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A study of the effects of sex, starting age and grade level on arithmetic and reading performance in the fourth and sixth grades as determined by standardized test scores

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A STUDY OF THE EFFECTS OF SEX, STARTING AGE, AND
GRADE LEVEL ON ARITHMETIC AND READING PERFORMANCE
IN THE FOURTH AND SIXTH GRADES AS DETERMINED BY
STANDARDIZED TEST SCORES

A Thesis
Presented to
the Graduate Faculty of
The University of Richmond

In Partial Fulfillment
of the Requirements for the Degree
Master of Science in Education

by
Linda Gouldin
August 1967

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APPROVAL SHEET

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This study was made under the direction of Dr. Edward F. Overton, Chairman of the Department of Education.

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CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

I. THE PROBLEM

Statement of the problem. It was the purpose of this study to determine the influences of (1) sex; (2) starting age; and (3) grade level on student performance in the fourth and sixth grades as measured by reading comprehension, reading vocabulary, arithmetic reasoning, arithmetic concepts, and arithmetic computations.

Importance of the study. Reading and arithmetic deficiencies have often been stumbling blocks in the performance of seventh grade students. In seeking a solution to this problem the author has conducted this study to determine the effect that sex, starting age, and grade level have had on the performance of students in the fourth and the sixth grades. The author realized that many factors other than the three mentioned above have affected the performance of students. A student's emotional, social, physical, and intellectual growth; the guiding influence of his parents; the competency of his teachers; the curriculum and organization of his school; the mores of his peers; and the economic status of his family and community have had decided results on the student's performance. However, in this study the author has concentrated on the effects of sex, starting age, and grade level on performance. Educators have stated that students in upper

grades who have had reading problems have most often been early starters and have been boys. Since reading ability has had a definite effect on learning arithmetic, both reading and arithmetic were considered in this study. The author also wanted to identify the area in which students showed the greatest strengths and weaknesses in the five skills measured: reading comprehension, reading vocabulary, arithmetic reasoning, arithmetic concepts, and arithmetic computations.

II. DEFINITIONS OF TERMS USED

Sex. This term designates whether the subject was a male or female.

Starting age. This term refers to the chronological age of a student when he entered the first grade of school. In this study the early starting age was set at the chronological age of five years eleven months to six years one month; the late starting age at six years eight months to seven years two months.

Grade level. This term refers to the fourth and sixth grades.

CHAPTER II

REVIEW OF THE LITERATURE

The review of literature has been centered around differences in performance in reading and arithmetic as related to sex and starting age.

I. SEX DIFFERENCES

Wyatt¹ stated that research reports have indicated that boys as a group have lagged behind girls as a group in reading achievement in the early years of school. As they have matured, boys as a group have tended to catch up with girls in achievement. However, all boys have not been able to overcome initial failures in learning to read as 75 to 90 percent of the children who have been referred to reading clinics for special treatment have been boys. Gates² found that, on the average, girls' reading abilities have excelled those of boys. Waetjen and Grambs³ pointed out that sex was a primary human difference and that it made a difference in behavior generally and in learning particularly;

¹Nita M. Wyatt, "Sex Differences in Reading Achievement," Elementary English, Vol. 48, No. 6, (October, 1966), 596.

²Authur I. Gates, "Sex Differences in Reading Ability," Elementary School Journal, Vol. 61, (May, 1961), 432.

³Walter B. Waetjen and Jean D. Grambs, "Sex Differences: A Case of Educational Evasion?", Teachers College Record, Vol. 65, (December, 1963), 261-266.

therefore, it made a great difference as to whether the student who was instructed was a boy or girl. Waetjen and Grambs⁴ referred to a study done by Deutsch in which he stated that girls have been significantly superior to boys in reading and arithmetic achievement. In a study done by Stroud and Lindquist⁵ in which the Iowa Every-Pupil Basic Skills Testing Program (for Grades III through VIII) was used, girls maintained a consistent and, on the whole, a significant superiority over boys in the subjects tested except in arithmetic where small, insignificant differences favored the boys.

Factors that Influence Sex Performance.

Biological. Wyatt⁶ stated that boys have been shown to be less mature physically than girls at the age of six. The difference in metabolic rate of boys and girls has been highly significant. The male's intake of oxygen and output of energy has been greater than the female's. Since his output of energy has been greater, the environment of the classroom may have been more restrictive and frustrating on the male than on the female. Waetjen and Grambs⁷ pointed out that girls babbled earlier and more than the boys. This may have been the first

⁴Waetjen and Grambs, op. cit., 266, citing Society for Applied Anthropology, 1960, Monograph #2.

