relatively little time was spent in kindergarten on formal drills in component reading and mathematics skills (such as sound blending, initial consonant stripping, and adding and subtracting). Informal instruction in kindergarten provided experiences in alphabet recognition, sounding out letters, narrative skills, number recognition, and counting.

In contrast, more formal instruction was reserved for first grade. Here, seating arrangements at tables were more permanent and periods of whole-group instruction were scheduled daily, along with more child-initiated sessions. Curricular guidelines emphasized direct instruction in alphabet recognition, letter-sound associations, initial consonant stripping, sound blending, and addition and subtraction. Overall, more instructional time was spent in first grade on reading and related skills than in mathematical skills, consistent with findings in other North American school districts (Stevenson, Lee, & Stigler, 1986; Stevenson & Lee, 1990).

In general, while kindergarten emphasized learning through child-initiated playlike activities facilitated by the teacher, first grade introduced more formal instruction in early reading and mathematics skills. As a result, although some measurable influence of schooling was pre-

dicted following kindergarten, more substantial changes were anticipated following first grade. Further, we expected schooling effects to be relatively greater in reading compared with mathematics, given the relatively greater instructional time spent in reading and related activities.

### Materials and Procedure

As part of a larger battery, three tests were administered to the kindergarten, young first-grade and old first-grade children. In the early fall and late spring of the school year, the Reading subtest of the Wide Range Achievement Test—Revised (WRAT-R; Jastak, 1978) and the Mathematics subtest of the Peabody Individual Achievement Test—Revised (PIAT-R; Markwardt, 1989) were given to each child individually. Order of test administration was counterbalanced within groups. The WRAT-R measures children's skills in letter knowledge and elementary word decoding. The PIAT-R measures a range of mathematical knowledge and skills in kindergarten and first grade, including number recognition, counting, cardinality and ordinality, and addition and subtraction. We chose these tests for their strong psychometric validity and reliability and because the focus of inquiry of this study was on general academic achievement and not on more specific components of reading and mathematical skills. During the middle of the year, each child received the six-subtest short form of the Stanford-Binet Intelligence Scale—4th edition (Thorndike, Hagen, & Sattler, 1986). Reliability indices for this version range from .95 to .97 for children in this age span. All tests were administered by research assistants trained by a licensed, clinical psychologist. Also, parents were asked to complete a questionnaire, developed by the experimenters, which yielded information on parental occupation derived from Pineo-Porter-McRoberts 16-point scale (Pineo, Porter, & McRoberts, 1977) on parental education and on each child's preschool experience.

### Results

#### *Background Variables for Old Kindergarten, Young First-Grade, and Old First-Grade Groups*

The old kindergarten, young first-grade, and old first-grade groups were compared on several background factors that could potentially differentiate the groups and contribute significantly to academic achievement. Specifically, child IQ, day-care experience, paternal and maternal occupation, and paternal and maternal education were compared in a series of one-way analyses of variance (ANOVAs). Because of the number of pairwise comparisons conducted on each measure (three), a Bonferroni correction was applied to hold the overall probability of a Type I error at  $p < .05$ . Across all comparisons, only mother's occupational status yielded a reliable effect,  $F(2, 207) = 3.365$ ,  $p < .03$ . Follow-up comparisons revealed that the occupational status of mothers of young first graders was relatively higher than that of older first graders,  $t(207) = 2.53$ ,  $p < .01$  (see Table 1; note that lower scores mean higher occupational status). With that exception, examination of these samples of children and families failed to reveal major systematic differences in important background characteristics that could influence academic achievement results. Similar comparisons on a number of other background variables (e.g., maternal employment status, number of siblings, single-parent homes) yielded no evidence of any differences among the old kindergarten, young first-grade and old first-grade groups of children.

Table 1  
*Background Characteristics of the Five Groups of Children in the Study*

