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ABSTRACT

Home environments have been linked to cognitive development and academic performance, with suggestions that family factors exert more influence on language and literacy learning than on mathematics achievement. This study's purpose was to learn how selected family factors might be differentially related to primary grade achievement in reading and mathematics in children from low-income families. Family factors were contrasted in first graders who scored in the highest and lowest quartile on Woodcock-Johnson tests of reading and mathematics. Participants were 167 children from low-income families (80% were African American) in a Head Start Transition Demonstration program, which provides low-income families with elementary school children the same support as received in Head Start. Children who did well in reading were from homes with higher scores on the Home Screening Questionnaire, were from smaller families, had better educated mothers, and were rated as more healthy. Children who did better in math were from families who scored high on the questionnaire and tended to have more contact with their fathers. Regression analyses indicated that transition treatment interacted with family size and showed a trend toward interacting with the questionnaire scores to predict reading scores summed across kindergarten and first grade. Treatment interacted with maternal education to predict similarly summed mathematics scores. Quality of the home environment independently predicted math scores. The conclusion was that children's learning is heavily influenced by home environment. Contains 26 references. (Author/BGC)

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Family Factors Associated with High and Low Reading and Mathematics Scores in Children from Low Income Families

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KEY WORDS: Reading Achievement, Math Achievement, Low-Income Families, Head Start Transition

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Abstract

Family factors were contrasted in first graders who scored in the highest and lowest quartile on Woodcock-Johnson tests of reading and mathematics. Study participants were 167 children taking part in a Head Start Transition Demonstration program. All were from low-income families and 80% were African American. Children who did well in reading were from homes with higher scores on the Home Screening Questionnaire, were from smaller families, had better educated mothers, and were rated as more healthy. Children who did better on math were from families who scored high on the Home Screening Questionnaire, and they tended to have more contact with their fathers. Regression analyses indicated that Transition treatment interacted with family size and showed a trend toward interacting with the Home Screening Questionnaire scores to predict reading scores summed across kindergarten and first grade. Treatment interacted with maternal education to predict similarly summed mathematics scores. The quality of the home environment independently predicted math scores.

Family Factors Associated with High and Low Reading and Mathematics Scores of Children from Low Income Families

Patterson, Kupersmidt, and Vaden (1990) found that child gender, family composition, income, and ethnicity were the strongest predictors of children's academic competence. Other investigators have reported that maternal characteristics, such as IQ, attitudes, employment status, or involvement in the educational process are also associated with children's academic performance. Home environments have been strongly linked to cognitive development and academic performance (Bradley & Caldwell, 1984; Bradley, Caldwell, & Rock, 1988). However, it has been suggested that family factors may exert more influence on language and literacy learning than on mathematics achievement (Majoribanks, 1980).

The purpose of the present study was to learn how selected family factors might be differentially related to primary grade achievement in reading and mathematics in children from low-income families. Previous studies of low-income families have shown that maternal intellectual or academic potential is related to child scores in both reading and math (Garrett, Ng'andu, & Ferron, 1994; Campbell & Ramey, 1994; Vandell & Ramanan, 1992). Although maternal beliefs about how children best learn were found to predict only reading scores (Campbell, Goldstein, Schaefer, & Ramey, 1990), other investigators found that parental expectations for child success were related to both reading and math scores (Reynolds & Gill, 1994). Parental involvement at school was also related to both reading and math scores (Reynolds & Bezruczko, 1993). Vandell and Ramanan (1992) found that the mother's employment history predicted both reading and math scores, but differentially according to the timing of employment. Math achievement was higher in children whose mothers were employed earlier in their life span whereas reading was positively related to more recent maternal employment.

In the present study, family demographic measures and kindergarten and first grade academic scores were available from children who were participants in a Head Start Transition Demonstration program. This program, implemented nationwide, was designed to provide low-income families with the same kinds of supports in elementary school that had been available to them in Head Start, thus each treated family had a Family Services Coordinator whose task was to assure continuity of family services from Head Start to elementary school. At this site,

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treated children also had Educational Coordinators who sought to enhance their academic progress.

As part of the evaluation of this program, children's reading and mathematics skills were assessed at the end of kindergarten and first grade. Analyses were designed to relate these academic scores to child and family factors. A secondary question to try to determine if Transition treatment might buffer the child against family circumstances that would otherwise have a negative impact on learning.

Method

Participants:

One hundred-seventy children, comprising the first two of three cohorts of children enrolled in the Transition Demonstration study, were potential participants in the research. Three of these were eliminated from the present analyses because, although they were followed by the evaluators, their families had too much income for them to have been eligible to attend Head Start. Thus, all children included in the analyses were from low-income families. Fifty-nine percent were Head Start graduates.

