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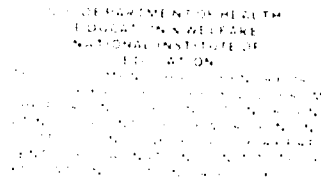
ABSTRACT

This project was designed to explore the relationship between school achievement and birth weight in a population of poverty black school children in the hope that the assumptions about environmental similarity might be approximated, and that the relatively advanced age of the subjects would allow examination of the lasting effects of birth weight. For this study, children from 13 of the 22 poorest schools in the city of East St. Louis, Illinois, were selected. The sample comprised 43 percent of the third and sixth grade students enrolled in those schools during the 1970-71 academic year. It was found that low birth weight children are far above their proportionate share of the classes for the mentally handicapped. Birth weight does persist as a significant variable in school achievement even in an area characterized by poor educational preparation and results. But though this relationship interest in that it does persist beyond infancy and does occur in a generally uniform (and poor) social and economic environment, academic failure cannot be accurately predicted from birth weight nor can one, from this information, predict that a child will be born at low weight. These data do not indicate that improved prenatal care might have more effect than special education programs for the poor. (Author/JM)



birth weight, early childhood and school achievement

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BIRTH WEIGHT, EARLY CHILDHOOD AND SCHOOL ACHIEVEMENT

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The Center for Urban and Environmental Research and Services, though relatively new in name, has a lengthy history of applied research and public service activities at Southern Illinois University, Edwardsville. As the Public Administration and Metropolitan Affairs program and as Regional and Urban Development Studies and Services, the unit has published numerous research monographs relating to urban problems. It has served as a source of consultants for governmental agencies and for public and private organizations intent upon solutions to local and regional needs. In addition, it has engaged in a systematic program of data collection and storage.

The staff of the Center comes from varied disciplinary and experience backgrounds. It includes a core of permanent professionals, most of whom maintain appointments with academic faculties, support personnel and temporary members from other units of the University. No specific curriculum emanates from the Center. Rather, the staff teaches in and plans for standard, as well as innovative and interdisciplinary, degree programs directed toward training in urban and environmental areas.

Center for Urban and Environmental
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Southern Illinois University
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On the CUERS staff, Graduate Assistant Dennis Patton and Staff Assistant Sally Ferguson did most of the actual file search in St. Louis. Other Center personnel were involved in the review of the monograph through its many revisions and were helpful in suggesting modifications and encouraging us to complete the work. The completed draft was prepared by our very able manuscript typist, Rose Modene.

Though the assistance of all of these persons, and others, is gratefully acknowledged, the authors take full responsibility for the project and for the conclusions drawn.

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CHAPTER 1

THE STUDY DESIGN

Background

Poor people are the subject of many studies and are subject to intervention designed to change their behavior and improve their opportunities. Concern with the educational performance of poverty children has led to the development of special programs in schools. The assumption behind many of these curricula is that cultural deprivation alone is the limiting factor for these children.[31] There clearly may be, however, other circumstances which destine some of these young people to perpetual failure or at least to limited achievement in school.

One such factor may be nutrition. A large body of literature links known or assumed malnutrition in infancy to subsequent mental impairment. In addition, and basic to this study, researchers have found that slowed intrauterine growth of the fetus during the last ten weeks of pregnancy is related both to low weight at birth and to lessened brain development.[46] Low birth weight (for purposes of this study defined as five and one-half pounds or less) then, stands as a potential surrogate for examination of inferior prebirth brain maturation.

Such factors as sex,[50] the age of the mother and the parity of the child,[6] and the smoking habits of the pregnant woman[42, 45] have been found significantly related to birth weight. Such variables can be broadly termed "biological." In addition there are found relationships between low birth weight and race,[65] income,[34] legitimacy,[68] and other variables probably reflective of the socio-economic level of the infant or the family. These might be called "environmental." Each is argued strongly.

Regardless of the causality of the low weight at birth, nearly all research examining it in relation to diminished mental ability establishes such an association. (See the references contained in the bibliography following Chapter 4.) The attention of the studies is differentially focused, however, and the results are not always consistent. Some authors cite a relationship between low birth weight and inferior intellectual capacity only when physical abnormalities are present as well. Others feel that this association occurs even among the healthy. Two additional sets of conclusions persist, and upon these are based this study design.

The Hypotheses

Two types of analysis in studies of the relationship between low birth weight and intellectual abilities form the basis for the hypotheses to be tested here: First, some research indicates that while low birth weight children may suffer initial mental deficiencies, such differences are not permanent.[4, 62] Examining children with birth weights of four and one-half

pounds or less, one study found the effect of birth weight was "most significant in infant tests and then gradually became less distinct."[26]

Second, though most authors feel that there is a relationship between birth weight and ability, some do question whether or not the differences, short or long term, are not primarily factors of social class.[7, 22, 41, 57, 71] Sandra Scarr summarizes: "As many researchers have noted . . . this relationship between birth weight and intelligence is highly biased by social class variables. Both lower birth weight and lower social class are independently related to lower intelligence. To separate the effects of birth weight from those of social class requires a carefully controlled study of a special type."[59]

Best for purposes of proof, perhaps, would be a longitudinal study of siblings differing in birth weight but living in the same environment. An appropriate modification might exist if in a study of children whether siblings or not, one could truly characterize the home and community conditions as uniform. Unfortunately this cannot be assured.

This project was designed to explore the relationship between school achievement and birth weight in a population of poverty black school children in the hope that the assumptions about environmental similarity might be approximated, and that the relatively advanced age of the subjects would allow examination of the lasting effects of birth weight. In addition to testing hypotheses about the long term association between low birth weight and inferior mental ability when controlled by social class, certain data interrelationships will also be displayed. Since they are not based upon preproject hypotheses, the associations found must be considered descriptive only, subject to the vagaries of sample variability, but indicating areas for future study.

Indeed, the entire project might be considered exploratory. The dependent variables examined are not the carefully administered and interpreted aptitude tests commonly employed but rather are the more readily available measures existing in the real world of educational rewards and punishments. The researchers recognize the limitations of standardized tests given and scored by many different people. Nonetheless special programs are developed on the basis of such scores. The authors are also aware that retention in grade may well be a subjective decision only partly reflective of school achievement. On the other hand such retention is seen by the student and others as a measure of his ability and/or educational progress. To find an association between low birth weight and these aspects of school achievement, while adding little to medical knowledge, may improve one's capacities in educational planning.

Selection of the Study Area

The city of East St. Louis, Illinois, offered an opportunity for research of the kind just described. "The East St. Louis area, this most stricken area of Illinois, has the highest maternal death rate in the state (1967 statistics), one of the highest premature rates, the highest venereal

and tuberculosis morbidity rates, and one of the highest crude death rates in the country for an area of its population."[14]

According to the United States Census of Population, 1970, the city of East St. Louis was approximately seventy percent black. Of the 10,652 Negro families in that city, 30.6 percent received public assistance income and 37.8 percent had incomes less than the poverty level.

The elementary schools in this city draw their children from fairly small, economically homogeneous neighborhoods. As might be expected, many of these are poverty areas.

Title I of the Aid to Education Act offered funds for schools with large concentrations of disadvantaged students. Eligibility criteria included the number of children receiving free textbooks (based upon family incomes of less than $2,000 in 1966) and the number of children from homes that obtained Aid to Families with Dependent Children (AFDC). Twenty-two schools in District 189 (which includes the city of East St. Louis and some surrounding communities) were eligible for these funds because the percentage of deprived children there was greater than the average for the district as a whole.

The Sampling Frame

For this study, children from thirteen of these twenty-two poorest schools were selected. These particular schools were generally located in the most depressed parts of the city, where nearly all enrolled students were black and would meet poverty criteria. All black third and sixth grade children in these schools were included in the initial selection. The two grades were chosen for a number of reasons: Students needed to be sufficiently far into their elementary education to have accumulated some test results and to be of an age to enable examination of long term effects of birth weight. It was felt inappropriate however to concentrate efforts on the upper grades where heavy exodus from the school system was occurring since a study of adolescents found that, for both males and females, school dropouts had the lowest birth weights.[30] Also, elementary schools have more homogeneous populations than do the junior or senior high schools which draw their students from a larger area and from a wider socio-economic span. Such "environmental" similarity must be maximized, of course, if the analytical problems including class level are to be avoided. Finally, some of the children in the third grade during the year of study (1970-71) were in the special Follow Through program. This is a federally funded project designed to provide a continuing experimental curriculum for the children of the preschool Head Start program. If these students are found to have characteristics (including the proportion born at low weight) no different than those of the other sample children, the direct effect of special education on some measures of achievement can be studied.

Also included in the sample were children of appropriate ages in the educable mentally handicapped (EMH) and trainable mentally handicapped (TMH) classes in East St. Louis. No test data is available for these children

but their mere presence in these programs indicates inferior academic achievements or abilities. It was felt that if there is a correlation between birth weight and school achievement, disproportionate numbers of low birth weight children would be found in these special classes.[2, 69]

The Data Records

The procedure followed in this research was to obtain the class cards for all students in the selected grades and to copy pertinent information for those who indicated birth in Illinois or in St. Louis, Missouri. Standardized achievement tests, administered annually, served as the primary indicator of educational progress, but information on family characteristics and on absences and retention in grade, was also taken.

Until the mid-1960's, only limited numbers of blacks entered the maternity wards of the hospitals in East St. Louis. This meant that many children were delivered in the St. Louis City Hospital, and a few were born at home. As a result St. Louis records were needed in order to maximize the sample size.

The St. Louis city vital records office allowed our own staff, with proper supervision and confidentiality assurances, to obtain birth information from their files while the personnel in the Illinois Department of Public Health conducted a search for births recorded in that state. All identifying information was removed, after initial matching, so as to protect the privacy of the data.

Experience in the St. Louis office leads to the conclusion that the name under which the birth was recorded was sometimes changed prior to school entrance and that the school information may also be inaccurate as to the date of birth. Day, month and even year were misreported on some school forms and only a concentrated and imaginative search in the City office permitted the recovery of the birth related data.

These inaccuracies probably accounted for a difference in the proportion of students whose birth records were located in Illinois and those located in Missouri. Since the Illinois office was forced, by the enormity of their record files and by the limitations of their staff time, to rely on the information as reported to the school, a smaller percentage of records were matched there. A further constraint exists in finding birth information for those from Illinois. "At home" births of East St. Louis children are most likely to have occurred in that city, and information about these deliveries is far less likely to exist in any vital records office. Birth records were located, then, for 95.3 percent of children whose class cards indicated birth in St. Louis, and 87.4 percent of those giving Illinois as their place of birth.

