DOCUMENT RESUME

ED 137 094 SE 022 257

AUTHOR Flexer, Barbara K.; Wright, Robert J.
TITLE Interrelationship of Age and Sex in Achievement in an Accelerated Eighth Grade Algebra Course.
PUB DATE [76]
NOTE 17p.

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS Ability; Accelerated Programs; *Achievement; *Age Differences; *Algebra; Educational Research; Mathematics Education; Secondary Education; *Secondary School Mathematics; *Sex Differences
IDENTIFIERS Research Reports

ABSTRACT

Eighty-one bright eighth-grade students were selected for an accelerated program in algebra. Students were classified by sex and by chronological age; the three age cohorts were 143-156 months, 157-159 months, and 160-165 months old. Success in the course, as measured by course grade, was considered in relation to age and sex; IQ score was used as a covariate. A 3x2 analysis of covariance was performed; the main effect for age and the interaction of age and sex were found to be significant at the .05 level. The Newman-Keuls multiple comparison test revealed significant differences in achievement of the youngest group of boys and the other two male cohorts. The oldest group of boys achieved significantly more than the youngest groups of either sex. (SD)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED137094

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

Barbara K. Flexer

Lower Moreland School District

Robert J. Wright

Beaver College

Interrelationship of Age and Sex in Achievement in an Accelerated Eighth Grade Algebra Course

Running Title: Achievement in Algebra

SE 022 257

ABSTRACT

In this study of the success of bright eighth grade students in an "accelerated" mathematics program, maturation (as measured by chronological age) and sex were found to be significantly related to achievement. In these analyses, ability was used as a covariate. Multiple comparison tests of the interaction indicated that the effect of age was most pronounced for boys, with the oldest male cohort group achieving significantly more than the younger groups of either sex.

ERIC

Interrelationship of Age and Sex in Achievement in an Accelerated Eighth Grade Algebra Course

It is current practice for students of outstanding ability and exceptional past achievement in mathematics to be given the opportunity to study Algebra I in eighth grade as the first course of an accelerated high school mathematics program. Despite academic indications to the contrary, some students in this category do not succeed.

A number of recent studies have been reported that have attempted to predict success in high school algebra (Barnes, & Asher, 1962; Mogull, & Rosengarten, 1972; Rothenberger, 1967). Generally these studies have found previous grades in mathematics the best single predictor, yielding correlational coefficients between .60 and .70. For the most part these studies have been confined to algebra courses which were taught after the eighth grade, and have included students from a wide range of ability levels. Thus, very little is known of those factors which may be related to achievement among the talented group of younger students who are enrolled in "advanced" or "high school equivalent" algebra courses in the seventh and eighth grades.

One factor which may be related to algebra achievement among these children is age. The literature concerning the effect of age on achievement has generally been confined to studies of elementary school children.

Carter (1956), and Dickinson and Larson (1963) conducted studies which found that younger children were not able to achieve as well as the older ones of equivalent ability. In a comprehensive review of literature related to the age question, Halliwell (1966) indicated that achievement of early entrants was approximately seven months behind pupils of similar in-

ERIC

telligence who were one year older. Yet the results reported by Braga (1969) were not in agreement with these previous studies. In this study Braga found no significant differences in academic achievement between early-admit, mentally advanced children and their classmates at the third, fifth, and seventh grade levels.

The question of a possible effect of chronological age among students in the advanced seventh and eighth grade algebra classes is made all the more complex by the observation that these students are frequently among the youngest members of their grade level. This is brought about primarily by the early admission policies of many school systems. It is possible for the typical eighth grade advanced algebra class to have students who cover a 24 month span of chronological ages.

The relationship between cognitive maturation and the ability to cope logically with problem solving situations such as those encountered in the study of algebra has been well established. Possibly the most influential model for understanding this relationship has been proposed by Piaget (Inhelder, & Piaget, 1958). Piaget has postulated that by about the age of eleven or twelve years a child has reached the point in the ontogenetic development of his reasoning capacity where for the first time he becomes capable of hypothetical and deductive logic. This stage in cognitive growth has been termed the stage of formal operational thinking (Flavel, 1963). The achievement of formal reasoning at an adult level is not complete until later during high school years. The development of this reasoning ability is linked to normal maturation; and, this development process has been shown to be resistant to acceleration by direct instruction (Piaget, 1970).

This cognitive theory does not provide any rationale for accelerating a child if such a program would require mental operations not compatible with his level of development (Sigel, 1969).

Another potential factor which may be related to success in an advanced algebra program for bright junior high school children is sex. Research on the effect of sex on achievement in mathematics indicates that eighth grade is a period of transition. Up to about age 13, differences between sexes in mathematics achievement have been found to be negligible (Hilton, & Berglund, 1974; Maccoby, & Jacklin, 1974; Parsley, Powell, O'Connor, & Deutsch, 1963). Maccoby and Jacklin (1974) noted that by about 12 to 13 years of age, boys' skills in mathematics begin to increase faster than the skills of girls. In a follow-up study, Parsley, Powell, & O'Connor (1964) found that brighter boys achieve at higher levels than girls of the same intelligence level. In one study (Lavach, & Lanier, 1975) this effect was linked with a motive on the part of high-achieving girls to avoid success.