⁵J. B. Stroud and E. F. Lindquist, "Sex Differences in Achievement in the Elementary and Secondary Schools," Journal of Educational Psychology, Vol. 33, (December, 1942), 665.

⁶Wyatt, op. cit., 596-597.

⁷Waetjen and Grambs, op. cit., 261-270.

step of the girls in their linguistic gain over the boys. Girls have done better in language and language areas than boys. Wyatt⁸ found that girls were better equipped than boys for reading at the beginning of their instructional period in the first grade and maintained this advantage throughout the year.

Cultural. Preston,⁹ in a study of reading achievement of German and American children, stated that we have been able only to conjecture concerning the relative potency of cultural as distinguished from biological influences upon reading achievement and reading ability. In his study, he used fourth and sixth grade pupils of Wiesbaden, Germany and Philadelphia, U. S. A. He found that in both grades on all tests of reading, the means of American girls exceeded that of American boys. In the German sample, he found that the reverse was true with the exception of the mean reading speed score in Grade Four. He pointed out that American boys have felt that reading was feminine since most American elementary teachers have been women, whereas in Germany, most of the teachers have been men. In his results he suggested that variability in reading may have been a cultural or environmental conditioning, not a universal biological principle.

It has been stated by Waetjen and Grambs¹⁰ that society has dwelt

⁸Wyatt, op. cit., 600.

⁹Ralph C. Preston, "Reading Achievement of German and American Children," School and Society, Vol. 90, (October, 1962), 351-352.

¹⁰Waetjen and Grambs, op. cit., 261.

on the innate differences of boys and girls and accentuated and directed the two sexes along different developmental patterns. They noted that males have tended to identify with a cultural stereotype of the masculine role whereas females have tended to identify with aspects of their own mother's role specifically. This type of identity has suggested that girls have enjoyed a greater ease in learning specific behaviors because they chose specific models. Kohn and Fiedler¹¹ concurred that females have perceived significant persons more favorably than have males because they have been treated more kindly by the world and because they have been less exposed to disillusioning interpersonal experiences. Also females may have reported more favorable attitudes because our culture has taught them to mask their genuine feelings.

Gates¹² presented the idea that it has been possible that more girls than boys have pursued a kind of life in which more respect, more incentives, and more opportunities for reading have appeared earlier and persisted longer; on the other hand, more boys than girls may have found little or no early need for learning to read.

Environmental.

Home. Waetjen and Grambs¹³ stated that it has been hypothesized that the female has learned to listen and observe acutely as an

¹¹R. A. Kohn and F. E. Fiedler, "Age and Sex Differences in the Perception of Persons," Sociometry, Vol. 24, (June, 1961), 162-163.

¹²Gates, op. cit., 432.

¹³Waetjen and Grambs, op. cit., 263.

aspect of child rearing as she has been the one to differentiate among various baby cries and has had to take the appropriate action. Having developed this acute perception of persons and a greater sensitivity to the outside world has helped her to determine right responses more quickly than a male. This characteristic has aided her in being a more apt learner than the boy as she has been able to sense what the teacher has wanted and given it to her more quickly.

It was also pointed out by Waetjen and Grambs¹⁴ that the importance of self perception in general adjustment and learning has been a powerful determinant of a person's behavior. Girls have seen themselves more accepted by their parents than boys and have thus identified themselves more positively. Since girls have related closer to others, more learning has taken place as it has been easier to emulate and adopt what others have learned than to have learned by the trial-and-error method. Having developed a greater sensitivity than the boy, a girl has had a greater possibility of being sensitive to someone in the classroom; if this has been the teacher, it has been a decided factor in her favor. Whereas a boy has had to shift his identification from his mother to his father and having felt somewhat guilty in this partial rejection of his mother, he has had to learn to repress his sentiments and control his expressions of feelings.

¹⁴Ibid., 264.

Environmental.

School. Waetjen and Grambs¹⁵ stated that research has documented that boys and girls have been different in inherited components yet our schools have been "neutral" schools. Wyatt¹⁶ said that our schools have operated on a sex neutral basis. Teachers have used approximately the same techniques in teaching both boys and girls.