Children attended six different elementary schools. Three of the schools were randomly assigned to receive the Transition services, the other three were comparison sites. Eighty-one children attended Demonstration schools, 86 were in comparison schools. Some of the non-Head Start children in Treatment schools were nominated by teachers as children who appeared at particularly high risk for academic or behavior problems. The parents of all included children gave informed consent for their family to be involved in the evaluation of the program.

Table 1 presents data on child gender, ethnicity, and selected family characteristics for the study sample. Slightly more than half the children were boys. Approximately two-thirds of them lived in households without their father present. Most of the mothers were at least high school graduates, and 53.7 % of them were employed when the child was in first grade. Demographic characteristics of the participant families did not differ across treatment and comparison schools, except that more parents of children in comparison schools were employed.

Procedures

Parents were interviewed three times in the period covered by this study: in the fall when their child entered kindergarten, in the spring of kindergarten, and in the spring of the next year, when all but the children who repeated kindergarten had completed first grade. A number

of psychological scales were also administered to parents during the interview sessions. All questions and scales were read to parents and marked by the interviewer. Parents had copies of the materials for reference.

Children were tested at school in the fall and spring of kindergarten and in the spring of first grade by examiners blind with respect to the school's assignment to Transition Demonstration or comparison status.

Measures

Family Interview. The parent interviews contained questions to describe the intactness of the family (father presence); amount of contact with father (ranging from 0 = never to 10 = daily); number of siblings; estimates of monthly income within 12 categories (ranging from 1 = $1-$200 per month to 12 = $6001 or more per month); parental education; and maternal employment. In addition, mothers rated the child's overall health status on a five point scale from 1 = Fair to 5 = Excellent.

Home Screening Questionnaire. Parents completed the HOME Screening Questionnaire (HSQ; Frankenburg & Coons, 1986), a shortened interview form of the Home Observation for Measurement of the Environment (HOME) developed by Caldwell and Bradley (1984). The HSQ version for families of children aged 3 to 6 years was used in this study; test-re-test reliability is.83 for this version of the scale. It has 34 items that can be answered Yes or No, plus, up to an additional 14 points can be earned depending on the type of toys available. The total possible HSQ score for this version is 48; scores of 41 or below constitute a "suspect screening result" (Coons, Gay, Fandal, Ker, & Frankenburg, 1981)

Family Resources Scale. Interview respondents also completed the Family Resource Scale (Dunst and Leet, 1987), an instrument designed to measure the adequacy of resources available to families with young children. The 30 items (e.g., "Food for 2 meals a day") are rated on a scale from 1 = Not at all Adequate to 5 = Almost Always Adequate. Factor analysis indicated 8 orthogonal factors: Personal Growth, Health and Necessities, Necessities and Protection, Shelter, Intrafamily Support, Communication/Employment, Childcare, and Independent Income. Test-retest reliability (stability) for this test has been reported as .52; internal consistency reliability was .95.

The demographic variables examined in this study represent parental responses at the end of the second school year with two exceptions:

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maternal educational level was asked and the HSQ was completed only during the interview conducted in the fall of kindergarten.

Child Academic Measure. The Woodcock-Johnson Psycho-Educational Battery-Revised (WJR; Woodcock & Johnson, 1989) was individually administered to the children at the end of first grade (Form B), following the standard procedures. The WJR was normed on a stratified sample of individuals ranging in age from 2 to 90 years. A full range of SES levels and all major ethnic groups were included in proportion to their representation in the US Census of 1980. Four subtests, two for reading and two for math were given: Letter-Word Identification, Passage Comprehension, Calculation, and Applied Problems. Reliabilities for these four subtests in Form B ranged from .96 to .84 for six-year-old children (McGrew, Werder, & Woodcock, 1991).

Raw scores were analyzed in this study without any transformation into age or grade-referenced percentiles or Standard Scores. One-hundred-sixty children had reading and math scores collected at the end of the second year in school. This represented the end of Grade 1 for all but six children who were retained in kindergarten. These six were assessed following the identical procedures used for the others.

Data Analysis

Two analytic strategies were used. First, t-tests contrasted means on demographic measures obtained from families of children scoring within the top and bottom quartiles on the academic tests to learn whether the extreme groups differed significantly on these variables. Next, utilizing all available cases, child, family structure, family environment, and Transition treatment were then entered into regression analyses predicting reading and mathematics scores. Child and family factors were crossed with Transition treatment status, to see if treatment might interact with family circumstances to predict children's academic success.

Results

Table 2 gives raw score means, standard deviations, and standard errors of the mean for children's reading and mathematics scores in the spring of the first and second year in school. These data are for all children tested each year, arrayed by Transition treatment and comparison school status. They show that, on average, children in Transition and comparison schools gained approximately the same number of points from one year to the next in both subjects.