Among the students in the educational programs for the handicapped (EMH-TMH), a particularly large discrepancy between states existed. Fifty-five of a total of 57 of these births reportedly occurring in St. Louis were located while only 17 of 26 in Illinois could be found. Enrollment

in these EMH and TMH classes would suggest severe dysfunction or brain damage which may be related to unattended or midwife deliveries for which formal birth registration is poor. Age at entry into these programs for mentally handicapped children may not be of particular importance, and little may be attempted in the way of birth date verification. The ability to intensively search the St. Louis name files allowed the location of many records in spite of school data inaccuracies.

A family with an intellectually exceptional child (be he retarded or unusually bright) may, in the society as a whole, elect to have that child educated in the private sector. This option is not taken to any degree in a poverty population. Nonetheless, it should be made clear that by using public school records as the starting point, certain low birth weight correlates are automatically excluded: Those children whose abnormalities or insufficiencies result in early death are clearly eliminated, and death hazards are particularly great for low weight infants.[64] In addition, those with physical problems[9, 49] or with very severe retardation may not be involved in the educational system at all, even in programs for the handicapped. Thus the results to be shown here should be looked at as the minimal relationships between birth weight and achievement factors.

A few students from the sample grades were excluded because of the lack of any test records, and a very small fraction because they were not black. A total of 1,215 students were matched on school and birth information and these students form the final sample for study.

The Sample Students

The sample comprised 43 percent of the third and sixth grade students enrolled in all of the poverty schools in East St. Louis during the 1970-71 academic year. The following table indicates the number of records for each grade and the place of birth of these students.

Table 1 Sample Students - Grade by Place of Birth

Grade	Place of Birth					
	St. Louis		Illinois		Total	
	Number	Percent	Number	Percent	Number	Percent
Third	389	59.5	265	40.5	654	100.0
Sixth	353	72.2	136	27.8	489	100.0
EMH-TMH	55	76.4	17	23.6	72	100.0
Total	797	65.6	418	34.4	1,215	100.0

The parents of these children to a large extent came originally from one of the southern states. This proportion is greater for parents of sixth grade students than for parents of those currently in the third grade, reflecting the slowed migration to the north evident in other demographic data. Nearly all of the other parents were born in either Illinois (often in East St. Louis itself) or Missouri. (Reporting errors exist as people do not make a distinction between their actual place of birth and their early childhood residence area. For this reason, Missouri and Illinois have been combined.)

Table 2 Current Grade by Birthplace of Father and Mother*

Parent & Grade	Place of Birth: Illinois or Missouri		South Central Region**		Other Known Birthplace		Total***	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Fathers of								
3rd Graders	188	36.3	321	62.0	9	1.7	518	100.0
6th Graders	111	27.3	288	70.6	8	1.9	407	100.0
All (Incl. EMH-TMH)	310	32.0	643	66.2	17	1.8	970	100.0
Mothers of								
3rd Graders	243	37.3	392	60.1	17	2.6	652	100.0
6th Graders	163	33.4	315	64.6	10	2.0	488	100.0
All (Incl. EMH-TMH)	428	35.4	754	62.4	27	2.2	1,209	100.0

Though all sample students live in low income areas of East St. Louis, certain information on the school forms allowed us to separate those who would meet even more stringent poverty definitions. Students were given free books and free lunches (and this fact noted on their class cards) if their family was obtaining Aid to Families with Dependent Children (AFDC) or offered evidence of other public assistance. In addition, the occupation of the father and/or the mother was reported at the time of birth. Knowing, from the birth records, the number of older siblings of the sample child, we could estimate the minimum family size and thereby, with the other data, make assignment to a "severe poverty" group. Some of the classification was, of course, arbitrary, but if there is an error of assignment, it is to understate the proportion living in extreme deprivation. In any case, few students would meet the common criterion for the middle class. All students were classified as in the following table:

Table 3 Poverty Sub-Classification

Poverty Level	Number	Percent
AFDC Recipients	488	40.2
Other Severe Poverty	310	25.5
Lesser Poverty	417	34.3
Total	1,215	100.0

* The difference in the number of fathers and of mothers in this table is due to the large number of illegitimate births in this sample. In some cases in Missouri, information about the father was included in the birth record even if the birth was not legitimate but in Illinois no information exists for the father if the mother is not married.

** The South Central Region includes Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Oklahoma, Tennessee and Texas.

*** In this and subsequent tables, numbers will be shown only where relevant subject information is available unless the "unknown" category is itself important to the analysis. Missing data on either the birth or the school record accounts for the incompleteness.

According to the vital statistics information obtained from the Department of Public Health, State of Illinois, about three percent of all births to resident mothers (regardless of race) were multiple births in East St. Louis in 1962 (the "normal" birth year for the third grade students). In the sample, about four percent were other than single births. As can also be seen in this table, a minor preponderance of females exists here:

Table 4 Sex by Single or Multiple Birth

	Type of Birth				
Sex	Single	Twin	Triplet	Unknown	Total
Male	552	21	4	6	583
Female	602	25	1	4	632
Total	1,154	46	5	10	1,215

Finally, since weight at birth is such an important variable for this study, a description of the sample in that regard is needed. In 1959* (the "normal" birth year for sixth grade students) a total of 13.5 percent of all births to Negro mothers resident in East St. Louis weighed five and one-half pounds or less (this being the weight standard to which the term "premature" is applied in vital records). A total of 13.7 percent low birth weight children were found in our sample.

Table 5 Weight at Birth for the Sample, the City and the State

			E.S.L. Negro		State of Illinois (all races)			
Weight	Sample		1959		1959		1962	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
4 lb 8 oz or under	55	4.6						
4 lb 9 oz to 5 lb 8 oz	108	9.1						
Total Low Birth Weight	163	13.7	176	13.5	18,072	7.5	17,898	7.8
5 lb 9 oz to 6 lb 8 oz	298	25.0						
6 lb 9 oz to 8 lb 8 oz	656	54.9						
8 lb 9 oz or Over	77	6.4						
Total Normal or High Birth Wt.	1,031	86.3	1,127	86.5	221,799	92.5	212,586	92.2
Total Birth Wt. Reported	1,194	100.0	1,303	100.0	239,871	100.0	230,484	100.0

* Comparable data for 1962 was not available.

This proportion is remarkably large when one considers that low birth weight children have considerably higher death rates in the early post-natal period,[48] and that if severe retardation or physical disability exists, the individual will not enter or will soon leave the school system. Other factors, such as the absence of records on births at home, add to the suggestion that the bias of the sample is toward exclusion of low birth weight children.

The large proportion of low birth weight children found then, leads to the belief that these births occur most frequently in the most economically depressed portions of the community - that segment under study here. This conclusion is obviously consistent with other research showing the greater frequency of low birth weight children among the lower classes and with the presumption that nutritional deprivation is a factor causing both inferior brain development and slowed intrauterine growth.

The sample, then, is poor, is black, and is of basically southern parentage. Most children were single births, and a substantial proportion were born at weights below five and one-half pounds, these children being sufficient in number to test the effect of low birth weight on several education-related measures.

CHAPTER 2

DATA INTERRELATIONSHIPS

General Description

Though interest in the effect of low birth weight on school achievement was the factor which first inspired this research, the capacity to look at relationships between education measures and other variables was felt to be valuable as well. Association between the achievement information and the other data contained on the birth and school records led to an examination of the interrelationships among the independent variables themselves, and a check of assumptions about uniformity in the socio-economic environment of the sample.

Was it true that low weight at birth was generally a result of a short pregnancy? Were very poor mothers likely to postpone prenatal care and, thus, to increase their likelihood of having problems at birth? Were illegitimate children likely to be living in one-parent families by the time they entered school?

Since research hypotheses had not been specified, answers to these questions were not capable of the statistical verification used in the next chapter. They were, nonetheless, indicative and sometimes contradicted the commonly held notions about the nature of life in poverty. For this reason and because the associations found may need further examination for program planning, this chapter is devoted to a display of data interrelationships.

The Biological Variables

"Weight at birth" information is presumed to be quite reliable since it is recorded for hospital births and for almost no others. Additional birth record data may not be so accurate. For example, the length of the pregnancy seems often to be based upon the statement of the mother at the time of the birth, since early prenatal care is not indicated. The physician attending at birth, in addition, may not have been the physician involved during pregnancy, leading again to possible gestation misstatements. Nonetheless, it may be instructive to indicate the length of pregnancy recorded and the associated birth weight.

Table 6 Length of Pregnancy by Birth Weight

Length of Pregnancy	Weight					
	5 lb 8 oz or Under		5 lb 9 oz or Over		Total	
	Number	Percent	Number	Percent	Number	Percent
35 Weeks or Less	49	30.2	4	0.4	53	4.5
36 Weeks or More	113	69.8	1,020	99.6	1,133	95.5
Total	162	100.0	1,024	100.0	1,186	100.0

Weiner states: "Negro infants are at a greater risk of low birth weight. Apparently Negro mothers also tend to report their infants as having short gestation time, even when their birth weight is greater than 2,500 grams." (5 lbs., 8 oz)[66] The latter conclusion is not supported by this data. Almost no normal weight children are shown on their birth certificates to have been less than full term. This is certainly factual in most cases, but in addition there may be recording of full gestation when its actual length is unknown if the infant is of normal weight. Most low weight births, too, are recorded as having been full term.

Though there is also, as expected, a relationship between the term of pregnancy and multiple births, most short gestation children are single births and most twins are born after a full thirty-six week pregnancy according to these records:

Table 7 Length of Pregnancy by Single or Multiple Birth

Length of Pregnancy	Single or Multiple Birth							
	Single Birth		Twin		Triplet		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
35 Weeks or Less	39	73.6	13	24.5	1	1.9	53	100.0
36 Weeks or More	1,097	96.7	33	2.9	4	0.4	1,134	100.0
Total	1,136	95.7	46	3.9	5	0.4	1,187	100.0

Again, though most multiple births are of low weight, the majority of low birth weight children were single born:

Table 8 Birth Weight by Single or Multiple Birth

Birth Weight	Single or Multiple Birth							
	Single Birth		Twin		Triplet		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
5 lb 8 oz or Under	128	78.5	31	19.0	4	2.5	163	100.0
5 lb 9 oz or Over	1,014	98.6	13	1.3	1	0.1	1,028	100.0

One hundred and two of the 163 low birth weight children in this sample are female. This situation suggests a diminished association between birth weight and school achievement since females are reputedly better elementary school students.