Wyatt¹⁷ stated that literature has hypothesized that the school environment at the primary level has been more frustrating to boys than girls, basal reading materials have been less motivating and less satisfying to boys than girls, and that since most primary teachers have been women, they have tended as a group to be more punitive toward boys than girls. Wyatt¹⁸ pointed out a study done by McNeil in which he found that boys were superior to girls on a word recognition test after three weeks of programmed instruction in kindergarten, but after four months in the first grade with female teachers, these same boys achieved less well than the girls. The teachers did not adjust themselves as well to the behavioral tendencies of boys as they did to the behavioral tendencies of girls. Boys received more negative comments than girls.

¹⁵Ibid., 261.

¹⁶Wyatt, op. cit., 596.

¹⁷Ibid., 596.

¹⁸Ibid., 597, citing American Educational Research Journal, Vol. I, 113-119.

It has been noted by Waetjen and Grambs¹⁹ that girls have done better in language areas than boys and the school has rewarded them for it. This has had a bad effect on the boy as he has already felt negative about his language adequacy. Earl Hanson²⁰ stated that if teachers' grades as compared with scores on standardized tests have been proper grounds for judging, then boys have been given a rough deal. In no instances in teacher grading have boys appeared better than girls. He predicted that soon only girls would make up college enrollment.

In a study done by Willis W. Clark²¹ reference was made to an article entitled "Let's Give the Boys a Break" in which the author proposed that boys should have been admitted to school six months or so later than girls, that state legislatures or boards of education should have raised the legal entering age for boys (or lowered it for girls), and that all mental age norms published should have been revised to have provided norms for each sex.

II. STARTING AGE DIFFERENCES

In a study done by Clark²² it was stated that school entrance has been based primarily on chronological age, the age being the same

¹⁹Waetjen and Grambs, op. cit., 270.

²⁰Earl H. Hanson, "Do Boys Get a Square Deal in School?," Education, Vol. 79, (May, 1959), 597-598.

²¹Willis W. Clark, "Boys and Girls-Are There Significant Ability and Achievement Differences?," Phi Delta Kappan, Vol. 41, (November, 1959), 73, citing Phi Delta Kappan, Vol. 40, 281-283.

²²Ibid., 73.

for boys and girls. In 1950, U. S. Census data showed that the median chronological age was higher for boys than for girls. In Grade I, for boys it was 76.7 months and for girls it was 76.0 months. The median difference never became greater than three and one half months. Although for both boys and girls, the chronological age for school entrance has been the same, usually the median beginning age has been higher for boys than for girls.

Educators have indicated that most subjects referred to reading clinics for remedial help have been early starters. Breckenridge and Vincent²³ stated that confusion of symbols is typical of six-year-old children and that eighty percent of six-year-old children are normally farsighted. Muehl²⁴ in a study involving word recognition errors found that correct responses increased with age. Chansley²⁵ reported that age or some correlate of it was found to be related to improvement of reading.

In a study by Brzeinski, Harrison and McKee²⁶ to see whether

²³Marion E. Breckenridge and E. Lee Vincent, Child Development, (Philadelphia and London: W. B. Saunders Company, 1950), 410-411.

²⁴Siegmar Muehl, "Relation Between Word-Recognition Errors and Hand-Eye Preference in Preschool Children," Journal of Educational Psychology, Vol. 54, No. 6, (December, 1963), 316-321.

²⁵Norman M. Chansky, "Age, I. Q., and Improvement of Reading," The Journal of Educational Research, Vol. 56, No. 8, (April, 1963), 439.

²⁶Joseph E. Brzeinski, M. Lucile Harrison, and Paul McKee, "Should Johnny Read in Kindergarten?," NEA Journal, Vol. 56, No. 3, (March, 1967), 23-24.

reading could be taught effectively in kindergarten, the subjects were followed from kindergarten through the fifth grade. The experimental groups were evaluated and analyzed from the standpoint of chronological and mental age, the age at which the child was first taught reading, and other variables. In their results, they reported that no evidence was found that early instruction in beginning reading affected visual acuity, created problems of school adjustment, or caused dislike for reading.

Clark²⁷ stated that many educators have felt that chronological age has been a poor criterion for entrance into school. Maturity or mental age would have been better. He showed in his study that if the requirement for school entrance had been mental maturity or ability to learn, then changing the chronological entrance age for boys and girls would have been an inefficient way of meeting the problem, because it would have created as many problems as it would have solved. He concluded that little would have been gained by changing entrance ages of boys and girls.