Table 3 shows the number of children who scored in the high and low quartiles on either reading or math in the second school year. Of the

160 children who have data for that year, 24 scored low on both subjects, 21 scored low in one but not the other, and 27 scored high on both subjects. Figure 1 shows the proportions of boys and girls in the high and low categories. More boys scored low, but, by a narrow margin, more of them also scored high. Examining these proportions separately for reading and math showed more striking gender differences for reading. Fewer girls scored low on reading but, conversely, more boys than girls scored high. In contrast, the distributions for math were almost perfectly flat. These gender differences were not statistically significant.

Several of the family demographic variables distinguished children who scored higher from those scoring lower in reading, but few did for mathematics. Table 4 shows the measures that did and did not differ significantly. For reading scores, children scoring higher had mothers with more education, were more likely to have employed mothers, were rated as more healthy by their mothers, and their families had higher totals on the Home Screening Questionnaire. In contrast, only the mean scores on the Home Screening Questionnaire were significantly different for children scoring high and low on mathematics.

Intercorrelations among the academic predictors are shown in Table 5. Mother's education was a key variable, being correlated with the HSQ total, family resources total, maternal employment, and family income. Father's presence was highly correlated with family income as well.

Separate stepwise regression coefficients were calculated to predict reading and math raw scores summed across two years. Child characteristics (gender and health) were first entered as predictors, followed by family structure variables (father present, number of siblings), then measures of the family environment (mother's education, mother's employment, income, HSQ scores, Family Resource total), and lastly, Transition treatment. Treatment was then crossed with the family variables. Table 6 gives the results.

The models predicted approximately a quarter of the variance for both reading (R^2 = .24) and math (R^2 = .23). Slightly different sets of variables predicted the two scores, but the greatest change in R^2 for both subjects resulted from the entry of the family environment variables. Across treatment groups, children scored better on math as scores on the HSQ increased and a similar trend was apparent for reading, but it did not quite attain statistical significance (p = .06). For reading, there were no main effects for any of the predictors given this combination of factors, but Treatment x the number of children in

the family emerged as significant. Children in Transition treatment schools who were from smaller families did better on reading (Figure 2). The trend toward a main effect for HSQ on reading ($p = .06$) was modified by a trend toward a Treatment x HSQ interaction for reading ($p = .07$). Children whose families had low HSQ scores did better on reading if they were in the Treatment schools, whereas the Transition program did not enhance reading scores for children from homes with higher HSQ scores. Figure 3 illustrates this interaction.

There was a main effect for HSQ scores on mathematics, that is, across treatment groups, children from more supportive homes did better on math. However, treatment interacted with maternal education in predicting math, such that children's math scores increased as a function of the number of years of maternal education if children were in treatment schools. For those in comparison schools, no such linear relationship between maternal education and math scores was seen. (See Figure 4.)

Discussion

The present study reaffirms the importance of family factors on children's academic progress in the primary grades. There is evidence, however, that different factors predict reading and math scores. For reading in particular, academic progress was associated with several family characteristics, judging from the differences seen between families of children in the extreme quartiles. Children with higher reading scores had higher ratings on health, had better educated mothers, were more likely to have employed mothers, and had homes with higher HSQ scores. Children who did better on math had higher HSQ scores, and there was a trend for more of them to have a father present in the home. The family factors that distinguished high and low scoring children in this study are consistent with other reports in the literature that children with better educated parents do better in school (Entwisle & Alexander, 1990) and that the educational support qualities of the contemporaneous home environment is predictive of academic performance (Bradley, Caldwell, & Rock, 1988). The present study also tends to support the finding by Ginsburg and Russell (1981) that the presence of a father in the family is associated with better performance in math. Likewise, these results support results reported by Vandell and Ramanan (1992) that children of currently employed women earned higher scores on reading, but not math. Unfortunately, the information on early maternal employment that would have permitted a direct comparison between these findings and Vandell and Ramanan's

differential effect of early maternal employment on math scores was not available.

As Vandell and Ramanan noted, parental employment can be a reflection of increased maternal competence. Others have found that maternal ability level is a powerful predictor of child academic achievement (Campbell & Ramey, 1994; Garrett, Ng'andu, & Ferron, 1994). No direct measure of maternal ability was available in this study, but maternal educational levels were known, and a strong link between IQ and educational levels has been demonstrated (e.g., Jencks, 1972). Present data show the expected relationships between maternal education, maternal employment, the educational support potential of the home, and increased family resources. When the different factors of the Family Resource Scale were compared among children who scored high and low on reading and math, the most consistent finding was that Factor I, Growth Potential, differentiated those scoring high and low in both. This factor reflects a family that has some discretionary resources, both in time and money.