Previous research has indicated that the age of the mother is related to the birth weight of the child.[6] This finding is not supported in our sample of poverty black children. Though there are slight excesses of low birth

weight infants born to the very young mothers,[68] the differences throughout are not significant.*

Table 9 Birth Weight by Age of Mother

Birth Weight	Age of Mother: 17 Yrs. or Under		18-19 Yrs.		20-24 Yrs.		25-29 Yrs.		30-34 Yrs.		35 Yrs. and Over		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
5 lb 8 oz or Under	21	12.9	13	8.0	41	24.2	45	27.6	26	15.9	17	10.4	163	100.0
5 lb 9 oz or Over	80	7.8	103	10.0	282	27.3	265	25.7	171	16.6	130	12.6	1,031	100.0

χ^2=5.9816 5 df Not Significant

Parity (the birth order of the child) is, or might be expected to be, a reflection of the age of the mother. Though other analysts have found a relationship to birth weight,[6, 50] our study, as in the examination of age, found no such association.

Table 10 Birth Weight by Number of Previous Pregnancies

Birth Weight	Previous Pregnancies: No Previous Pregnancies		1-3 Previous Pregnancies		4 or More Previous Pregnancies		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
5 lb 8 oz or Under	29	17.9	61	37.7	72	44.4	162	100.0
5 lb 9 oz or Over	167	16.3	444	43.4	412	40.3	1,023	100.0

χ^2=1.8896 2 df Not Significant

Some portions of the data on birth records appears to have been more consistently and carefully handled than others. One dubious item is complications at birth. These include a variety of situations from a low forceps delivery to a Caesarean section and toxemia. Often the individual examining the records had to interpret from other parts of the form whether the lack of an entry meant no problem at birth or simply showed incomplete information obtained from the attending physician. The number of such entries was so small that the sample children have been grouped (perhaps inappropriately) into those with and those without any form of recorded birth complication. Low birth weight babies have had more birth problems than have those born at normal weight.

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* Though not subject to the conclusions which such a test allows about previously established hypotheses, chi-square is used throughout the examination of data interrelationships to indicate the strength of association.

Table 11 Birth Weight by Complications at Birth*

Birth Weight	Complications: No Complications Number	Percent	Some Form of Complication Number	Percent	Total Number	Percent
5 lb 8 oz or Under	112	80.0	28	20.0	140	100.0
5 lb 9 oz or Over	782	89.2	95	10.8	877	100.0

χ^2=9.5437 1 df Significant <.01

Since this is the only "biological" variable except gestation which shows a significant relationship to birth weight, and recognizing the problems inherent in the data, some suspicions may be offered: Caesarean sections are often programmed to insure delivery before term. Fetuses living in deficient intrauterine environments are also likely to be delivered early. Children of low birth weight may have experienced other pre-birth hazards which, though not terminating the pregnancy, may make delivery complications more likely. The data here is insufficient to allow more precise analysis.

Our information then, does not support conclusions that birth weight is related to either the age of the mother or the parity of the child. In fact, such weight is found to be associated only with gestation and, for unknown reasons, with complications at the time of delivery.

Biological-Social Interrelationships

The length of prenatal care might be considered to be both a biological and an environmental issue. Though it has obvious physical implications for the well-being of the infant, a decision and an ability to obtain care during a pregnancy is surely a product of the social situation.

Apparently the week at which prenatal care is begun is not related to birth weight in any consistent fashion in this group,[35, 68] though such a research conclusion has been drawn elsewhere.

Table 12 Birth Weight by Week Prenatal Care Began**

Birth Weight	Week Care Began: 15 Weeks and Under No.	%	16-23 Weeks No.	%	24-35 Weeks No.	%	36 Weeks and Over No.	%	Total No.	%
5 lb 8 oz or Under	34	35.4	30	31.3	25	26.0	7	7.3	96	100.0
5 lb 9 oz or Over	277	43.2	196	30.5	130	20.2	39	6.1	642	100.0

χ^2=2.7305 3 df Not Significant

* Birth complications were recorded only on the Missouri forms and in Illinois before 1962.

** Information on prenatal care was available on the Missouri records only.

Many of these previous studies used cross sectional samples and one would expect both deferred care and low weight to be more common among the poor. Lack of a strong relationship between them in this sample might occur for two reasons: physicians checked for the more serious hazards during prenatal examinations but felt that nutritional matters were beyond their area of control, or patients disregarded or were unable to follow diet recommendations when made.

One might expect that a mother living in severe poverty would also run a greater risk of birth complications. Our sample produces the opposite finding. In the poorer group more hazardous complications during pregnancy might result in miscarriage and therefore in no live birth. It may be, however, that the records for the "less severe poverty" babies are simply more accurate.

Table 13 Poverty Status by Complications at Birth

Poverty Level	Complications: No Complications		Some Complications		Total	
	Number	Percent	Number	Percent	Number	Percent
Severe Poverty	610	89.7	70	10.3	680	100.0
Lesser Poverty	287	84.4	53	15.6	340	100.0
Total	897	87.9	123	12.1	1,020	100.0

χ^2=5.99 1 df Significant <.02

The severity of poverty as established through information on the school entry records is also not related to weight at birth. Again, this is a generally impoverished population segment, and the fact that the children living in what was coded as "less severe poverty" were as great a proportion of the low as of the normal weight group[46] reinforces the presumption of similar economic and social conditions experienced throughout the sample.

Table 14 Birth Weight by Poverty Status

Birth Weight	Poverty Status: AFDC Recipients		Other Severe Poverty		Less Severe Poverty		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
5 lb 8 oz or Under	71	43.5	41	25.2	51	31.3	163	100.0
5 lb 9 oz or Over	412	40.0	264	25.6	355	34.4	1,031	100.0

χ^2=0.8704 2 df Not Significant

Legitimacy is clearly reflected in the poverty classification since AFDC recipiency creates one of the economic groups. It is not surprising, therefore, that legitimacy is also not significantly related to weight at birth here though other research has found limited association.[68]

Table 15 Birth Weight by Legitimacy

Birth Weight	Legitimacy: Legitimate Number	Legitimate Percent	Not Legitimate Number	Not Legitimate Percent	Total Number	Total Percent
5 lb 8 oz or Under	108	66.7	54	33.3	162	100.0
5 lb 9 oz or Over	725	70.4	305	29.6	1,030	100.0

χ^2=0.9212 1 df Not Significant

Legitimacy, a factor in the environmental situation experienced by the child, is associated with other biological variables. For example, an illegitimate child is more apt to have a young mother (and, relatedly, fewer older siblings) than a child born in wedlock. Such a circumstance may influence the learning situation experienced in the home.

Table 16 Age of Mother by Legitimacy of Sample Child

Age of Mother	Sample: Legitimate No.	Legitimate %	Not Legitimate No.	Not Legitimate %	Total* No.	Total* %	Total All Births: E.S.L. Negro 1959 No.	E.S.L. Negro 1959 %	E.S.L. Negro 1962 No.	E.S.L. Negro 1962 %
Under 20 Years	114	13.5	103	28.6	220	18.2	286	21.9	311	22.8
17 Yrs. & Younger	(40)	(4.7)	(61)	(16.9)	(103)	(8.5)				
18-19 Yrs.	(74)	(8.8)	(42)	(11.7)	(117)	(9.7)				
20-24 Yrs.	231	27.5	94	26.1	326	27.0	407	31.2	391	28.6
25-29 Yrs.	237	28.2	73	20.3	311	25.8	290	22.3	296	21.7
30-34 Yrs.	144	17.1	56	15.6	201	16.7	203	15.6	182	13.3
35 Yrs. & Over	115	13.7	34	9.4	149	12.3	117	9.0	185	13.6
Total	841	100.0	360	100.0	1,207	100.0	1,303	100.0	1,365	100.0
Median Age	26.6 Yrs.		24.1 Yrs.		25.9 Yrs.		24.5 Yrs.		24.8 Yrs.	

Many illegitimate births are first births. It may be noted, however, that nearly three-fourths of those sample children designated as illegitimate have older siblings. Often the sample child born out of wedlock was not the first birth, and probably not the first illegitimate birth - further factors in the learning environment.

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* Includes unknown legitimacy.

Table 17 Number of Older Siblings by Legitimacy of Sample Child

Number of Living Older Siblings	Legitimacy: Legitimate		Legitimacy: Not Legitimate		Total (incl. unknown legit.)	
	Number	Percent	Number	Percent	Number	Percent
None	116	13.8	99	27.6	218	18.1
1	135	16.1	63	17.5	198	16.4
2	130	15.5	58	16.1	190	15.8
3	122	14.5	34	9.5	156	12.9
4	90	10.7	38	10.6	128	10.6
5	79	9.4	27	7.5	107	8.9
6	64	7.6	15	4.2	79	6.6
7	39	4.6	10	2.8	49	4.1
8	35	4.2	4	1.1	39	3.2
9 or More	30	3.6	11	3.1	41	3.4
Total	840	100.0	359	100.0	1,205	100.0

The interrelationships between the biological and the social variables, then, do not negate the assumption of similar environmental experiences in the sample. Severity of poverty, within this sample of the poor, is not found to be related to weight at birth. Length of prenatal care, also, does not differ between the weight groups. Legitimate and illegitimate children are equally likely to be normal in weight. Only "birth complications," a precarious piece of information, shows statistical significance when associated with the poverty level, and this in a direction opposite of that which might have been expected.

The Social Variables

Legitimacy status is clearly of more analytical value in this study if the illegitimate child is still living in a one-parent household at the time he enters the school system:

Table 18 Legitimacy of Sample Child by Family Structure at Time of Public School Entrance

Legitimacy of Sample Child	Family Structure: "Parents" Living Together		Family Structure: "Parents" Not Living Together		Total	
	Number	Percent	Number	Percent	Number	Percent
Legitimate	468	68.8	212	31.2	680	100.0
Not Legitimate	35	17.4	166	82.6	201	100.0
Total (incl. unknown legit.)	507	57.0	382	43.0	889	100.0

This is obviously the case though many mothers of illegitimate children do marry and, in fact, may have done so in the interim only to be left alone

by the time the child is of school age. Whether legitimate or not, four out of ten children are living, at the age of school entrance, in single-parent families.

Most illegitimate births were not first pregnancies. This suggests the strong possibility that AFDC already had been established for the unwed pregnant woman. Welfare recipients normally have access to health care, and thus the lack of a significant difference in prenatal care by legitimacy status is not particularly surprising in this poverty sample. What difference does exist suggests less care for unwed mothers.