III. SUMMARY OF LITERATURE

Research has indicated that the sex of a child has been a strong determinant in influencing his work in arithmetic and reading and more especially in reading. The sex favored as doing well has been

²⁷Clark, op. cit., 281.

the female and the relevant literature suggests that she has been favored through biological, environmental, and cultural factors.

Educators have stated that reading problems have often occurred with early starters; however, age has not necessarily been the cause of the problem. Maturity or mental age may have been a better criterion for school entrance than chronological age.

IV. HYPOTHESIS OF THIS STUDY

In this study the author proposed the null hypothesis of no differences due to sex, starting age, grade level, and combinations of these factors in arithmetic and reading performance.

CHAPTER III

THE MATERIALS USED AND GROUPS STUDIED

Materials used. Grade equivalents from the S.R.A. (Science Research Associates) Achievement Series in (1) Reading Comprehension, (2) Reading Vocabulary, (3) Arithmetic Reasoning, (4) Arithmetic Concepts, and (5) Arithmetic Computations in Grade Four and Grade Six were used.

The chronological beginning age of the subjects was obtained from the Metropolitan Readiness Tests administered at the beginning of the first grade.

Groups studied. The subjects were selected from 263 seventh graders enrolled in the year of 1966-67 in Henrico High School located in Henrico County, Virginia. From this group scores were recorded from all who had complete records and had entered the first grade of Henrico County Schools in September. From this group the early and late boy starters and the early and late girl starters were selected. There were 17 early boy starters, 33 late boy starters, 20 early girl starters, and 19 late girl starters. Each of these four groups was reduced to 15 subjects by random selection to facilitate the statistical analysis. The use of larger numbers would not have added appreciably to the power of the statistical analysis.

CHAPTER IV

TECHNIQUES AND RESULTS OF THE INDIVIDUAL STUDY

Techniques. In this study three variables; (1) sex, (2) early versus late starters, and (3) grade level were studied to determine their effect on school performance as measured by reading comprehension, reading vocabulary, arithmetic reasoning, arithmetic concepts, and arithmetic computations. Specifically, the design used was a three-factor analysis of variance with repeated measures on the grade factor. This same design was employed for each of the five performance variables. The criterion scores in each case were grade equivalents on Science Research Associates Achievement Series. The .05 level of significance was employed for all analyses.

Results of reading comprehension. Table I presents the results of the analysis of variance for reading comprehension. The symbols in this table and others that follow have their usual meaning: df = degrees of freedom, MS = mean square or variance, and F = computed F value. Significant results were obtained for the grade factor, and examination of the means indicated a higher mean for the sixth grade, ($\bar{x}_6=7.9$), than for the fourth grade, ($\bar{x}_4=5.0$), indicating that the students had learned significantly between the dates of testing in the fourth and sixth grades.

Figure 1, page 16, shows that sex by grade interaction was significant. Both boys and girls improved from the fourth to the

TABLE I
ANALYSIS OF VARIANCE OF THE EFFECTS OF SEX (S), AGE AT
STARTING SCHOOL (A), AND GRADE LEVEL (G)
ON READING COMPREHENSION

Source	df	MS	F
Between Subject	59		
S	1	20.01	
A	1	1576.87	2.41
S x A	1	114.08	
Error Between	56	653.81	
Within Subject	60		
G	1	24055.01	147.57 *
S x G	1	1086.00	6.66 *
A x G	1	285.21	1.75
S x A x G	1	165.68	1.02
Error (within)	56	163.01	