Our findings are congruent with Majoribank's (1989) assertion that reading achievement is more strongly affected by family factors than is mathematics. Poverty significantly affects the family context (Garrett, Ng'andu, & Ferron, 1994). The educational level of adults in the home is likely to be low (Walker, Greenwood, Hart, & Carta, 1994; Kelly, Morisset, Barnard, & Patterson, 1996). Low-income parents are less likely to read to themselves or to their children (Heath, 1983). Unpublished data collected by Roberts on this same sample show that children's reading scores were positively correlated with how much parents described themselves as reading and engaging in other literacy-related activities at home (J. Roberts, personal communication, June 7, 1996). Another factor that could influence children's reading is the emotional tone of the home. Within poverty households, the socioemotional climate may be harsh (McLoyd, 1990), which could suppress children's language and literacy learning (Bernstein, 1960). Authoritarian beliefs in parents have been linked to lower reading scores in children (Campbell, Goldstein, Schaefer, & Ramey, 1990). Finally, the present data show a relationship between child health and reading in that reading scores were lower in children whose mothers rated them as less healthy. Although there is no direct evidence that nutritional factors influenced the children's health in the current study sample, nutrition is often poor in low income families (McDonald, Sigman, Espinosa, & Neumann, 1994), and this could certainly contribute

to poor health. However, it is unclear why there should be a relationship between child health and reading scores but not math scores.

There is no compelling evidence that having the Transition program available at school buffered children against the effects of negative family factors associated with poverty. Rather, the present results imply that children were better able to make use of positive home resources if they and their families had the support of the Transition program. Thus, children living in households with fewer other children did better on reading if they had the support of the Transition team, and those with better educated mothers did better on math, given Transition treatment. A strong trend in the reading scores suggests that children from homes with the fewest resources to support learning did differentially better, given Transition treatment.

These results generalize to low-income children, and primarily to African American children. Among African American students, boys have been found to be at especially high risk for academic problems (Hale-Benson, 1989), but no significant gender differences in achievement were seen in the current results. If more boys scored low in reading, more boys also scored high, and no gender trends were seen in math scores. These children were still in the very early grades when evaluated for this study, so it is not possible to say if a gender difference might have emerged had they been older.

Conclusions based on simply comparing family factors that differentiated extreme achievement groups and those from the regression analysis varied slightly. It is important to bear in mind that many of the predictors entered into the regression were highly intercorrelated, and that, had different factors been entered, or in a different order, the outcomes would have been somewhat different. The important point is that children's learning is heavily influenced by the characteristics of their homes. Transition treatment interacted with family factors to help children capitalize on family strengths.

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Table 1

Descriptive Statistics for Participants in Head Start Transition Demonstration Study with Reading and Math Scores in Kindergarten and First Grade

Characteristic	Score
Percent Male Child	55.9
Percent Ethnic Group	
African American	79.7
White	13.0
Hispanic	4.0
Other	3.4
Percent with father in home	30.3
Percent mother not high school graduate	19.0
Percent parent unemployed	34.9
Percent receiving welfare	44.3
Mean number of children living in home	.2.71

Table 2

Means and Standard Deviations for Child Woodcock-Johnson Raw Scores for Years 1 and 2 by Transition and Comparison Status

		Type of Transition		School Comparison	
		Year 1	Year 2	Year 1	Year 2
Subject		n = 81	n = 80	n = 86	n = 80
Reading					
	M	13.76	26.20	13.06	27.84
	SD	5.07	11.64	4.21	12.04
	SEM	0.56	1.30	0.45	1.35
Mathematics					
	M	17.23	25.52	16.68	26.55
	SD	5.12	7.08	5.32	6.17
	SEM	0.57	0.79	0.57	0.69

Table 3

Numbers of Children Scoring in High, Middle Two, and Low Quartiles on Woodcock-Johnson Reading and Math Subtests in Spring of First Grade*

		Math Scores			
		Low	Middle Two	High	Totals
Reading Scores	Low	24	5	0	29
	Middle	15	60	11	86
	High	1	17	27	45
	Total	40	82	38	160

* Six children repeated kindergarten and were not in first grade when these assessments were made.

Table 4

Mean Family Demographic Scores for Children in Highest and Lowest Quartiles on Woodcock-Johnson Reading and Math Scores

	Reading Scores					Math Scores				
	Low		High			Low		High		
Family Factor	M	(SD)	M	(SD)	p	M	(SD)	M	(SD)	p
Monthly Income	4.6	(2.0)	5.3[b]	(2.0)	NS	4.6[a]	(1.9)	5.3[b]	(1.9)	NS
Mother's Education	4.9	(1.9)	5.4	(1.6)	.02*	4.8	(1.8)	5.4	(1.5)	NS
Children in home	2.9	(1.2)	2.7	(1.1)	NS	2.8	(1.2)	2.8	(1.1)	NS
HOME Screening Total	36.8	(6.2)	40.3	(7.0)	.007**	35.0	(6.6)	40.2	(7.6)	.007**
Contact with Father	6.2	(3.9)	7.3	(3.4)	NS	6.3	(3.7)	6.9	(3.9)	NS
Rating of child health	4.0	(1.0)	4.5	(0.8)	.027*	4.0	(1.0)	4.5	(0.8)	NS
Percent mother employed	45%		76%		.01**	56%		72%		NS

[a] Monthly income = $600-$800/month; [b] Monthly income = $800=$1000/month.