Variable	Group				
	Old K ( <i>n</i> = 126)	Young G1 ( <i>n</i> = 152)	Old G1 ( <i>n</i> = 114)	Held-out ( <i>n</i> = 103)	Retained ( <i>n</i> = 44)
Entrance age <sup>a</sup>					
<i>M</i>	65.0	67.0	77.0	67.0	67.0
<i>SD</i>	0.7	0.7	0.7	0.7	0.7
IQ					
<i>M</i>	105.0	109.0	107.0	109.0	105.0
<i>SD</i>	11.6	10.6	11.4	9.3	8.6
Paternal occupational status <sup>b</sup>					
<i>M</i>	8.8	9.5	9.4	9.1	7.3
<i>SD</i>	4.4	4.1	4.4	4.1	3.9
Maternal occupational status <sup>b</sup>					
<i>M</i>	9.4	8.3	10.1	9.2	9.9
<i>SD</i>	4.1	4.1	4.1	4.1	4.1
Paternal education <sup>c</sup>					
<i>M</i>	14.0	13.6	13.9	13.4	12.6
<i>SD</i>	2.5	2.9	2.6	2.8	2.6
Maternal education <sup>c</sup>					
<i>M</i>	13.2	12.8	13.4	13.2	12.7
<i>SD</i>	2.5	2.2	2.3	2.2	2.0
Day-care experience <sup>d</sup>					
<i>M</i>	9.4	9.6	6.7	11.9	10.2
<i>SD</i>	15.4	16.3	13.6	18.8	17.8

Note. K = kindergarten; G1 = Grade 1.

<sup>a</sup> Age of child (in months) at beginning of the school year. <sup>b</sup> Derived from Pineo-Porter-McRoberts (1977) 16-point scale (1981). <sup>c</sup> Number of years of formal schooling. <sup>d</sup> Number of months of day-care experience.

### Comparisons of Background Variables for Young First-Grade, Held-Out, and Retained Groups

Like the previous analyses, results of a series of one-way ANOVAs revealed only one statistically reliable difference among the young first-grade, held-out, and retained groups. Paternal occupational status of young first graders was reliably higher than that of retained children,  $t(212) = 2.67, p < .05$ . Overall, minimal differences emerged in this study in the background characteristics of groups of identically aged children either promoted according to the appropriate age schedule, held out for 1 year prior to kindergarten entry, or retained an extra year in kindergarten.

Because relying exclusively on examination of mean differences can sometimes obscure group differences in the range or distribution of scores, frequency histograms of the scores for each major background variable were examined for young first-grade, held-out, and retained groups. In each case, there were no obvious differences across groups in overall distribution of scores. For example, Figure 1 depicts the frequency distribution of IQ scores for the young first-grade, held-out, and retained groups. As is readily discernible, the overall shape of the distributions is quite similar across groups, approximating a normal curve. The only possible difference among groups was a slight tendency for fewer, very high IQ scores in the group of retained children. Nevertheless, substantial numbers of children with normal and above average IQ scores were in the retained and, especially, the held-out group. One held-out child had an IQ of 138!

Overall, our examination of background variables gleaned little evidence that major differences existed among the groups of promoted, held-out, and retained children, which was consistent with the failure to find differences among the three study groups—old kindergarten, young first grade, and old first grade.

### Academic Achievement in the Old Kindergarten, Young First-Grade, and Old First-Grade Groups

We conducted a three-way mixed ANOVA on mean raw scores for reading and mathematics achievement, with group (old kindergarten, young first grade, old first grade) and gender as between-subject variables and test phase (pretest, posttest) as the within-subject variable. As in previous analyses, given the number of pairwise comparisons conducted on each measure (nine), a Bonferroni correction was applied within each area (i.e., reading and math) to hold the overall probability of a Type I error to  $p < .05$ . Gender did not yield any significant main effects or interactions on reading achievement scores. A reliable main effect of gender,  $F(1, 386) = 10.020, p < .002$ , and a significant Gender  $\times$  Group interaction,  $F(2, 386) = 3.280, p < .04$ , on mathematics achievement scores revealed that, for old first-grade students only, boys outperformed girls,  $t(386) = 3.29, p < .05$ , whereas no gender differences were found for the other two groups.