*F_{.95} (1,56)=4.02

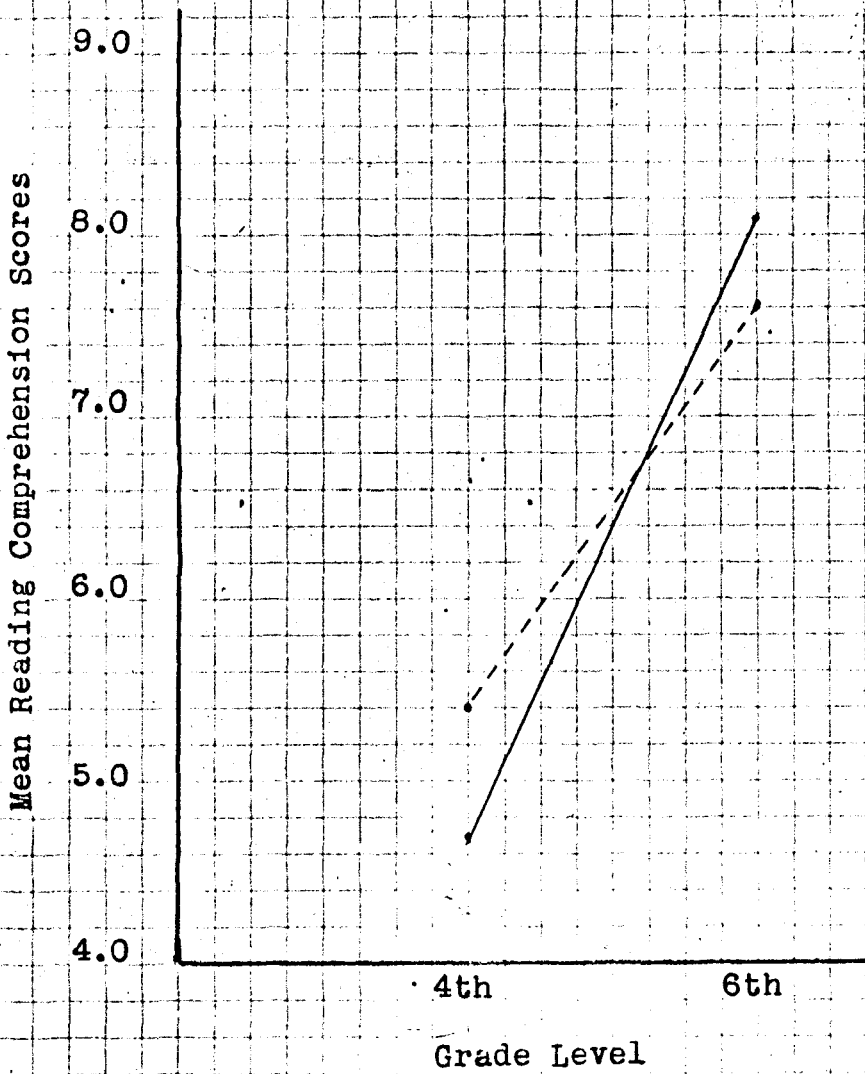


FIGURE I

MEAN READING COMPREHENSION SCORES
FOR BOYS AND GIRLS IN THE
FOURTH AND SIXTH GRADES

— boys
- - - girls

sixth grade, but the boys who started out lower than the girls improved faster and actually performed better than the girls at the sixth grade level.

Early versus late starting had no significant effect.

Results of reading vocabulary. Table II presents the results of the analysis of variance for reading vocabulary. Significant results were again obtained for the grade factor, and examination of the means indicated a higher mean for the sixth grade, ($\bar{x}_6=8.0$), than for the fourth grade, ($\bar{x}_4=4.9$), indicating that the students had made a very significant gain between the dates of testing in the fourth and sixth grades.

Neither sex nor age had significant effects, nor were there any significant interactions.

Results of arithmetic reasoning. Table III, page 19, presents the results of the analysis of variance for arithmetic reasoning. Significant results were obtained for the grade factor and examination of the means indicated a higher mean for the sixth grade, ($\bar{x}_6=8.1$), than for the fourth grade, ($\bar{x}_4=5.5$), which shows a significant gain between the dates of testing in the fourth and sixth grades.

Neither sex nor age had significant effects, nor were there any significant interactions.

Results of arithmetic concepts. Table IV, page 20, presents the results of the analysis of variance for arithmetic concepts. Significant

TABLE II
 ANALYSIS OF VARIANCE OF THE EFFECTS OF SEX (S), AGE AT
 STARTING SCHOOL (A), AND GRADE LEVEL (G)
 ON READING VOCABULARY

Source	df	MS	F
Between Subject	59		
S	1	297.67	
A	1	765.07	1.57
S x A	1	705.68	1.45
Error Between	56	487.63	
Within Subject	60		
G	1	28121.40	215.00 *
S x G	1	72.08	
A x G	1	336.68	2.57
S x A x G	1	12.67	
Error (within)	56	130.80	

* $F_{.95} (1,56)=4.02$

TABLE III
ANALYSIS OF VARIANCE OF THE EFFECTS OF SEX (S), AGE AT
STARTING SCHOOL (A), AND GRADE LEVEL (G)
ON ARITHMETIC REASONING