Table 5

Pearson Product-Moment Correlations Among Predictor Variables

Variable	1.	2.	3.	4.	5.	6.	7.	8.
1. Child Health	1.00							
2. Father in Home	-.00	1.00						
3. Number of Children	.07	-.03	1.00					
4. Mother's Education	.23*	.21*	-.15	1.00				
5. Mother Employed	.23*	.17*	-.02	.29*	1.00			
6. Monthly Income	.07	.41*	.02	.43*	.62*	1.00		
7. HSQ Score	.27*	.29*	-.12	.36*	.15	.27*	1.00	
8. Total Resources Score	.07	.15	-.17*	.20*	.08	.22*	.32	1.00

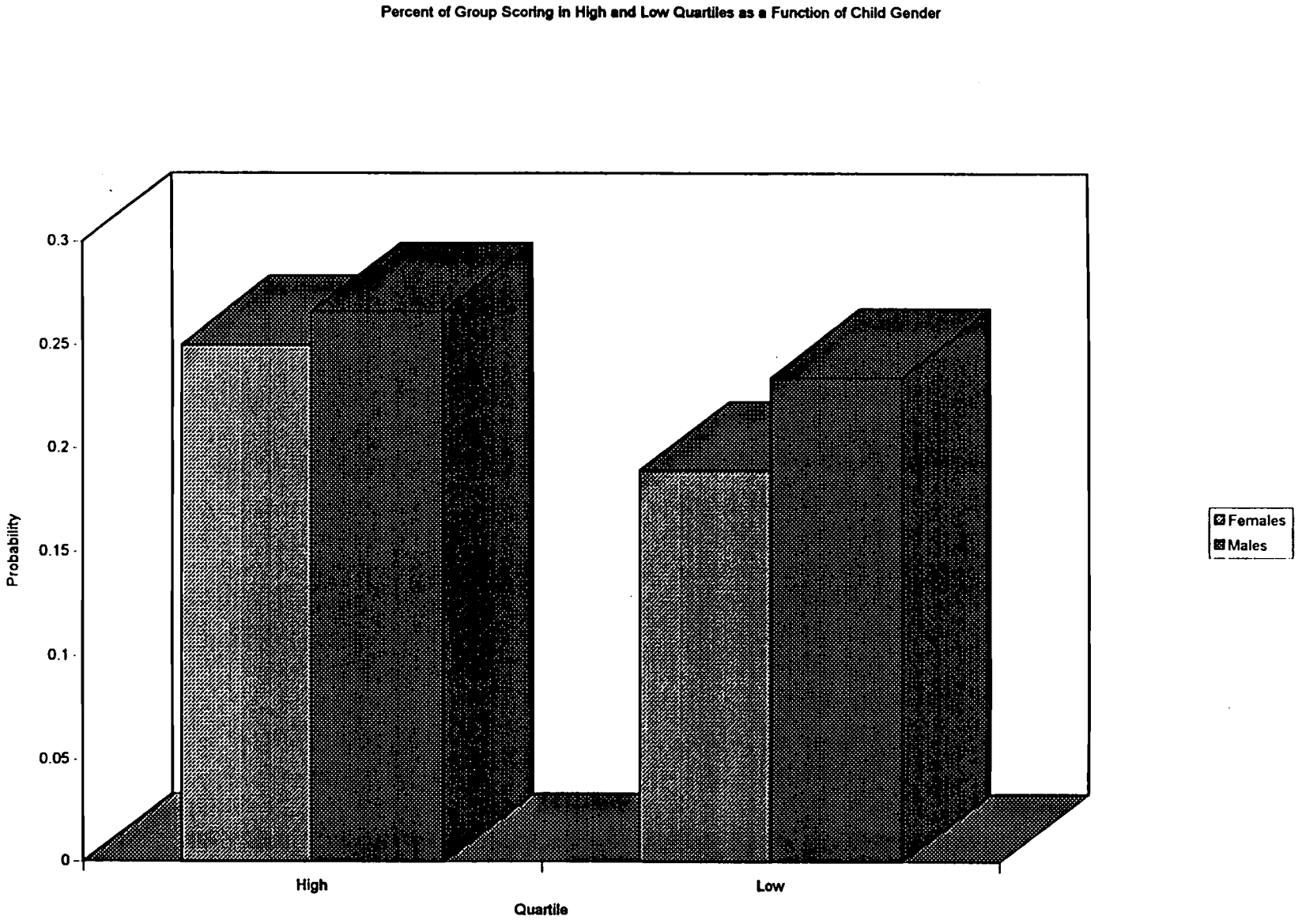
Table 6

General Linear Model Analysis Predicting First Grade Reading and Mathematics Scores From Child Characteristics, Family Structure, Family Environment, and Transition Treatment