**Reading.** Results for reading scores yielded significant group,  $F(2, 386) = 70.860, p < .0001$ , and test phase,  $F(1, 386) = 899.920, p < .0001$ , effects, both qualified by a significant Group  $\times$  Test Phase interaction,  $F(2, 386) = 98.280, p < .0001$ . As depicted in Figure 2, small but statistically reliable group differences in reading were observed at pretest. Old first-grade children outperformed young first-grade children,  $t(389) = 3.11, p < .05$ , who exceeded performance of old kindergarten children,  $t(389) = 3.88, p < .01$ . Although raw reading scores for the old first-grade and young first-grade groups differed significantly, for both groups, grade-level equivalent scores were 1.33, whereas the old kindergarten children performed at Grade 1.00. At posttest, again old first-grade children displayed a small but significant superiority in reading over young first-grade children,  $t(389) = 2.88, p < .05$ . Both young first-grade and old first-grade groups showed marked superiority over old kindergarten children at posttest,  $t(389) = 11.65$  and  $13.62$ , for comparisons of old kindergarten with young first-grade and old first-grade groups,  $p < .01$ . In grade-level equivalents, old kindergarten children ended their year reading at Grade 1.33, whereas young first-grade and old first-grade children were reading at Grades 2.00 and 2.33, respectively. Most important, a separate ANOVA performed on the change scores from pretest to posttest revealed that the degree of improvement exhibited by young first-grade and old first-grade children in reading achievement was not reliably different. In contrast, the degree of improvement of both young first-grade and old first-grade groups was reliably greater than that exhibited by the old kindergarten group,  $t(389) = 12.35$  and  $12.10, p < .01$ , respectively, for comparison of the old kindergarten group with young first-grade and old first-grade groups.

**Mathematics.** Separate examination of achievement in mathematics yielded significant group,  $F(2, 386) = 50.570, p < .00001$ , and test phase,  $F(1, 386) = 312.560, p < .00001$ , effects and a significant interaction,  $F(2, 386) = 6.700, p < .002$ . As depicted in Figure 3, at pretest, old first-grade children showed modest but significant superiority over young first-grade children,  $t(389) = 5.50, p < .01$ , who outperformed old kindergarten children,  $t(389) = 3.05, p < .05$ . In grade-level terms, old kindergarten, young first-grade, and old first-grade children

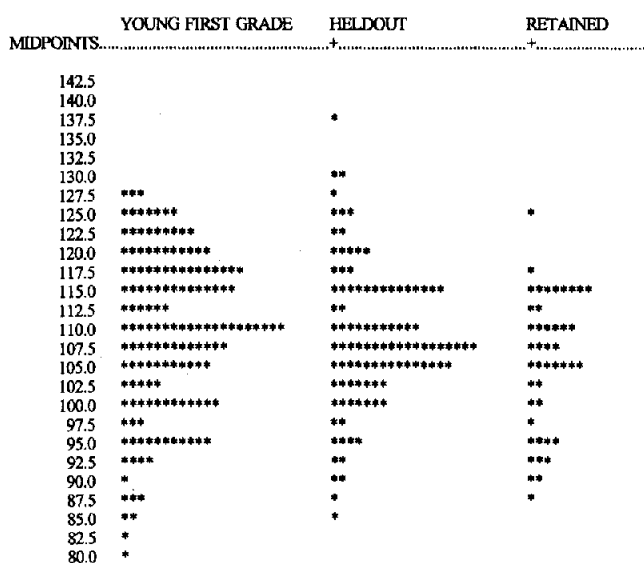


Figure 1. Distribution of IQ scores for young first-grade, held-out, and retained groups. Each asterisk represents one child.

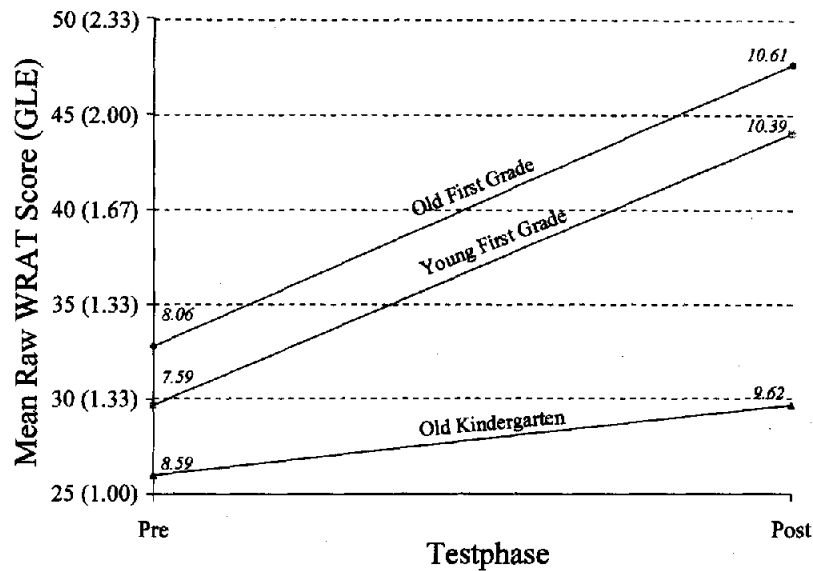


Figure 2. Mean levels of achievement in reading on the Wide Range Achievement Test (WRAT; raw scores and grade-level equivalents [GLE]) attained by the old kindergarten, young first-grade, and old first-grade groups at pretest (fall) and posttest (spring). Standard deviations are in italics.