Source	df	MS	F
Between Subject	59		
S	1	66.01	
A	1	500.21	1.10
S x A	1	221.40	
Error Between	56	456.76	
Within Subject	60		
G	1	20202.07	140.53 *
S x G	1	114.08	
A x G	1	4.41	
S x A x G	1	5.21	
Error (within)	56	143.76	

*F_{.95} (1,56)=4.02

TABLE IV
ANALYSIS OF VARIANCE OF THE EFFECTS OF SEX (S), AGE AT
STARTING SCHOOL (A), AND GRADE LEVEL (G)
ON ARITHMETIC CONCEPTS

Source	df	MS	F
Between Subject	59		
S	1	45.64	
A	1	433.20	1.37
S x A	1	367.50	1.16
Error Between	56	315.42	
Within Subject	60		
G	1	6336.54	60.22 *
S x G	1	425.62	4.04 *
A x G	1	10.80	
S x A x G	1	12.04	
Error (within)	56	105.23	

*F_{.95} (1,56)=4.02

results were obtained for the grade factor and examination of the means indicated a higher mean for the sixth grade, ($\bar{x}_6=8.0$), than for the fourth grade, ($\bar{x}_4=6.5$), indicating that the students had learned significantly between the dates of testing in the fourth and sixth grades. Also it is interesting to note that the mean for the fourth grade is 2.5 grade equivalents higher than the national average, indicating that concepts have been well learned prior to the fourth grade.

Figure 2, page 22, shows that sex by grade interaction was significant. The profiles of the means in the fourth and sixth grades show that both boys and girls improved from the fourth to the sixth grade, but the boys who started out lower than the girls, improved faster and actually performed better than the girls at the sixth grade level.

Early versus late starting had no significant effect.

Results of arithmetic computations. Table V, page 23, presents the results of the analysis of variance for arithmetic computations. Significant results were obtained for the grade factor and examination of the means indicated a higher mean for the sixth grade, ($\bar{x}_6=7.6$), than for the fourth grade, ($\bar{x}_4=5.1$), indicating that the students had learned significantly between the dates of testing in the fourth and sixth grades. The grade equivalent mean for arithmetic computations in the sixth grade was the lowest of all skills measured.

Sex by grade interaction was significant. Figure 3, page 24, shows the profiles of the means in the fourth and sixth grades. Both

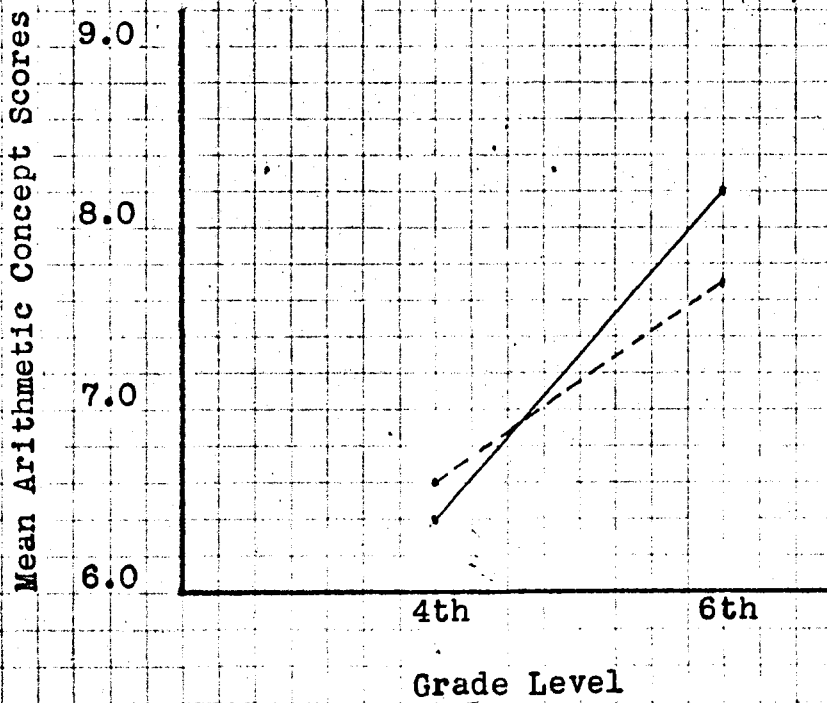


FIGURE II

MEAN READING ARITHMETIC CONCEPT SCORES
FOR BOYS AND GIRLS IN THE
FOURTH AND SIXTH GRADES

— boys
- - - girls

TABLE V
 ANALYSIS OF VARIANCE OF THE EFFECTS OF SEX (S), AGE AT
 STARTING SCHOOL (A), AND GRADE LEVEL (G)
 ON ARITHMETIC COMPUTATIONS