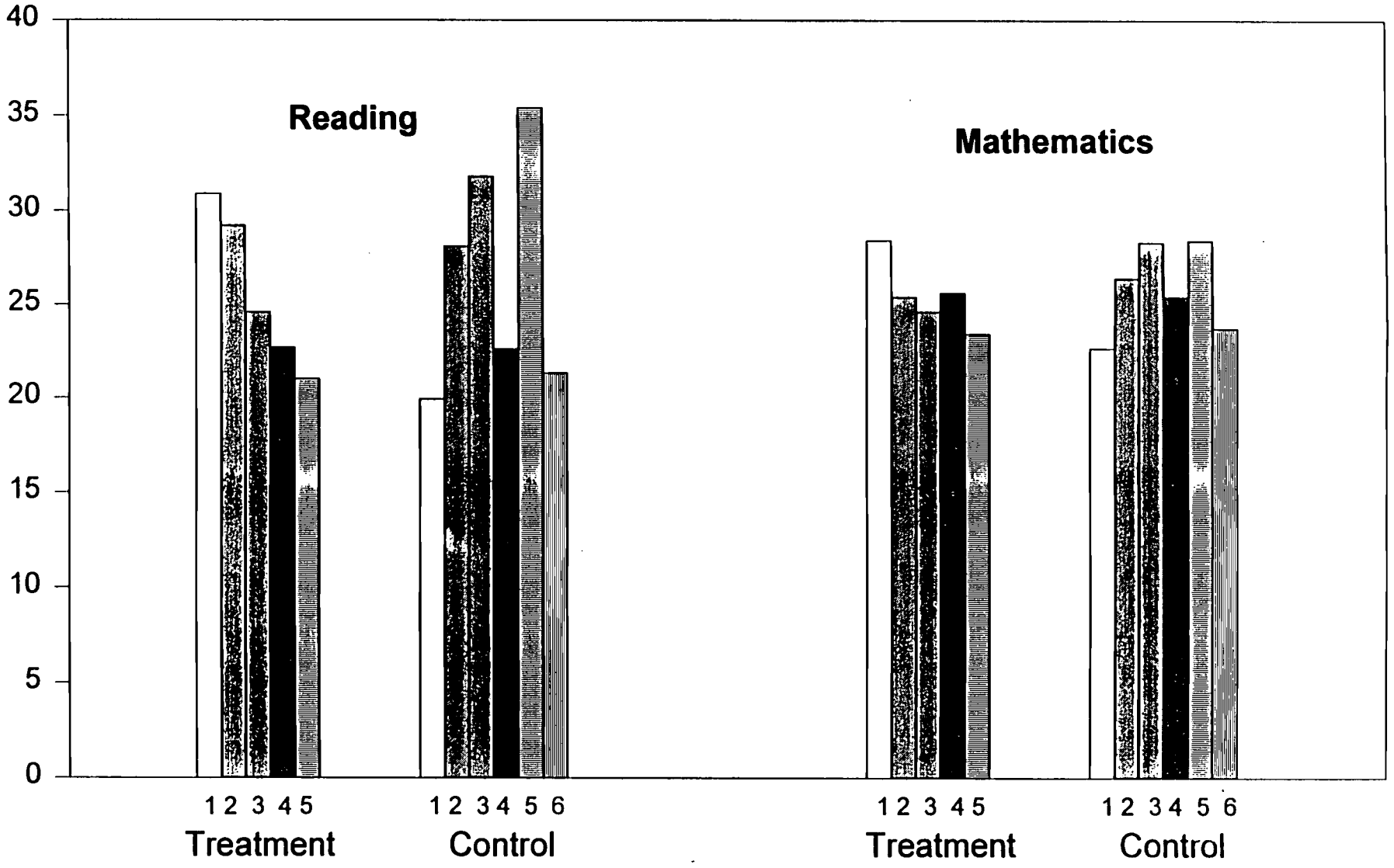
	Reading			Mathematics		
Source	R^2	B	t	R^2	B	t
Child Factors	.03			.04		
Health						
Gender						
Family Structure Factors	.06*			.04		
Father Present						
Number of Children						
Family Environment Factors	.16**			.15**		
Maternal Education						
Income						
Maternal Employment						
HSQ Score		.31[a]	1.9[a]		0.25	2.8*
Family Resources Score						
Treatment	.17**			.16**		
Treatment x Number of Children		-1.8	-2.1*			
.Treatment x HSQ Score		-.29	-1.8[b]			
Treatment x Mother's Education					0.86	2.1*
Total R^2	.24**			.23**		2.1*