at pretest were performing at about Grades 1.1, 1.4, and 1.9, respectively. At posttest, old first-grade children showed a similar trend with modest, but significant, superiority over young first-grade children,  $t(389) = 4.25$ ,  $p < .01$ , with grade levels of 2.4 and 2.1, respectively. In contrast, the posttest scores of both young first-grade and old first-grade children exceeded those of old kindergarten children, who had attained a grade

level of 1.7,  $t(389) = 5.17$  and  $8.89$ ,  $p < .01$ , respectively, for comparisons of old kindergarten group with young first-grade and old first-grade children. Finally, separate analyses on the change scores from pretest to posttest confirmed that the degree of improvement in mathematics performance during Grade 1 was not reliably different in young first-grade versus old first-grade children. In contrast, the degree of improvement made by

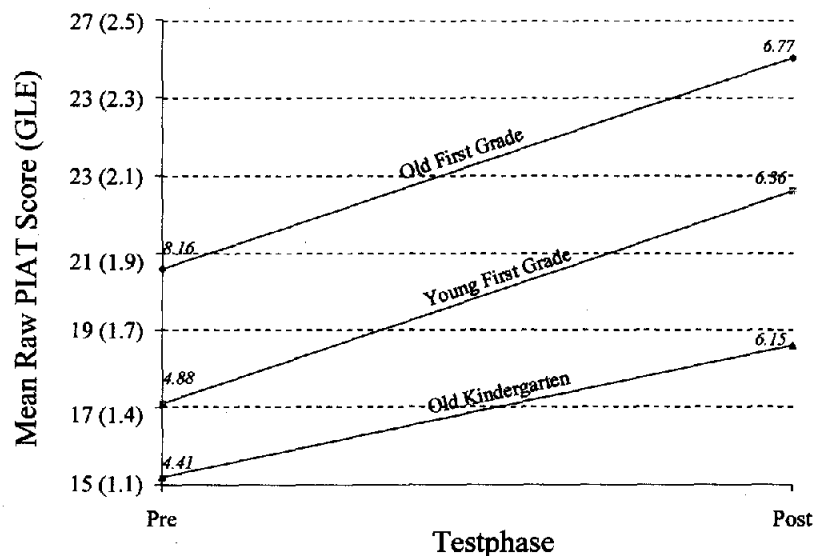


Figure 3. Mean levels of achievement in mathematics on the Peabody Individual Achievement Test (PIAT; raw scores and grade-level equivalents [GLE]) attained by the old kindergarten, young first-grade, and old first-grade groups at pretest (fall) and posttest (spring). Standard deviations are in italics.

both young first-grade and old first-grade groups was reliably greater than that manifested by the old kindergarten group,  $t(389) = 3.31$  and  $2.89$ , respectively, for comparisons of old kindergarten children with young first-grade and old first-grade children,  $p < .01$  and  $p < .05$ .

### Discussion

In this study, we sought to examine whether children who were relatively young when they entered first grade made as much progress as older children and whether they made any more progress than they would have if they had been in kindergarten. Findings from comparisons of growth of reading and mathematics skills for young first-grade children versus old first-grade and old kindergarten groups yielded strongly affirmative answers to these two questions. Further, in this research, we attempted to ascertain whether evidence demonstrating progress in younger first graders might be compromised by serious selection biases resulting from more younger first graders being held out from or retained an extra year in kindergarten. Comparisons of background variables for young first-grade, old kindergarten, old first-grade, held-out, and retained children failed to reveal any evidence of serious participant selection biases in the present samples. Overall, findings from this study demonstrated clearly that younger first graders, as a group, made normal progress over the course of first grade. Entrance age, in and of itself, did not appear to constitute a major risk factor in school readiness.