Table 19 Legitimacy by Week Care Began

	Week Care Began									
	15 Weeks & Under		16-23 Weeks		24-35 Weeks		36 Weeks & Over		Total	
Legitimacy	No.	%	No.	%	No.	%	No.	%	No.	%
Legitimate	232	44.1	161	30.6	105	20.0	28	5.3	526	100.0
Not Legitimate	77	36.7	65	30.9	50	23.8	18	8.6	210	100.0
Total	309	42.0	226	30.7	155	21.1	46	6.2	736	100.0

$\chi^2=5.57$ 6 df Not Significant

The coding of the poverty level is partly a function of legitimacy. Poverty was also found not to be associated with the length of prenatal care, augmenting the presumption of general social class similarity in the group studies.

Table 20 Poverty Status by Week Care Began

	Week Care Began									
	15 Weeks & Under		16-23 Weeks		24-35 Weeks		36 Weeks & Over		Total	
Poverty Level	No.	%	No.	%	No.	%	No.	%	No.	%
AFDC Recipients	123	42.7	86	29.9	56	19.4	23	8.0	288	100.0
Other Severe Poverty	75	41.0	56	30.6	42	22.9	10	5.5	183	100.0
Lesser Poverty	113	42.3	84	31.5	57	21.3	13	4.9	267	100.0
Total	311	42.2	226	30.6	155	21.0	46	6.2	738	100.0

$\chi^2=3.27$ 6 df Not Significant

Poverty status, then, is by definition related to the legitimacy of the sample child. It was also found related to the place of birth of the parents, but for less obvious reasons.

Table 21 Poverty Status by Parental Place of Birth

Poverty Level	Place of Birth: Illinois or Missouri No.	%	South Central Region No.	%	Elsewhere No.	%	Total No.	%
			MOTHER					
AFDC Recipients	172	35.6	307	63.4	5	1.0	484	100.0
Other Severe Poverty	91	29.5	210	68.2	7	2.3	308	100.0
Lesser Poverty	165	39.6	237	56.8	15	3.6	417	100.0
χ^2=15.43 4 df	Significant <.01							
			FATHER					
AFDC Recipients	100	30.6	221	67.6	6	1.8	327	100.0
Other Severe Poverty	58	23.3	189	75.6	3	1.2	250	100.0
Lesser Poverty	152	38.7	233	59.3	8	2.0	393	100.0
χ^2=18.63 4 df	Significant <.001							

The "other severe poverty" classification contains, generally, two-parent families with low occupational levels and many children. Since such a large percent of these families have southern born parents the "other severe poverty" label may be not only an economic but also a cultural categorization. No simple two-item analysis can isolate the influence of this social factor, but the data will be included in multiple variable procedures detailed in Chapter 4.

Some of the examination, then, such as that showing no association between age of mother (or parity) and birth weight is in clear contradistinction to the work of other authors. Other relationships (or the lack thereof) suggest need for further study. That the proportionately large number of low birth weight children found in this population is not capable of differentiation on the basis of "intensity" of poverty implies either some labeling fault or some generally substandard level of fetal development among all of the poor. The lack of association between the length of prenatal care and birth weight suggests something of the same conclusion in that the type of pregnancy health service available to the poor may have little to do with nutrition, whatever else it provides.

Our information, then, does not discourage an assumption that the sample children have been recruited from one kind of environment, and thus allows the school achievement analysis proposed in the study design.

CHAPTER 3

SCHOOL ACHIEVEMENT

The primary thrust of this chapter will be to examine the relationships between various data items and measures of school achievement. Basically four sets of educational circumstances exist as indicators: First, the children in the programs for the educable and trainable mentally handicapped will be examined, and the proportion of these who are of low birth weight will be assessed. Since no other measures of school achievement exist for this group, other analyses will exclude it. Second, grades obtained on nationally standardized tests will be shown and the attainment levels matched with predominantly biological variables. Third, a brief look at school absences will be undertaken, and finally, retention in grade will be used as a further measure of school achievement and tested against other data items. For this last analysis, students in the Third Grade Follow Through program will also be excluded since the curriculum itself limits or excludes grade retention.

Before beginning to detail the hypotheses or to test them, some general display of educational attainment is appropriate. Here (with one exception) are shown relationships with no causality either attributed or appropriate.

School Achievement - Its Overall Level

School records in the East St. Louis system have not been uniformly maintained. If a child transfers from one school to another his earlier class card may never follow. Often test scores were not recorded at all or were recorded in a manner clearly indicating inaccuracy. Some children had to be dropped from our sample because we could locate no school achievement indicators at all. However, unless one has reason to believe that birth weight is itself related to the lack of information, the record inaccuracies for this examination may be assumed to be randomly distributed, and thus not to negate conclusions drawn.

Test scores used for comparisons in this study were the Gates MacGinitie Reading Test administered each year to the primary grades, and the California Achievement Test given in the upper elementary classes. Admittedly, standardized tests have limitations for comparative evaluation of the white middle class and children of minority groups or from the lower economic strata. These suspected biases, however, do not seem particularly pertinent in this project since it concerns a single race and economic group. Scores were translated into "above" and "below" national grade norms and were used to make comparisons between groups only within this relatively homogeneous population.

Since the tests are administered annually, children who have been retained in grade may have more than one score at a given grade level. In all cases, results for the first-time-in-grade only have been used.

What, then, were the overall results of the test scoring for this sample?

Table 22 Achievement Level for Sample Students

Gates Test	Achievement Level: Above Grade Norm Number	Above Grade Norm Percent	Equal to Grade Norm Number	Equal to Grade Norm Percent	Below Grade Norm Number	Below Grade Norm Percent	Total Number	Total Percent
Grade 1, First Time in Grade	394	55.3	23	3.2	296	41.5	713	100.0
Grade 2, First Time in Grade	422	45.9	36	3.9	462	50.2	920	100.0
Grade 3, First Time in Grade	145	41.9	8	2.3	193	55.8	346	100.0
California Test								
Grade 4, First Time in Grade	91	55.1	10	6.1	64	38.8	165	100.0
Grade 5, First Time in Grade	146	39.0	15	4.0	213	57.0	374	100.0

One might be surprised at the rather high standing of these poverty students in comparison to national norms. The trend, however, is a reasonably steady decline in the proportion of students scoring above their grade level. The fourth grade is the only deviant in this progression and some known circumstances may account for this. The number of tested students here is small, and this is at least partly the result of the exclusion of one large school, in a severely impoverished area, where no test scores were recorded that year. It may also be that students, often retained at least once prior to entering the fourth grade, have obtained some additional background education before the California Test (with its different standardization) is administered.

Another factor in the fairly high early attainment is the score level on the first grade Gates test exhibited in the current sixth grade sample.

Table 23 Current Grade by Achievement Level on First and Second Grade - Gates MacGinitie Tests

Current Grade	Achievement Level: Above Grade Norm Number	Above Grade Norm Percent	Equal to Grade Norm Number	Equal to Grade Norm Percent	Below Grade Norm Number	Below Grade Norm Percent	Total Number	Total Percent
	(First Grade, First Time in Grade)							
Third Grade	170	41.5	20	4.9	219	53.6	409	100.0
Third Grade - Follow Through	71	53.8	3	2.3	58	43.9	132	100.0
Sixth Grade	153	89.0	0	0.0	19	11.0	172	100.0
	(Second Grade, First Time in Grade)							
Third Grade	192	40.8	14	3.0	265	56.2	471	100.0
Third Grade - Follow Through	65	54.6	4	3.4	50	42.0	119	100.0
Sixth Grade	165	50.0	18	5.5	147	44.5	330	100.0

Test scores for the third through fifth grades are, of course, recorded almost entirely for the current sixth graders only (with a few retained third grade students having first-time-in-grade scores for that year). To find that, of the sixth graders with first grade test scores, nine-tenths were above grade norm while less than half of the comparable third graders scored so well demands an examination of the assumption of random information availability.

Sixth grade contemporaries with very low elementary scores may have dropped from school. In addition, when the now sixth grade students were in grade one, many were not tested at all because of poor achievement, or their low test results were discarded. The current third grade classes, on the other hand, had their primary tests administered and scored with the special assistance of the Head Start Program evaluation staff.

In the sixth grade sample, only 19 percent (12 in 62) of the low birth weight children, as compared to 38 percent of the normal weight, have recorded first grade Gates scores. Among current third graders, each weight group is equally represented (85 percent of low weight and 82 percent of normal weight have first grade scores). This unavailability of first Gates scores, particularly for the low birth weight sixth graders, makes analysis of the relationship between birth weight and test achievement more complex. Lack of scores below grade norm, and, simultaneously, of results for children of low birth weight supports the research hypotheses, but only indirectly.

Thus a bias is suspected regarding current grade and test achievement, and controls will be applied later in this chapter and in the multiple variable analysis contained in Chapter 4.

As previously mentioned, the Follow Through students are not generally kept back in grade even in those cases where their achievement is poor. This demands special analysis of the materials contained in the "retention" portion of this chapter. Here, however, the disparity of scores of the current third and the third Follow Through students is noteworthy.* These children do not differ significantly from each other on any independent variable under study. That the achievement level of the Follow Through classes is elevated appears causal evidence that the special curriculum does improve this aspect of educational attainment.

The authors recognize that this is one sample passing through elementary school and exhibiting the abilities and achievements that it has. Whatever the cause of poor test scores, it may persist. Thus, the analysis of the scores of this group in all grades may simply be showing the predominant relationship which exists in any single grade. Longitudinal study does not strengthen these conclusions, as would replication involving a different sample. It was found, however, that the measures of achievement are not themselves entirely consistent. The level recorded for a student on one test does not necessarily reflect his level on another:

Table 24 Achievement Levels - First Gates Compared with Second and Third Gates - Total Sample

Achievement Level	Achievement Level - First Grade Gates: Above Grade Norm	Equal to Grade Norm	Below Grade Norm	Total
Second Grade Gates				
Above Grade Norm	240	7	66	437 Same
Equal to Grade Norm	13	1	8	213 Different
Below Grade Norm	105	14	196	
Third Grade Gates				
Above Grade Norm	66	0	3	84 Same
Equal to Grade Norm	3	0	0	64 Different
Below Grade Norm	58	0	18	

This categorization by grade norm is, of course, a gross measure. Persons who remain either above or below grade level may have shown a more marked change in actual score than those who have moved from category to category. The movement, however, is impressive. Repetition of a grade could be the factor in changing the skill level in later years. A breakout of those persons who were not retained in the grades under study, however, still shows a considerable shift in achievement levels over time:

* Chi-square for these two groups on the First Gates is 6.75 and on the Second Gates is 7.85, each significant at less than .05.