Source	df	MS	F
Between Subjects	59		
S	1	330.00	2.17
A	1	255.20	1.67
S x A	1	52.02	
Error Between	56	152.41	
Within Subject	60		
G	1	19635.20	358.44 *
S x G	1	336.69	6.15 *
A x G	1	114.09	2.08
S x A x G	1	3.65	
Error (within)	56	54.78	

*F_{.95} (1,56)=4.02

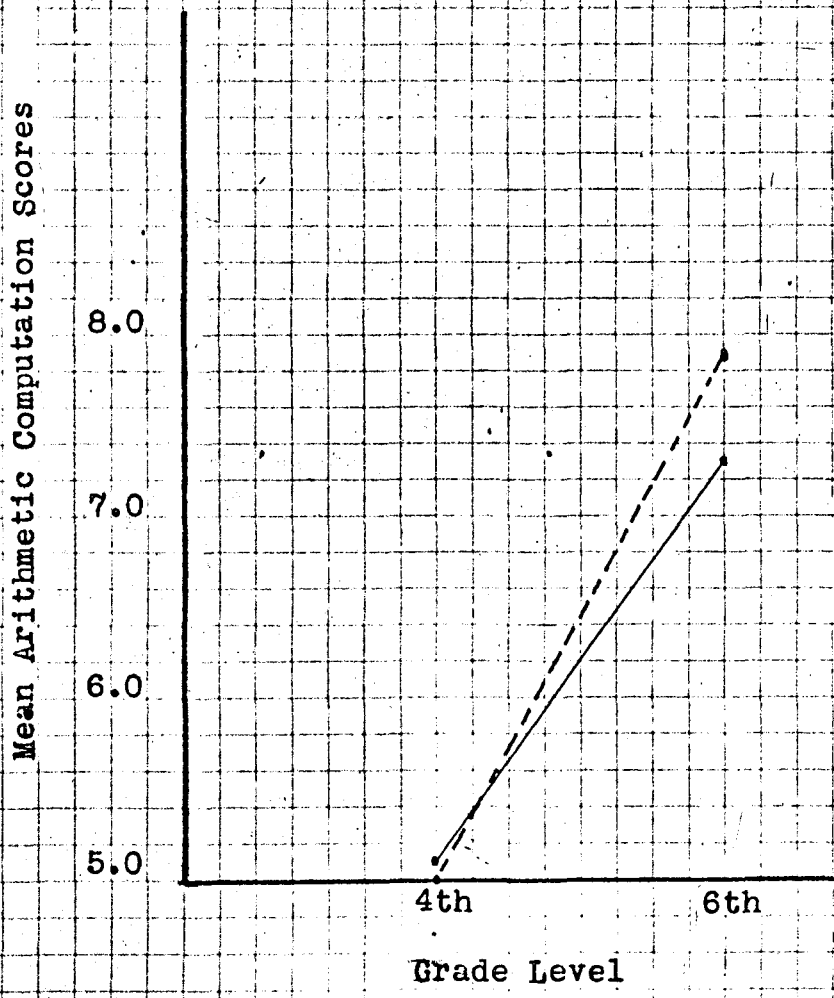


FIGURE III

MEAN ARITHMETIC COMPUTATION SCORES
FOR BOYS AND GIRLS IN THE
FOURTH AND SIXTH GRADES

— boys
- - - girls

boys and girls improved from the fourth to the sixth grade, but the girls who started out lower than the boys, improved faster and actually performed better than the boys at the sixth grade level. It is interesting to compare this result of sex by grade interaction with the results of reading comprehension, page 14, and the results of arithmetic concepts, page 21, in which the boys performed better than the girls.

Early versus late starting had no significant effect.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary. In the survey of literature, research indicated that the female sex had done better in reading and arithmetic than the male sex. Also it was indicated that reading problems most often occurred with early starters but that the early starting age was not necessarily the cause of the problem.

In this study the author proposed the null hypothesis of no difference due to sex, starting age, and grade level, and combinations of these factors in arithmetic and reading performances.