### *Growth of Academic Skills*

Results from the reading and mathematics tests confirmed earlier findings (Davis et al., 1980; Shepard & Smith, 1985) that, at the end of first grade, achievement levels of younger first graders were slightly below those of older first graders. Yet, this study clearly demonstrated that virtually the same degree of difference existed between younger and older first graders at the beginning of first grade. Further, the degree of progress made by the younger first graders, given their starting point, was identical to that made by older students. In grade-level terms, the younger school entrants made a good year's worth of progress in reading and close to a year's worth of progress in math. Perhaps more revealing, the degree of progress exhibited by the younger first graders surpassed that shown by the older kindergarten group. As stated earlier, if relatively young children (around 5 years of age) were not ready to benefit from formal Grade 1 schooling in reading and math, they should have demonstrated no more progress over the course of their year in Grade 1 than an almost identical age-matched group of children who had just missed the cutoff and had gone to kindergarten. Clearly, findings from this study strongly disconfirmed that notion. The progress of younger first graders as a group clearly surpassed that of their kindergarten counterparts.

Finding group differences between old kindergarten and young first-grade children at pretest demonstrated that instructional experiences in kindergarten also served to enhance growth of elementary reading and mathematics skills, although to a lesser degree. Interpretation of the pretest differences between young first-grade and old first-grade children is more difficult.

It is possible that the old first-grade group benefited more from the kindergarten experience the year before. It is equally likely that the old first-grade group, being approximately 10 months older than the young first-grade group, started out the kindergarten year slightly ahead of the young first-grade group and remained so when they entered this study at the beginning of first grade. A clear answer to that question would require conducting a study similar to this one but starting with assessments at the beginning of kindergarten.

The relative magnitude of the schooling influence on reading versus mathematics performance deserves comment. In particular, instruction in first grade appeared to produce greater progress in reading than in mathematics. This difference is consistent with recent evidence from Stevenson, Lee, and Stigler (1986) demonstrating that teachers in early elementary classrooms in American schools spent much more instructional time in reading and language arts than in mathematics. Differential emphasis on reading versus mathematics may help explain the poorer performance of American elementary students compared with Asian students in mathematics as well as the smaller influence of schooling on progress in mathematics observed in this study.

In a related vein, the exact pattern of schooling effects observed in this study may have been largely due to the educational practices and emphases operating at the time the children were tested. For example, minimal formal instruction in either reading or mathematics occurred in kindergarten, consistent with the emphasis in the district on "developmentally appropriate" practices for this age group. A different pattern of results may have emerged for children in more traditional, "academic" kindergartens. Yet, depending on one's philosophy of early education, either larger or smaller effects of traditional kindergarten schooling could be predicted. On the one hand, larger influences of traditional kindergarten might be predicted because earlier formal instruction in elementary decoding skills is introduced. On the other hand, to the extent that formal instruction is not appropriate for children at this age, smaller influences in kindergarten might be expected. A third alternative is also possible, namely that different educational philosophies and practices will influence cognitive and academic skills in different ways and at different times. For example, traditional practices may produce schooling effects on elementary letter and word decoding skills (including spelling), whereas they may have little or no effect on higher order narrative comprehension or storytelling skills. In contrast, a "whole language" approach may produce more substantial schooling influences on narrative skills, with relatively little effect on more elementary decoding or spelling skills.

One concern in this study is the possibility that differences in levels of performance between younger first-grade and older kindergarten children might be due to differential familiarity with formal testing procedures like those used in school settings. Such practices are not common in preschool settings and only become an integral part of most school practices around first grade. Although plausible, recent evidence from other studies with the same methodology casts doubt on this simple interpretation. Using the method of comparing old kindergarten with young first-grade children in a pre-post design (the so-called cutoff methodology), researchers in a series of studies have examined growth of a variety of cognitive and language skills

with formal testing procedures similar to those used in the present study: free recall of pictures (Morrison, Smith, & Dow-Ehrensberger, 1995), conservation of number and number addition (Bisanz, Morrison, & Dunn, 1995), story recall and production (Varnhagen, Morrison, & Everall, 1994), and syntactic processing (Ferreira & Morrison, 1994). The pattern of findings across studies clearly refuted the notion that old kindergarten children uniformly performed more poorly than young first-grade children. In each case, patterns of performance were consistent with theoretical predictions about the relative influence of schooling-related or age-related factors contributing to development of the cognitive or linguistic skills under investigation. Hence, group differences between old kindergarten and young first-grade children in this study were most likely due to real differences in the acquisition of reading and math skills in the two groups. Regardless of how one interprets the performance differences between the old kindergarten and young first-grade groups, the separate finding of identical progress for young first-grade and old first-grade groups constitutes additional direct evidence that younger first graders were benefiting substantially from formal schooling in first grade.