Table 25 Achievement Levels - First Gates Compared with Second and Third Gates - Students Not Retained in Grades 1 through 3

Achievement Level	Achievement Level - First Grade Gates: Above Grade Norm	Equal to Grade Norm	Below Grade Norm	Total
Second Grade Gates				
Above Grade Norm	235	6	45	356 Same
Equal to Grade Norm	13	1	4	179 Different
Below Grade Norm	98	13	120	
Third Grade Gates				
Above Grade Norm	62	0	1	73 Same
Equal to Grade Norm	3	0	0	48 Different
Below Grade Norm	44	0	11	

These data indicate that the comprehensive test score, at least when grouped as above and below grade norm, may not be a thoroughly consistent measure of one's abilities in the educational system.

One alternate indicator may be retention in grade. Though a birth certificate is nominally required before one enters the public school system, our difficulties in locating birth data show that this information is often falsified or not examined. Children frequently start to school before their normal entrance age. By the time students have reached the third grade, however, early enrollment has been overtaken by many retentions:

Table 26 Previous Retention by Current Grade

Previous Retentions	Current Grade: Third		Third - Follow Through		Sixth		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Never Retained	307	60.1	128	92.1	320	65.4	755	66.3
Retained One or More Times	204	39.9	11	7.9	169	34.6	384	33.7
Total	511	100.0	139	100.0	489	100.0	1,139	100.0

Two of five students in the regular third grade have been retained in that or some previous year. (Third Grade Follow Through, by the nature of the program, contains very few retained children.) Since the sixth grade students have had more years in which retention could occur, their slightly smaller proportion retained is somewhat surprising and the explanations must be speculative: It may be that the patterns of early grade failure have changed; it may be that the records for older students (those with frequent retentions) have had more opportunity to be lost; it may be that children with educational problems have already left the school system by the time they would be in the sixth grade. There are slightly greater excesses of sample females in the

sixth grade (56%) than in the third (51%) and females are retained less often than males.

Test scores and retention in grade exist, then, as measures of achievement, allowing study of relationships between biological or social variables and presumed intellectual ability. The following section examines these, and other, associations.

School Achievement - Analysis of Relationships

The Handicapped Student

Throughout most of the remainder of this chapter, achievement in school will be examined for sample students enrolled in regular classes. First, however, we wish to look at the special programs for the educable or trainable mentally handicapped. If the thesis holds that low birth weight children have deficient intellectual abilities, their proportions in these groups should be large:

Table 27 Current Grade by Birth Weight

Current Grade	Birth Weight: 5 lb 8 oz or Under		5 lb 9 oz or Over		Total	
	Number	Percent	Number	Percent	Number	Percent
Educable Mentally Handicapped	9	19.6	37	80.4	46	100.0
Trainable Mentally Handicapped	7	28.0	18	72.0	25	100.0
Third Grade	68	13.4	441	86.6	509	100.0
Third Grade - Follow Through	17	12.7	117	87.3	134	100.0
Sixth Grade	62	12.9	418	87.1	480	100.0

Clearly this is the case.* While the normal grades do not differ greatly from each other in their inclusion of low birth weight children, the proportion in the EMH-TMH classes is considerably higher. If one views these special program students as intermediate between those able to function in the public school system and those with problems so severe as to make them inappropriate to any learning environment, the relationship is further reinforced. Low birth weight is a concomitant of inferior brain development for these children, and the association persists beyond infancy.

* Chi-square between the EMH-TMH group and the normal classes is 5.05, significant at the .05 level.

The Regular Student - Test Scores

Since a concern about weight at birth and later school achievement formed the impetus for this study, it is appropriate to examine that association first.

Table 28 Birth Weight by Achievement Level

Birth Weight	Achievement Level: Above Grade Norm No.	%	Equal to Grade Norm No.	%	Below Grade Norm No.	%	Total No.	%
	(Gates - First Grade, First Time in Grade)							
5 lb 8 oz or Under	34	41.0	5	6.0	44	53.0	83	100.0
5 lb 9 oz or Over	354	57.3	17	2.7	247	40.0	618	100.0
χ^2=9.02 2 df	Significant <.02							
	(Gates - Second Grade, First Time in Grade)							
5 lb 8 oz or Under	44	36.7	4	3.3	72	60.0	120	100.0
5 lb 9 oz or Over	369	47.1	31	4.0	383	48.9	783	100.0
χ^2=5.13 2 df	Not Significant							
	(Gates - Third Grade, First Time in Grade)							
5 lb 8 oz or Under	18	38.3	0	0.0	29	61.7	47	100.0
5 lb 9 oz or Over	125	42.8	8	2.7	159	54.5	292	100.0
χ^2=1.87 2 df	Not Significant							
	(California - Fourth Grade, First Time in Grade)							
5 lb 8 oz or Under	10	45.5	2	9.1	10	45.4	22	100.0
5 lb 9 oz or Over	81	57.1	8	5.6	53	37.3	142	100.0
χ^2=1.17 2 df	Not Significant							
	(California - Fifth Grade, First Time in Grade)							
5 lb 8 oz or Under	12	22.6	0	0.0	41	77.4	53	100.0
5 lb 9 oz or Over	133	42.2	13	4.1	169	53.7	315	100.0
χ^2=11.07 2 df	Significant <.01							

Though the chi-squares in only two grades are significant, the direction of the relationship is constant and supportive of the hypothesis. Interpretation of the results, however, is difficult partly because of the confounding factor of grade retention. The student, probably poorer than

average when held back in grade, has more extended educational training before further achievement testing, and thus may excel his "never retained" classmates in later years.

Because of this complicating issue, it seemed appropriate to examine the relationship between birth weight and achievement tests for the subgroup with no grade retentions. Since the Follow Through students are seldom failed regardless of their skills, we looked at tests for the "never retained" in the regular third and the sixth grades only:

Table 29 Birth Weight by Achievement Level for Regular Third Grade and Sixth Grade - Never Retained

Birth Weight	Achievement Level: Above Grade Norm No.	%	Equal to Grade Norm No.	%	Below Grade Norm No.	%	Total No.	%
	(Gates - First Grade, First Time in Grade)							
5 lb 8 oz or Under	21	56.8	4	10.8	12	32.4	37	100.0
5 lb 9 oz or Over	266	73.1	12	3.3	86	23.6	364	100.0
χ^2=7.05 2 df	Significant <.05							
	(Gates - Second Grade, First Time in Grade)							
5 lb 8 oz or Under	31	48.4	2	3.2	31	48.4	64	100.0
5 lb 9 oz or Over	252	54.7	16	3.5	193	41.9	461	100.0
χ^2=0.99 2 df	Not Significant							
	(Gates - Third Grade, First Time in Grade)							
5 lb 8 oz or Under	13	50.0	0	0.0	13	50.0	26	100.0
5 lb 9 oz or Over	106	56.4	7	3.7	75	39.9	188	100.0
χ^2=1.70 2 df	Not Significant							
	(California - Fourth Grade, First Time in Grade)							
5 lb 8 oz or Under	7	63.6	1	9.1	3	27.3	11	100.0
5 lb 9 oz or Over	74	71.9	6	5.8	23	22.3	103	100.0
χ^2=0.37 2 df	Not Significant							
	(California - Fifth Grade, First Time in Grade)							
5 lb 8 oz or Under	8	25.8	0	0.0	23	74.2	31	100.0
5 lb 9 oz or Over	118	53.9	12	5.5	89	40.6	219	100.0
χ^2=12.77 2 df	Significant <.01							

Though one would expect that a student would be held back in school if his achievement were really poor, many of the children who were never retained scored below the norm for their grade. Birth weight remained a significant factor in school achievement in the first and the fifth grades as before. It is interesting to note, additionally, that only about half

of the low birth weight children for whom we have test scores remain when this special "non-retained" group is examined, while nearly two-thirds of the normal weight sample reappear in this table. A multiple variable analysis involving test achievement, retention and birth weight will be conducted in Chapter 4.

Some studies of the relationship between birth weight and mental ability make a distinction between the "true premature" (meaning pre-term but within the expected weight range) and the "small-for-date" (meaning weight below that normal for the gestation period). Most conclude that anomalies are more likely in the small-for-date than in the true premature.[17, 37, 38, 39, 51] Though our length-of-pregnancy data is somewhat suspect, a comparison of short and normal gestation low weight children was made on the basis of their Gates test scores:

Table 30 Low Weight Sample - Gestation by Gates Achievement Level

Length of Gestation	Achievement Level for Low Weight Sample: Above Grade Norm No.	%	Equal to Grade Norm No.	%	Below Grade Norm No.	%	Total No.	%
	(Gates - First Grade, First Time in Grade)							
35 Weeks or Less	11	52.4	1	4.8	9	42.8	21	100.0
36 Weeks or More	22	35.5	4	6.4	36	58.1	62	100.0
χ^2=1.95 2 df	Not Significant							
	(Gates - Second Grade, First Time in Grade)							
35 Weeks or Less	13	43.3	1	3.3	16	53.4	30	100.0
36 Weeks or More	31	34.8	3	3.4	55	61.8	89	100.0
χ^2=0.71 2 df	Not Significant							
	(Gates - Third Grade, First Time in Grade)							
35 Weeks or Less	5	50.0	0	0.0	5	50.0	10	100.0
36 Weeks or More	13	36.1	0	0.0	23	63.9	36	100.0
χ^2=0.66 2 df	Not Significant							

The number of students is small when distributed in this manner, and in no case does the chi-square even approach significance. The "true premature" group (35 weeks or less) does, however, approximate the achievement level distribution of the normal weight sample shown in Table 28 and the presumption that the small-for-date child is at the most disadvantage is at least not refuted.

Since 63 percent of the low birth weight children in the sample are female, the relationship between birth weight and school achievement might be explained if females were generally low achievers. In fact, this is not the case:

Table 31 Sex by Achievement Level

Sex	Above Grade Norm		Equal to Grade Norm		Below Grade Norm		Total	
	No.	%	No.	%	No.	%	No.	%
	(Gates - First Grade, First Time in Grade)							
Male	179	52.1	9	2.6	156	45.3	344	100.0
Female	215	58.3	14	3.8	140	37.9	369	100.0
χ^2=4.37 2 df	Not Significant							
	(Gates - Second Grade, First Time in Grade)							
Male	178	41.4	17	3.9	235	54.7	430	100.0
Female	244	49.8	19	3.9	227	46.3	490	100.0
χ^2=6.69 2 df	Significant <.02							
	(Gates - Third Grade, First Time in Grade)							
Male	61	37.9	5	3.1	95	59.0	161	100.0
Female	84	45.4	3	1.6	98	53.0	185	100.0
χ^2=2.54 2 df	Not Significant							
	(California - Fourth Grade, First Time in Grade)							
Male	31	45.6	4	5.9	33	48.5	68	100.0
Female	60	61.8	6	6.2	31	32.0	97	100.0
χ^2=4.75 2 df	Not Significant							
	(California - Fifth Grade, First Time in Grade)							
Male	55	33.4	5	3.0	105	63.6	165	100.0
Female	91	43.5	10	4.8	108	51.7	209	100.0
χ^2=5.48 2 df	Not Significant							

Though one finds most differences not significant, in all cases the proportion of females scoring above grade average was greater than of males. The California Achievement Test scores used throughout this report are the averages of a battery of subject examinations. It is the "language" portion of the test which creates most of the sex differential in the fourth and fifth grades. In the fourth grade, 58.5 percent of the females compared with 35.1 percent of the males scored above grade norm on this portion of the examination while in the fifth, the percents were 46.8 for females and 29.0 for males.