The findings suggest the following conclusions:

A. Sex

1. There was a significant difference in reading comprehension. The boys who started out lower than the girls in the fourth grade improved faster and actually performed better than the girls at the sixth grade level.
2. There was no significant difference in reading vocabulary.
3. There was no significant difference in arithmetic reasoning.
4. There was a significant difference in arithmetic concepts. The boys who started out lower in the fourth grade than the girls improved faster and actually performed better than the girls in the sixth grade.

5. There was a significant difference in arithmetic computations. The girls who started out lower than the boys in the fourth grade improved faster and actually performed better than the boys in the sixth grade.

Discussion. Most of the literature indicated that girls did better than boys on reading and arithmetic scores; however in this study the boys did as well as the girls in reading vocabulary and arithmetic reasoning, and better than the girls in reading comprehension and arithmetic concepts. Evidently, early frustrations imposed on boys by biological, cultural, and environmental factors had diminished by the sixth grade. Also the two areas in which the boys exceeded the girls required thinking and logical reasoning by the sixth grade. In grades below the sixth grade, reading was mainly concerned with the interpretations of words, not sentences, and arithmetic with the learning of fundamental skills. Boys seemed to learn arithmetic computations as easily as the girls, but girls by nature have been neater than boys and have developed and maintained to a degree more accuracy in computations than boys.

B. Age

There was no significant difference in early versus late starting subjects in reading comprehension, reading vocabulary, arithmetic reasoning, arithmetic concepts, or in arithmetic computations.

Discussion. The literature pertaining to early versus late starting age was controversial. This study found no significant differences due

to starting age. The factors that influence performance would more nearly be mental or maturative age rather than chronological age. Perhaps difficult reading skills taught to early boy starters have been too complex for them and caused undue frustrations that some never overcame, as most referrals to reading clinics have been early boy starters. However, in this study the number having such problems was not sufficient to show a significant difference.

C. Grade Level

1. There was a significant difference in reading comprehension of ($\bar{x}_4=5.0$) to ($\bar{x}_6=7.8$), a gain of 2.8.
2. There was a significant difference in reading vocabulary of ($\bar{x}_4=4.9$) to ($\bar{x}_6=8.0$), a gain of 3.1.
3. There was a significant difference in arithmetic reasoning of ($\bar{x}_4=5.5$) to ($\bar{x}_6=8.1$), a gain of 2.6.
4. There was a significant difference in arithmetic concepts of ($\bar{x}_4=6.5$) to ($\bar{x}_6=8.0$), a gain of 1.5.
5. There was a significant difference in arithmetic computations of ($\bar{x}_4=5.1$) to ($\bar{x}_6=7.6$), a gain of 2.5.

Discussion. There was a significant gain from the fourth to the sixth grades in all areas analyzed. Not only was there a gain but the grade equivalent at each level was considerably higher than the national norm. This was an expected outcome as Henrico County, the area in which the subjects were tested, has an environment that is better than the national average.

The weakest area in the fourth grade was reading vocabulary; however, a large gain was made between the fourth and sixth grades. This is quite interesting as Virginia children have generally scored low in vocabulary. This marked growth may be the result, in part, of the influx of television.

The strongest area in the fourth grade was arithmetic concepts. This may be due to the teaching of modern arithmetic in comparison to traditional arithmetic. Modern arithmetic has stressed an understanding of concepts.

The weakest area in the sixth grade was arithmetic computations. This is very possibly due to carelessness in simple computations.

The strongest area in the sixth grade was arithmetic reasoning. The implications here again point to the teaching of modern arithmetic in which sound reasoning is stressed.

Conclusions.

1. Boys as a group perform better than girls as a group when logic and reasoning are concerned.
2. Girls as a group perform better than boys as a group on materials involving language and on materials requiring mechanical skills such as arithmetic computation.
3. The chronological starting age of a girl or boy is not as important as his maturity or mental ability.
4. Environment is a strong determinant of growth.

Recommendations.

1. To reduce frustrations of boys in the lower grades, provide them with instructional materials that are exclusively for boys, be less punitive, and provide more activities that allow release of energy.
2. Help the girls to gain a better understanding of arithmetic so that they may rely more on their thinking skills than their mechanical skills.
3. Place more emphasis on reading vocabulary in or before the fourth grade.
4. Place more emphasis on arithmetic computations in the sixth grade and below.

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