Thus the eighth grade, with children between 12 and 14 years of age, can be considered as being a critical point in the development of those skills and capacities related to success in advanced mathematics courses. It is a time when both the cognitive maturation is reaching a new level, and also when sex related differences in achievement first emerge.

This study was initiated to investigate the possible relationship of chronological age and sex as factors in achievement in an accelerated algebra program.

ERIC

Method

The subjects used in this study included all of the students (41 boys and 40 girls) enrolled in all of the advanced eighth grade Algebra I sections in a suburban junior high school during the school years of 1973 through 1975. The students had been placed in this accelerated program on the recommendation of their seventh grade mathematics teachers. The IQ range of the subjects was 111 to 147; and, at the beginning of eighth grade their ages ranged from 143 to 165 months.

Subjects were divided for the purpose of this analysis into one of three age cohort groups. These age cohort groups were established in such a way as to be approximately equal in number. The youngest group (N=26) consisted of those students who were less than 156 months old at the beginning of eighth grade. Ages in the second group (N=30) ranged from 156 to 159 months. The oldest group were those eighth grade students who were older than 159 months (N=25).

Group intelligence test data was collected for all subjects of this study as a part of the regular standardized testing program during the first semester of seventh grade. Achievement in eighth grade algebra was determined as the letter grade for that course after the first semester. As one teacher was involved in teaching the several sections of this course, it was assumed that a consistent achievement standard was employed. For the purpose of analysis, course grades were converted into the usual four point scale (A=4, B=3, C=2, D=1, F=0).

ERIC

Results

The means and standard deviations of the four variables: age, IQ, seventh grade mathematics grade, and eighth grade algebra grade, are presented by sex in Table 1. The extremely high ability level of the sample

Insert Table 1 about here

is reflected by a combined mean IQ in excess of 130. An examination of this Table indicates minimal age differences between the sexes.

Table 2 presents the matrix of correlations among the various variables.

Insert Table 2 about here

Age, IQ, and achievement in seventh grade mathematics were all found to be highly correlated with algebra achievement. A significant positive correlation is also evident in the relationship between IQ and seventh grade achievement. A significant negative relationship was noted between age and IQ.

The hypothesized relationships of age and sex of algebra achievement were tested by a 3 X 2 (age by sex) analysis of covariance with IQ as the covariate. Table 3 presents a summary of this analysis. The main effect

Insert Table 3 about here

for age was found to be significant ($F = 3.76$, $df = 2,75$, $p < .05$), as well as the interaction of age and sex ($F = 3.48$, $df = 2,75$, $p < .05$). The interaction of sex and age factors is graphically presented in Figure 1. The Newman Keuls

---

Insert Figure 1 about here

---

multiple comparison test was used to analyze the significant interaction effect. By this procedure, no significant differences were moted in achievement among the three age groups of girls. Table 4 presents the results of this multiple comparison test for the three age groups of boys. Significant differences

---

Insert Table 4 about here

---

were found between the youngest group of boys and both of the other two groups. Simple main effects analysis indicated significant differences between boys and girls among both the oldest age group ($F = 4.05$, $df = 1,74$, $p < .05$). Differences were not significant for the other two groups.

Discussion

The importance of maturation in the achievement of boys in this accelerated mathematics program can be seen by the monotonic relationship between achievement and age. Also, the present data support the literature which suggests that at about the age of 13 mathematics achievement of boys surpasses that of girls.

Generally, academic variables are the most important predictors used by school counselors and administrators in making placement decisions. Yet, these variables may have minimum value when attempting to predict the success of the most advanced students. This lower efficiency of prediction is a function of the restricted variance on these predictor variables, with this type of sample.

This study has demonstrated that age may be one important factor to be considered when making these placement decisions. The effect of cognitive maturation is most critical in quantitative subjects such as mathematics. This ability can develop independently of the child's IQ. While bright students can employ various learning strategies in many subject areas, the hypothetical logic used in algebra requires an advanced type of cognitive organization. The typical academic indices do not measure this development.

One possible consequence of a poor placement decision is the "turning off" of a student toward mathematics. When this occurs to one of our brightest students, this loss is especially tragic.

There is a further implication for parents. Serious reflection needs to accompany decisions to push a child beyond the capabilities of his developmental maturity. This is especially true in the case of boys already young for their grade placement. Too often the status element of acceleration may be the most important consideration for parents.