Though a more extensive analysis of data interrelationships will be conducted in the next chapter, a three-way tabulation of sex, birth weight and test scores was undertaken. Because of the disproportionately small number of low birth weight sixth grade students with early test score records, the grade samples were separated for clarity.

Examination was made, in the third grade group, of the effect of birth weight and sex on the Gates first grade scores:

Table 32 Birth Weight and Sex by Achievement Level
Third Grade Sample Only
First Grade Gates Test

Birth Weight and Sex	Achievement Level: Above Grade Norm No.	%	Equal to Grade Norm No.	%	Below Grade Norm No.	%	Total No.	%
MALES								
5 lb 8 oz or Under	8	34.8	0	0.0	15	65.2	23	100.0
5 lb 9 oz or Over	104	43.5	8	3.4	127	53.1	239	100.0
χ^2=1.68 2 df	Not Significant							
FEMALES								
5 lb 8 oz or Under	16	32.7	5	10.2	28	57.1	49	100.0
5 lb 9 oz or Over	108	48.9	9	4.1	104	47.0	221	100.0
χ^2=6.16 2 df	Significant <.05							

Only for females were the differences significant though for both sex groups the distribution was in the direction expected. On the second Gates test, this same third grade sample showed no significant relationship between birth weight and achievement for either males or females, though the percentage of low weight children scoring below grade norm was again consistently higher than of normal weight.

In the sample drawn from the current sixth grade, birth weight was found to be significantly related to achievement only for males when the California tests administered in the fourth and fifth grades were examined. Why this shift by sex occurs cannot be answered with these data.

Though the results were not always statistically significant, a summary of the biological attributes shows low birth weight children having test results consistently inferior to those of the normal weight sample, with the strongest relationship found in the oldest age group. The "small-for-date" child may be the low weight student at the most disadvantage though the numbers in this sample are too small and gestation information too unreliable for strong support of this conclusion. Females, while more often born at low weight, test generally higher than the male students, though here again, not always significantly so. The combined association of sex, birth weight and test levels is in the expected direction for birth weight and achievement scores but is not consistently significant for either males or females.

What can be said about the relationship between test scores and the social class factor? As previously referenced, many authors feel that both low birth weight and inferior school achievement are functions of the life style in poverty populations. Some studies, however, conclude that children

of normal birth weight do better than their own low birth weight siblings who have apparently experienced similar home lives and health care - that in fact the heavier twin tests at higher intelligence than the lighter.[4, 23, 59] The number of cases for such a test in our sample was very small, due partially to our selection of only two school grades. Because of this sample selection, only some of the instances of sibling birth weight variation were found. Many of the remaining children may have brothers or sisters born at drastically different weights, but not included in this study. There were 139 "families" in the sample (students with one or more siblings in the group under study). Most of these contained only children of normal birth weight and an additional few of entirely low birth weight siblings.

The original test scores could be translated into months above and below grade norm. Taking the small group of known divergent birth weight siblings, the following existed:

Table 33 Achievement by Birth Weight for Siblings and Total Sample

Gates Test	Low Birth Weight Sample			Normal Birth Weight Sample		
	Total	With Known Normal Weight Siblings		Total	With Known Low Weight Siblings	
		Total	Single Births		Total	Single Births
First Grade, First Time:						
Mean Months Above or Below Grade Norm	+1.4	+2.0	+0.5	+2.3	+0.3	+0.1
Mean Birth Weight	4 lb 15 oz	4 lb 6 oz	4 lb 8 oz	7 lb 1 oz	7 lb 1 oz	7 lb 2 oz
Number	(83)	(25)	(10)	(618)	(20)	(19)
Second Grade, First Time:						
Mean Months Above or Below Grade Norm	-1.1	0.0	-1.4	0.9	-0.2	-0.3
Mean Birth Weight	4 lb 15 oz	4 lb 8 oz	4 lb 9 oz	7 lb 1 oz	6 lb 15 oz	7 lb 0 oz
Number	(120)	(35)	(16)	(783)	(26)	(25)

Any results from such a small sample must be interpreted cautiously. The data are, additionally, somewhat contradictory. Normal birth weight children with low weight siblings score less well than do all normal weight students (a finding in line with existing theory and one which might be strengthened if normal weight sample children with unknown low weight

siblings could be appropriately categorized). On the other hand only if the multiple births under five pounds, eight ounces are included do low weight students with known normal siblings score better than their low birth weight peers. (This may be because twins are born of low weight for reasons unlike those in single births, and are not peculiar in other ways. That they have normal weight siblings may imply a generally acceptable level of nutrition missing for the single low weight birth.) Low birth weight children, in this group, known to have normal weight siblings weigh less at birth than does the total low weights sample. Further study involving considerably larger numbers is clearly indicated since, as was shown in Table 14, the poverty sub-categories, for which one might infer differential life styles and health levels, are unrelated to weight at birth in this impoverished group.

In some grades, however, these poverty classifications are related to test scores:

Table 34 Poverty Status by Achievement Level

Poverty Level	Achievement Level: Above Grade Norm No.	%	Equal to Grade Norm No.	%	Below Grade Norm No.	%	Total No.	%
(Gates - First Grade, First Time in Grade)								
AFDC Recipients	119	45.9	8	3.1	132	51.0	259	100.0
Other Severe Poverty	102	58.3	8	4.6	65	37.1	175	100.0
Lesser Poverty	173	62.0	7	2.5	99	35.5	279	100.0
χ^2=16.92 4 df	Significant <.001							
(Gates - Second Grade, First Time in Grade)								
AFDC Recipients	127	37.0	17	5.0	199	58.0	343	100.0
Other Severe Poverty	116	51.1	7	3.1	104	45.8	227	100.0
Lesser Poverty	179	51.1	12	3.4	159	45.5	350	100.0
χ^2=17.52 4 df	Significant <.001							
(Gates - Third Grade, First Time in Grade)								
AFDC Recipients	46	38.6	2	1.7	71	59.7	119	100.0
Other Severe Poverty	30	35.3	4	4.7	51	60.0	85	100.0
Lesser Poverty	69	48.6	2	1.4	71	50.0	142	100.0
χ^2=6.96 4 df	Not Significant							
(California - Fourth Grade, First Time in Grade)								
AFDC Recipients	24	44.5	6	11.0	24	44.5	54	100.0
Other Severe Poverty	22	66.7	0	0.0	11	33.3	33	100.0
Lesser Poverty	45	57.7	4	5.1	29	37.2	78	100.0
χ^2=7.14 4 df	Not Significant							
(California - Fifth Grade, First Time in Grade)								
AFDC Recipients	41	34.5	8	6.7	70	58.8	119	100.0
Other Severe Poverty	40	38.8	4	3.9	59	57.3	103	100.0
Lesser Poverty	65	42.8	3	2.0	84	55.2	152	100.0
χ^2=5.09 4 df	Not Significant							

Though the position of the "other severe poverty" group varies, it is clear that the lesser poverty students score better than do the AFDC recipient children. It is noticeable that this relationship is strongest in the first two grades of school. This may be because the effects of poverty upon readiness for school entry are greater than upon later school achievement. On the other hand, most information upon which we based our poverty classification was recorded at the time the child entered the first grade, and thus was most accurate then. Errors of assignment to poverty categories no doubt increase in the upper grades.

Poverty levels, though unrelated to the incidence of low weight at birth, are apparently associated with school achievement, especially evident during those years when such a classification is most accurate.

The Regular Student - School Absence

Absence from school might be considered a cause of problems in educational achievement. In another context, however, absence from school is itself a measure of inferior performance. In this regard, relationships between absence and birth weight, the primary biological variable, and between absence and poverty level, the primary social/environmental factor, will be examined.

If absences from school are a result of ill health or of discouragement due to inability to achieve well in the classroom, they may be related to weight at birth.

Table 35 Birth Weight by Percent of Days Absent

Birth Weight	Percent of Days Absent							
	Under 5%		5 - 9%		10% and Over		Total	
	No.	%	No.	%	No.	%	No.	%
1969-70 School Year								
5 lb 8 oz or Under	67	50.4	39	29.3	27	20.3	133	100.0
5 lb 9 oz or Over	444	51.4	252	29.1	169	19.5	865	100.0
1968-69 School Year								
5 lb 8 oz or Under	85	62.1	30	21.9	22	16.0	137	100.0
5 lb 9 oz or Over	524	60.6	201	23.2	140	16.2	865	100.0

There is almost no difference between normal and low birth weight children in the number of days they are absent from school. If absences in this system are a result of physical illness (which may well not be the case at all), this illness is apparently not related to low birth weight abnormalities.

Again, poverty was found to be associated with the percent of days absent in recent years. Students classified as belonging to the most severe poverty group missed school more often than did the somewhat less poor.

Table 36 Poverty Status by Days Absent

Poverty Level	Percent of Days Absent: Under 5% No.	%	5 - 9% No.	%	10% and Over No.	%	Total No.	%
			1969-70 School Year					
Severe Poverty*	301	47.3	196	30.8	139	21.9	636	100.0
Lesser Poverty	218	57.8	100	26.5	59	15.7	377	100.0
χ^2=11.25 2 df	Significant <.001							
			1968-69 School Year					
Severe Poverty	367	57.0	155	24.1	122	18.9	644	100.0
Lesser Poverty	254	67.9	78	20.9	42	11.2	374	100.0
χ^2=14.44 2 df	Significant <.001							

Absence, while not related to birth weight, is affected by one's poverty level. Does it, in turn, affect still one further measure of achievement?