* = p < .05; ** = < .01; a = p value for this predictor is .06; b = p < .08

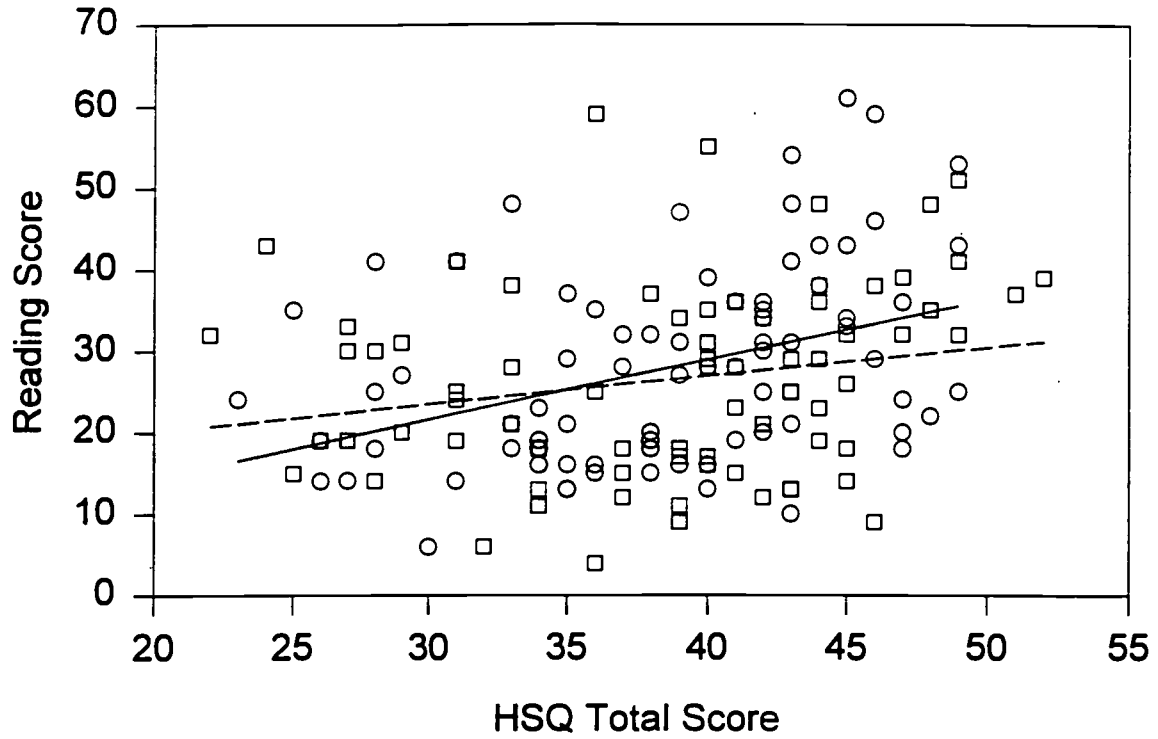
Figure 1

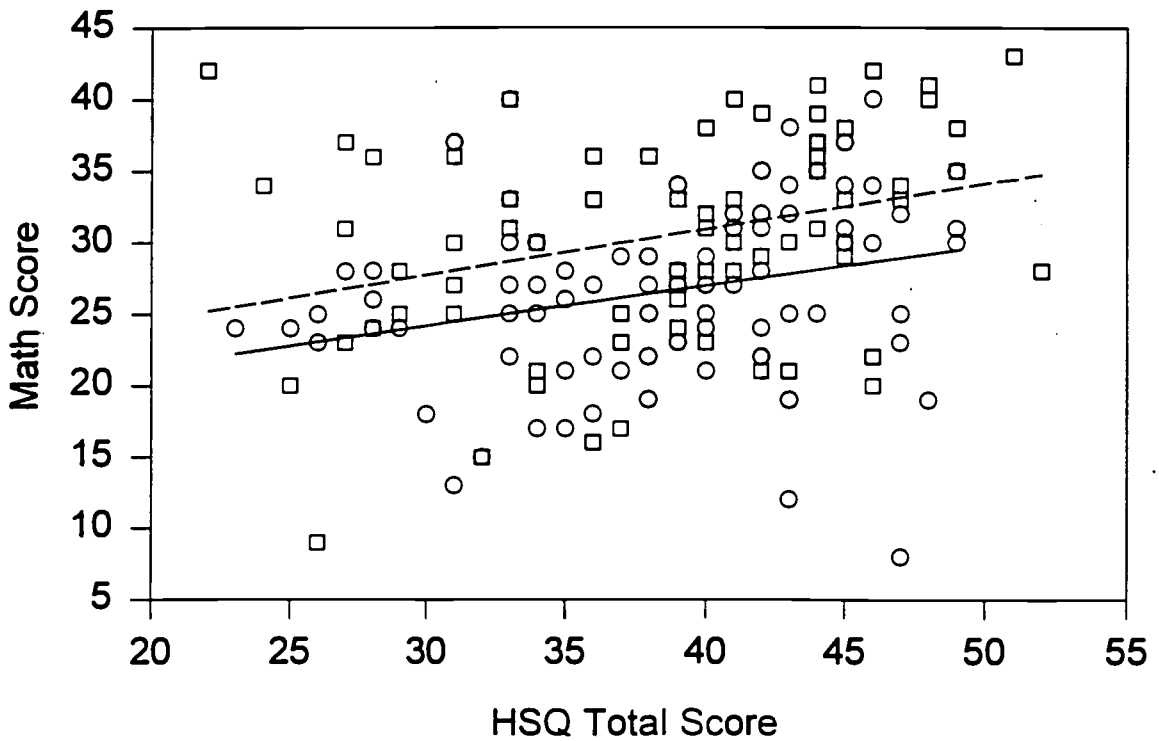

Percent of Group Scoring in High and Low Quartiles as a Function of Child Gender
0.3
0.25
0.2
0.15
0.1
0.05
0
Probability
High
Low
Quartile
Females
Males