### *Question of Background Variables*

A separate attempt was made to examine whether group differences in background variables contributed to achievement outcomes. Using two separate assessments, in this research, we found almost no evidence that background variables contaminated the results or conclusions. Younger first graders were slightly higher than older first graders on maternal occupational status but did not differ at all from older first graders or older kindergartners on measures of general cognitive ability, parental educational levels, paternal occupational status, or amount of day-care experience. Other comparisons revealed that, with the exception of paternal occupational status, the group of younger first graders did not differ significantly on the same set of background characteristics from identically age-matched groups of children held out from or retained an extra year in kindergarten. On the surface, the latter findings are surprising, given the reasonable assumption that parents and teachers must be holding out or retaining these children for some reason. Notwithstanding the fact that some younger students eligible for school entry are thought by parents and teachers to be relatively cognitively or socially immature and, hence, would benefit from being held out or repeating a year, significant numbers of parents of bright, mature, younger children have elected in recent years to postpone school entry or have their child repeat a year in kindergarten for reasons other than fears about their child's readiness to learn in school. Full consideration of the nature and consequences of current practices of retaining and holding out children is beyond the scope of this article (for analysis and review of this complex issue, see Shepard & Smith, 1988). For present purposes, it is sufficient to note that substantial numbers of bright, mature children from economically and educationally advantaged families were not entering school at the age-appropriate time. Given this fact, it is not surprising that the background characteristics of groups of promoted, retained, and held-out children would not differ substantially.

### *Implications*

Findings from this study have implications for future research as well as for selected social policy questions in early education.

*Research.* Although these findings document clearly that younger first graders as a group were progressing academically as well as their older peers, the results raise additional important questions for future consideration. First, although entrance age failed to produce a main effect on academic achievement, might not entrance age interact with other variables (e.g., child IQ, gender, and social maturity) to yield smaller subgroups of children at risk for poor academic progress? Many teachers and parents commonly assume that younger boys are more at risk than younger girls and that socially immature, younger boys are the most vulnerable of all younger entrants. Shepard and Smith (1985) found that differences in reading and math performance between older and younger age entrants were pronounced only for students in the lowest 25th percentile of performance. The authors concluded that the purported disadvantage exhibited by younger school entrants may be produced by younger children of lower intellectual ability. An important direction for future studies will be closer examination of the interactive role of entrance age with other psychological variables.

Second, findings from the present study are limited to performance in kindergarten and first grade, leaving open the possibility that entrance-age problems may not surface until later in elementary school or even in the transition to high school. Academic demands of the first two school years are relatively light, hence younger age entrants may be able to hold their own during this period. As school becomes more difficult, younger entrants may possibly begin to experience more academic problems. Longitudinal data comparing younger with older entrants over the course of early elementary school are needed to address this question.

Third, despite the successful levels of learning and achievement of younger age entrants in this study, we did not examine learning and achievement in the held-out and retained groups. It is possible that these two groups might have benefited from the extra year before entering first grade and, as a consequence, might have outperformed their promoted peers. Nevertheless, it should be noted that recent reviews of the effects of nonpromotion on children (Gredler, 1984; Shepard & Smith, 1986, 1988) have uniformly failed to find either academic or social-emotional benefits of retaining immature children.

Finally, in the present study, we used relatively global measures of achievement. Hence, it is possible that age differences might have emerged for selected components of reading and mathematics. For example, Morrison, Smith, and Dow-Ehrensberger (1995) found age-related differences in phonemic awareness in spring of the kindergarten year. Yet, in that study, age differences disappeared by the end of first grade. On balance, the present findings leave open the possibility of age-related effects on selected reading and mathematics skills.

*Educational policy.* In conjunction with other findings (Alexander & Entwistle, 1988; Jones & Mandeville, 1990; Shepard & Smith, 1985), the present results raise doubts about the validity of recent claims that entrance age may contribute substantially to the academic and literacy problems of American children (Davis et al., 1980). Moreover, the findings caution



against facile solutions like raising the entrance age, holding out or retaining young entrants, or adding "transition" years for "young fives." As several authors have repeatedly made clear (May, Kundert, & Brent, 1995; Meisels, 1992), such policies may actually be counterproductive. For example, the present findings revealed that substantial numbers of bright children from relatively affluent homes were being held out or retained prior to first grade. As Shepard and Smith (1988) have pointed out, such practices actually increase the range of variation among children in kindergarten and first-grade classrooms, thereby significantly exacerbating the relative immaturity and perceived unreadiness of the youngest children in the class. Clearly, wholesale retention of sizable numbers of younger school entrants is not warranted by existing data and is of dubious educational benefit.

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