The Regular Student - Retention in Grade

Recent school absence is at least a measure of educational "attention." It also offers a clue to the success of the student in other school attainment. Retentions occur most frequently in the first or second grade and accurate absence data for these years is not now available for the current sixth grade sample. In the regular third grade**, retentions and absences are associated:

Table 37 Previous Retention by Percent of Days Absent
Regular Third Grade Students Only

Retention	Percent of Days Absent: Under 5% No.	%	5 - 9% No.	%	10% and Over No.	%	Total No.	%
			1969-70 School Year					
Retained One or More Times	70	40.4	51	29.5	52	30.1	173	100.0
Never Retained	116	41.4	109	38.9	55	19.7	280	100.0
χ^2=7.64 2 df	Significant <.05							
			1968-69 School Year					
Retained One or More Times	87	50.2	43	24.9	43	24.9	173	100.0
Never Retained	170	62.3	64	23.4	39	14.3	273	100.0
χ^2=9.16 2 df	Significant <.02							

* Includes AFDC recipient families.

** Third Grade Follow Through students are excluded because they are almost never retained.

Presumably students who have been retained have been poor achievers in some way. Does retention, then, reflect test results for the regular third and the sixth grade samples? To a high degree, yes.

Table 38 Retention in Any Grade by Achievement Level
Regular Third Grade and Sixth Grade Only

Retention	Achievement Level: Above Grade Norm No.	%	Equal to Grade Norm No.	%	Below Grade Norm No.	%	Total No.	%
(Gates - First Grade, First Time in Grade)								
Retained One or More Times	30	17.5	3	1.8	138	80.7	171	100.0
Never Retained	291	71.3	17	4.2	100	24.5	408	100.0
χ^2=157.45 2 df	Significant <.001							
(Gates - Second Grade, First Time in Grade)								
Retained One or More Times	65	24.8	14	5.3	183	69.9	262	100.0
Never Retained	290	54.1	18	3.4	228	42.5	536	100.0
χ^2=61.16 2 df	Significant <.001							
(Gates - Third Grade, First Time in Grade)								
Retained One or More Times	24	19.0	1	0.8	101	80.2	126	100.0
Never Retained	121	55.0	7	3.2	92	41.8	220	100.0
χ^2=47.80 2 df	Significant <.001							
(California - Fourth Grade, First Time in Grade)								
Retained One or More Times	10	20.0	3	6.0	37	74.0	50	100.0
Never Retained	81	70.4	7	6.1	27	23.5	115	100.0
χ^2=39.02 2 df	Significant <.001							
(California - Fifth Grade, First Time in Grade)								
Retained One or More Times	19	16.0	1	0.8	99	83.2	119	100.0
Never Retained	127	49.8	14	5.5	114	44.7	255	100.0
χ^2=49.27 2 df	Significant <.001							

Though the relationship between school achievement and retention in grade is very strong, there are nonetheless students scoring below grade norms who have not been retained (even apart from those in the Follow Through program) and students scoring well on the first grade test who are retained in that or in a subsequent year. For this reason, variables which are associated with test scores may relate differently to retention.

It appears that whether or not one is retained in grade does not bear a close relationship to one's weight at birth:

Table 39 Birth Weight by Retention in Any Grade
Regular Third Grade and Sixth Grade Students Only

Birth Weight	Retention: Retained One or More Times		Never Retained		Total	
	Number	Percent	Number	Percent	Number	Percent
5 lb 8 oz or Under	58	44.6	72	55.4	130	100.0
5 lb 9 oz or Over	314	36.7	541	63.3	855	100.0

χ^2=2.99 1 df Not Significant

Nor is there any evident association between birth weight and the number of times one is kept back in grade:

Table 40 Birth Weight by Number of Times Retained
Regular Third Grade and Sixth Grade Students Only

Birth Weight	Number of Retentions: None		One		Two		Three or More		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
5 lb 8 oz or Under	72	55.4	44	33.8	14	10.8	0	0.0	130	100.0
5 lb 9 oz or Over	541	63.3	241	28.2	67	7.8	6	0.7	855	100.0

χ^2=4.47 3 df Not Significant

These results led to questions about whether or not retention, particularly in later years, was a function of disciplinary problems as much as of classroom achievement. Since control of behavior is easier among the young, first grade retention may show a closer relationship to birth weight than that occurring in the more advanced grades.

Table 41 Percent Distribution - Birth Weight by Grade of Retention
Regular Third Grade and Sixth Grade Students Only

Birth Weight	Grade Retained: Never Retained	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade Unknown
5 lb 8 oz or Under	55.4	32.3	12.3	4.6	3.1	0.0	2.3
5 lb 9 oz or Over	63.3	24.7	12.4	4.1	0.7	0.2	2.3

(Note: Row percentage totals exceed 100.0 since some students have been retained more than once.)

Tests of significance of the difference between the two birth weight groups were made for the "never retained" and the "retained in first grade" categories. Neither were significant, with the probabilities of such weight differences being for "never retained": .084; for "retained in first grade": .064. The weight relationship is, however, strongest in the first grade and this suggests that early grade retention may indeed be partially a reflection of birth weight.

That being kept back in grade is a function of something other than normally measured test scoring is further indicated when sex is added as a factor in the analysis:

Table 42 Birth Weight and Sex by Retention in Any Grade Regular Third Grade and Sixth Grade Students Only

Birth Weight and Sex	Retention: Retained One or More Times		Never Retained		Total	
	Number	Percent	Number	Percent	Number	Percent
MALES						
5 lb 8 oz or Under	33	66.0	17	34.0	50	100.0
5 lb 9 oz or Over	181	42.9	241	57.11	422	100.0
χ^2=9.63 1 df	Significant <.01					
(Total*	214	44.9	263	55.1	477	100.0)
FEMALES						
5 lb 8 oz or Under	25	31.2	55	68.8	80	100.0
5 lb 9 oz or Over	133	30.7	300	69.3	433	100.0
χ^2=0.01 1 df	Not Significant					
(Total*	159	30.4	364	69.6	523	100.0)

Girls, even underachievers, are far less likely than boys to be retained. Birth weight is, for this sex group, totally unrelated to retention. For the males, however, weight at birth and retention do show a significant association. It appears likely that the better behavior of girls may mitigate other possible reasons for failure. Examination of a number of variables cumulatively associated with retention will be made in the following chapter.

Looking now at retention as it may be affected by environmental situations, one finds that poverty is a significant factor:

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* Includes those of unknown birth weight. Chi-square for the comparison (of retention) by sex only is 22.31 (1 df) which is significant at less than .001.

Table 43 Poverty Status by Retention in Any Grade
Regular Third Grade and Sixth Grade Students Only

Poverty Level	Retention: Retained One or More Times		Never Retained		Total	
	Number	Percent	Number	Percent	Number	Percent
Severe Poverty	284	44.7	352	55.3	636	100.0
Lesser Poverty	89	24.5	275	75.5	364	100.0
χ^2=40.40 1 df	Significant	<.001				

The severity of poverty was shown to be associated with test scores in grades one and two (Table 34) and with absence (Table 35). Clearly the poorest students are also the most likely to be retained. Legitimacy showed no association, and though a slightly greater proportion of students with parents living together had not been retained, the differences were not significant.

Children known to have a large number of siblings were more often retained than those from smaller families:

Table 44 Number of Older Siblings by Retention in Any Grade
Regular Third Grade and Sixth Grade Students Only

Number of Older Siblings	Retention: Retained One or More Times		Never Retained		Total	
	Number	Percent	Number	Percent	Number	Percent
0	51	28.3	129	71.7	180	100.0
1 - 3	167	36.1	295	63.9	462	100.0
4 or More	155	44.2	196	55.8	351	100.0
χ^2=13.44 2 df	Significant	<.01				

This table is reflected in the poverty relationships as well, since the size of the family was a consideration in assignment to a poverty classification. There is no reason to assume, of course, that the family size has remained as it was at the birth of the sample child. It seems, however, that the first born and those with fewer older siblings (and, possibly with fewer total siblings) are retained less often. In fact, it may be that a family circumstance allowing little time for individual attention and concern is more detrimental to achievement in school than are some other aspects of an impoverished environment.

In summary, weight at birth is clearly associated with almost every measure of early school achievement. That low weight at birth implies a greater likelihood of prolonged mental inferiority is lent credence by the high proportion of such children found in classes for the retarded. Early achievement test scores are associated with birth weight. Retention in grade one, though not reaching statistical significance, does seem to be at least affected by birth weight, probably through the mechanisims implied by the association between weight and tested achievement. Birth weight is

not, however, related to school absence, suggesting either that low weight may not increase one's propensity for illness or that illness is not the primary reason for such absence.

As one reaches the later elementary grades, a number of elements appear to confuse or negate these previous relationships. Females are not often retained no matter what their tested abilities or their birth weight. Retention in grade confuses what might be expected of achievement tests. Further examination of these complications is contained in Chapter 4.

On the environmental side, there is clear indication that the Third Grade Follow Through program does increase one's achievement level as measured by standardized tests, since the students in these classes did not differ in any background characteristics from the others in the third grade. Poverty levels, as assigned within this impoverished sample, relate also to achievement scores, to absence and to retention in grade. That AFDC recipiency (implying the lack of an adult male in the household) and a large number of known siblings were factors which themselves helped to create the poverty classification makes it important to view this poverty relationship with caution, recognizing that it is a totality of environmental circumstances rather than an issue of income alone. Again, a more multifaceted analysis will follow, as the next chapter attempts to assess the strengths of these variables in combination as they relate to test scores, to retention and to birth weight itself.

CHAPTER 4

MULTIPLE VARIABLE ANALYSIS AND SUMMARY

Single variables compared with achievement have been examined. It is already known that the classes for retarded children contain very high proportions of those with low birth weight. Birth weight does relate significantly to the Gates MacGinitie test levels for first grade students and to the California Achievement Test in the fifth grade. For other grades the relationships are in the expected direction though not statistically significant.

The poverty level of the child (within this poverty sample) is also relevant to his achievement in the first and second grades. These poorest children, as well as scoring below their grade norm, are more likely to be absent from school while birth weight itself does not show any relationship to school absences.

Though analyses of the association between a single independent and a dependent variable are interesting and often significant, it is clear that there are interrelationships between some of these independent variables themselves. It therefore seemed that valuable insights might be obtained through the use of a program which allowed examination of the association of some of the factors after standardizing for the effects of others. Computer manipulation was used to accomplish this goal.[36]

Since the scores on the Gates MacGinitie test for the first grade (first time in grade) appeared to be the most "uncluttered" by other factors (such as retention) a multiple regression equation was run using ten factors thought to be related to above or below average achievement on this test. The R^2 for the full set of variables against Gates achievement was .21 (indicating that four-fifths of its variation is left unaccounted for by all of these factors). Nonetheless, with the inclusion of all variables, birth weight remained significant at the .01 level.