Child Academic Scores by Number of Children
Spring First Grade



Child Academic Scores by Home Scores
Spring First Grade



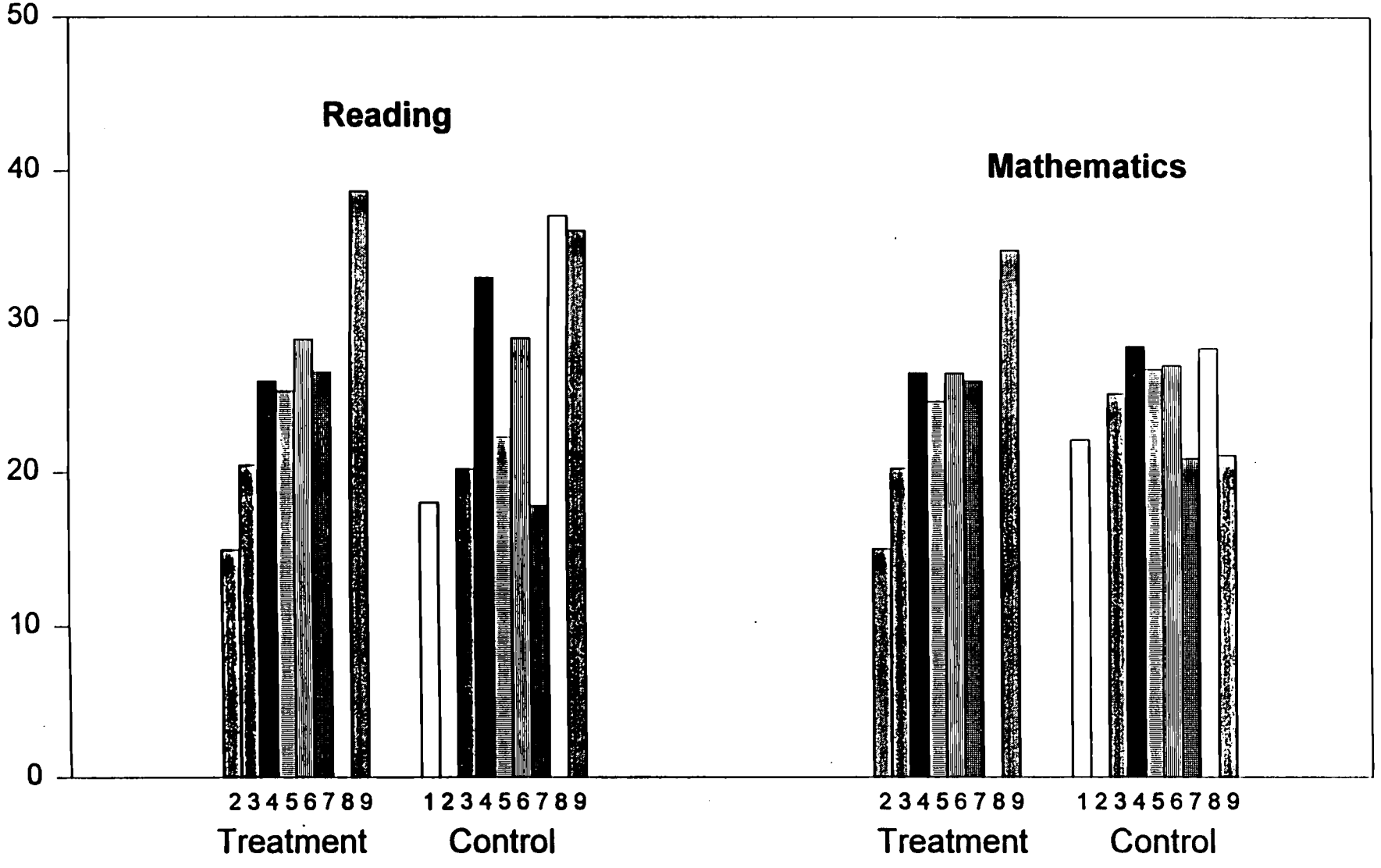


First-Order Regression Lines

Control

Treatment

Child Academic Scores by Mother's Education Level
Spring First Grade



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