ERIC

Table 1

Means and Standard Deviations of Age, IQ, Math Grade, MAT Math Score, and Algebra Grade by Sex Groups

	Boys (N = 41)		Girls (N = 40)		Combined	
Variable	M	SD	M	SD	M	SD
Age	157.46	4.26	157.38	3.71	157.42	4.06
IQ	132.07	8.46	127.98	7.47	130.05	8.30
Math Grade	3.61	.49	3.38	.53	3.49	.52
Algebra Grade	2.83	.82	2.65	.72	2.74	.79

Table 2

Intercorrelations among Variables

	IQ	Math	Algebra
Age	-.366**	.071	.187*
IQ		.297**	.364***
Math Grade			.463***

*$p < .05$

**$p < .01$

***$p < .001$

Table 3

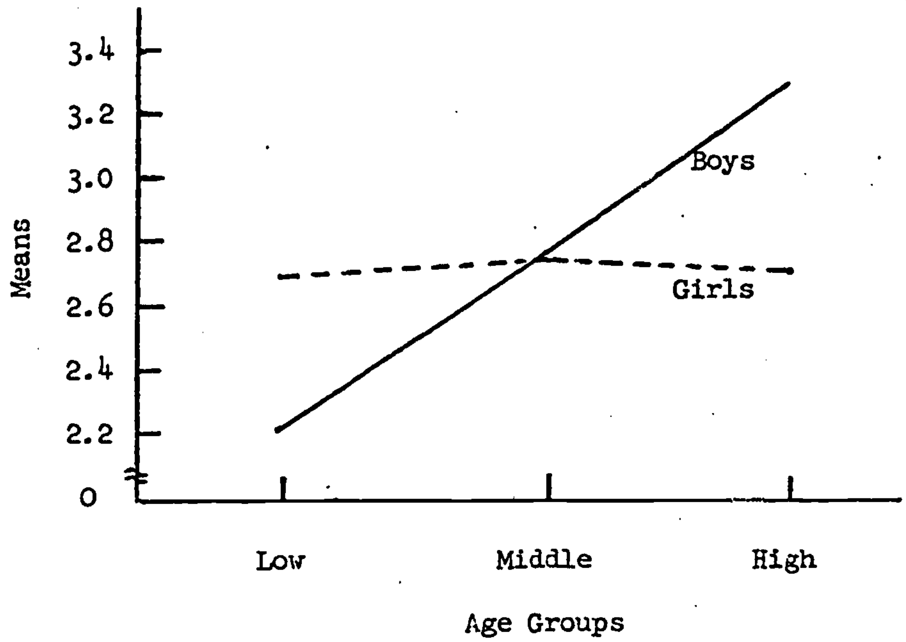
Analysis of Covariance of Algebra Grades
for 2 Sex X 3 Age Groups, Using IQ as Covariate

Source	SS	df	MS	F
Sex (S)	.003	1	.003	.006
Age (A)	3.656	2	1.828	3.763*
S X A	3.384	2	1.692	3.483*
Within	35.941	74	.486	

*p < .05

ERIC

Figure 1. Effect of Age and Sex on Achievement in Algebra



ERIC

Table 4

Results of Newman Keuls Test of Comparison
for Algebra Means for Three Age Groups among Boys

	Low	Middle	High	r	Critical value
Means	2.21	2.78	3.28		
Low		.57*	1.07*	3	.65
Middle			.50	2	.54

* significant at the .05 level

References

Barnes, W. E., & Asher, J. W. Predicting students' success in first-year algebra. Mathematics Teacher, 1962, 55, 651-654.

Braga, J. L. Analysis and evaluation of early admission to school for mentally advanced children. Journal of Educational Research, 1969, 63, 103-105.

Carter, L. B. The effects of early school entrance on the scholastic achievement of elementary school children in the Austin Public Schools. Journal of Educational Research, 1956, 50, 91-103.

Dickinson, D. J., & Larson, J. D. The effects of chronological age in months on school achievement. Journal of Educational Research, 1963, 56, 492-493.

Flavel, J. H. The developmental psychology of Jean Piaget. New York: Van Nostrand, Reinhold Co., 1963.

Halliwell, J. W. Reviewing the reviews on entrance age and school success. Journal of Educational Research, 1966, 59, 395-401.

Hilton, T. L., & Berglund, G. W. Sex differences in mathematical achievement: A longitudinal study. Journal of Educational Research, 1974, 67, 231-237.

Inhelder, B., & Piaget, J. The growth of logical thinking. New York: Basic Books, 1958.

Lavach, J. F., & Lanier, H. B. The motive to avoid success in seventh, eighth, ninth, and tenth grade high-achieving girls. Journal of Educational Research, 1975, 68, 216-218.

Maccoby, E., & Jacklin, C. The psychology of sex differences. Stanford: Stanford University Press, 1974.

Mogull, R. G., & Rosengarten, W., Jr. Predicting student success in elementary algebra. California Journal of Educational Research, 1972, 23, 104-107,

Parsley, K. M., Powell, M., O'Connor, H. A., & Deutsch, M. Are there really sex differences in achievement? Journal of Educational Research, 1963, 57, 210-212.

Parsley, K. M., Powell, M., O'Connor, H. A. Further investigation of sex differences in achievement of under-, average-, and over-achieving students within five IQ groups in grades four through eight. Journal of Educational Research, 1964, 57, 268-270.

Piaget, J. [_Science of education and the psychology of the child_] (D. Coltman, trans.). New York: Orion Press, 1970.

Rothenberger, M. L. Who should take algebra? _Clearing House_, 1967, _42_, 226-228.

Sigel, I. E. The Piagetian system and the world of education. In D. Elkind & J. H. Flavell (Eds.), _Studies in cognitive development: Essays in honor of Jean Piaget_. New York: Oxford University Press, 1969.