Table 45 Multiple Variable Analysis of Gates First Grade Achievement Levels - Total Sample

Variable	Degrees of Freedom		R^2 Excluding Variable	F-Ratio	Probability*
	Numerator	Denominator			
Zero Order	23	689	.20819	7.8764	0.00000
Current Grade	2	689	.08644	52.9684	0.00000
Sex	1	689	.20141	5.9004	0.01542
Birthplace-Mother	2	689	.20705	0.4966	0.61176
Current Family Status	1	689	.20489	2.8664	0.09074
Number Older Siblings	9	689	.18129	2.6012	0.00598
Poverty Level	2	689	.19864	4.1553	0.01609
Single-Multiple Birth	1	689	.20546	2.3766	0.12340
Age of Mother	4	689	.19369	3.1548	0.01388
Legitimacy	1	689	.20537	2.4560	0.11731
Birth Weight	1	689	.19879	8.1787	0.00442

It is clear that the bulk of what is known of the variation is accounted for by current grade. This is not surprising since we have already noted the peculiar distribution of first grade test scores among our current sixth grade students. The sex of the student, when other variables are held constant, is significantly related to the Gates 1 test level. Poverty too shows a statistically significant relationship apart from the influence of the other items. Legitimacy, on the other hand, does not, probably because much of its effect is already encompassed in poverty and current family status. It is interesting that parity, when measured by the number of living older siblings, does show significance even when its impact is limited by the inclusion of age of mother (surely related to the order of the pregnancy) and of poverty (the coding of which made use of the size of the known family).

Single or multiple birth is not an important variable in this analysis, but birth weight itself does account for a small but significant part of the variation in achievement level even when other factors are included. That this relationship is significant is an important finding, though one can surely not attribute much test score variation to this factor.

Since the sixth grade students confound the overall average attainment level on the first grade Gates test (because poor test results were not recorded at the time these children were in the first grade or because of selective dropout behavior) the multiple regression analysis was rerun for current third grade students only.

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* Probability is the likelihood of an association of this strength appearing due to mere sample variation rather than to a "real" relationship.

Table 46 Multiple Variable Analysis of Gates First Grade Achievement Levels - Third Grade Sample Only

Variable	Degrees of Freedom		R^2 Excluding Variable	F-Ratio	Probability
	Numerator	Denominator			
Zero Order	22	518	.10176	2.6674	0.00007
Current Grade	1	518	.08918	7.2509	0.00733
Sex	1	518	.09379	4.5928	0.03251
Birthplace-Mother	2	518	.10018	0.4554	0.63564
Current Family Status	1	518	.09468	4.0829	0.04378
Number Older Siblings	9	518	.05749	2.8368	0.00290
Poverty Level	2	518	.09408	2.2148	0.10993
Single-Multiple Birth	1	518	.09324	4.9117	0.02708
Age of Mother	4	518	.07896	3.2867	0.01123
Legitimacy	1	518	.10038	0.7947	0.37345
Birth Weight	1	518	.09334	4.8527	0.02801

The zero order correlation, when sixth grade students were excluded, dropped considerably, but birth weight remained significant when the other nine variables were included.

Another item appropriate to a complex analysis of school achievement is retention in grade. Retention has been shown to be associated with achievement scores but by no means are all low scorers retained nor those with high levels passed. Children in severe poverty are kept back in grade in greater proportion than those in "lesser poverty," and children with a number of older siblings are more likely to be retained than those who were first born or those in families with few older children.

As previously discussed, retention in the first grade appears to be the most relevant to issues of academic achievement. In later grades behavior problems and other factors impose themselves. Multiple variable analysis (for the regular third grade and the sixth grade students only) using retention in the first grade contrasted with "never retained" in any grade created the following:

Table 47 Multiple Variable Analysis of Retention in Grade 1 (v Never Retained) - Regular Third and Sixth Grade Students Full Model

Variable	Degrees of Freedom Numerator	Degrees of Freedom Denominator	R^2 Excluding Variable	F-Ratio	Probability
Zero Order	17	863	.24846	16.7832	0.0
Current Grade	1	863	.24199	7.4389	0.00663
Sex	1	863	.23664	13.5775	0.00026
Current Family Status	1	863	.24597	2.8635	0.09066
Number Older Siblings	9	863	.23697	1.4660	0.15439
Poverty Level	2	863	.22118	15.6648	0.00000
Gates 1	2	863	.10632	81.6151	0.0
Birth Weight	1	863	.24420	4.8965	0.02722

Clearly the achievement level on the first grade Gates MacGinitie test is, among these variables, the primary factor involved in promotion, but issues such as current grade, sex, poverty and, to a significant degree, birth weight do still play a part even when the others are included. Since the Gates score itself included birth weight as a minor predictor, the same set of factors excluding the Gates first grade level was run:

Table 48 Multiple Variable Analysis of Retention in Grade 1 (v Never Retained) - Regular Third and Sixth Grade Students Model Excluding Gates Test Level

Variable	Degrees of Freedom Numerator	Degrees of Freedom Denominator	R^2 Excluding Variable	F-Ratio	Probability
Zero Order	15	863	.10632	6.8444	0.00000
Current Grade	1	863	.09536	10.5768	0.00124
Sex	1	863	.09188	13.9431	0.00022
Current Family Status	1	863	.10417	2.0707	0.15005
Number Older Siblings	9	863	.09062	1.6842	0.08760
Poverty Level	2	863	.06591	19.5072	0.00000
Birth Weight	1	863	.09832	7.7174	0.00570

Elimination of the test score level for the first grade strengthens the significance of birth weight. Little additional assistance is gained from this, however, in predicting grade retention since the zero order R^2 is only .11 with all of these variables included.

Further examination of retention can be made by using, as the dependent variable, retention ever as contrasted to never retained in any grade. Some of the previously examined factors are stronger in this analysis:

Table 49 Multiple Variable Analysis of Retention Ever (v Never Retained) - Regular Third and Sixth Grade Students - Full Model

Variable	Degrees of Freedom		R^2 Excluding Variable	F-Ratio	Probability
	Numerator	Denominator			
Zero Order	17	983	.24685	18.9521	0.0
Current Grade	1	983	.24595	1.1809	0.27628
Sex	1	983	.22867	23.7299	0.00000
Current Family Status	1	983	.24267	5.4520	0.01987
Number Older Siblings	9	983	.23466	1.7682	0.06929
Poverty Level	2	983	.22334	15.3445	0.00000
Gates 1	2	983	.10351	93.5454	0.0
Birth Weight	1	983	.24167	6.7599	0.00963

Birth weight remains a significant factor for this group - a situation which ceases to exist when females are examined separately.

Table 50 Multiple Variable Analysis of Retention Ever (v Never Retained) by Sex* - Regular Third and Sixth Grade Students - Full Model

Variable	Degrees of Freedom		R^2 Excluding Variable	F-Ratio	Probability
	Numerator	Denominator			
		Males			
Zero Order	16	461	.25727	9.9800	0.00000
Current Grade	1	461	.25725	0.0092	0.92348
Current Family Status	1	461	.25089	3.9567	0.04715
Number Older Siblings	9	461	.25027	0.4824	0.88361
Poverty Level	2	461	.24041	5.2302	0.00568
Gates 1	2	461	.08087	54.7431	0.00000
Birth Weight	1	461	.24326	8.6904	0.00337
		Females			
Zero Order	16	507	.23182	9.5629	0.00000
Current Grade	1	507	.22874	2.0370	0.15381
Current Family Status	1	507	.22822	2.3801	0.12326
Number Older Siblings	9	507	.20940	1.6441	0.09950
Poverty Level	2	507	.19420	12.4165	0.00001
Gates 1	2	507	.11533	38.4420	0.00000
Birth Weight	1	507	.22789	2.5954	0.10753

* Increasing probability levels here are due, at least in part, to the decreased sample size remaining when the group is divided by sex.

As was shown in Table 42, females of low and of normal birth weight were equally likely to be retained, while the relationship between birth weight and retention was significant for males.

As expected, since retention is most common in grade one, much of the variation in "retention ever" for both sexes is reflected in the Gates MacGinitie levels for that year. When one excludes this variable, poverty alone retains low probability in both groups:

Table 51 Multiple Variable Analysis of Retention Ever (v Never Retained) by Sex - Regular Third and Sixth Grade Students - Model Excluding Gates Test Level

Variable	Degrees of Freedom		R^2 Excluding Variable	F-Ratio	Probability
	Numerator	Denominator			
		Males			
Zero Order	14	463	.08087	2.9097	0.00031
Current Grade	1	463	.08070	0.0836	0.77242
Current Family Status	1	463	.07817	1.3599	0.24394
Number Older Siblings	9	463	.06170	1.0728	0.38179
Poverty Level	2	463	.05955	5.3704	0.00496
Birth Weight	1	463	.05912	10.9563	0.00101
		Females			
Zero Order	14	509	.11533	4.7399	0.00000
Current Grade	1	509	.11127	2.3376	0.12667
Current Family Status	1	509	.10829	4.0546	0.04448
Number Older Siblings	9	509	.09537	1.2762	0.24670
Poverty Level	2	509	.05752	16.6311	0.00000
Birth Weight	1	509	.11263	1.5565	0.21249

Birth weight again appears as a significant variable for males, while only current family status, in addition to poverty, shows strength among females.

One can, then, recognize birth weight as a statistically significant factor for some groups of students when related to school achievement if this achievement is defined in terms of standardized test scores in the first grade, or as retention in grade. The amount of information for predictive purposes is small, however, and efforts directed toward remediation of low birth weight hazards would not have a marked effect on overall educational attainment in this group.

Even assuming that such endeavors would be fruitful, can we, with the data available here, predict the birth of such a low weight infant?

Since no two-way analyses showed a major relationship between weight at birth and any social data, one would not expect a multiple variable analysis to improve one's ability to predict in advance from "environmental" information.

Table 52 Multiple Variable Analysis of Birth Weight

Variable	Degrees of Freedom		R^2 Excluding Variable	F-Ratio	Probability
	Numerator	Denominator			
Zero Order	12	1181	.31567	45.3985	0.0
Gestation	1	1181	.14288	298.1978	0.0
Single-Multiple Birth	1	1181	.26059	95.0643	0.00000
Sex	1	1181	.30969	10.3228	0.00147
Birthplace-Mother	2	1181	.31310	2.2159	0.10761
Legitimacy	1	1181	.31432	2.3260	0.12609
Birth Complications	1	1181	.31445	2.1065	0.14539
Age of Mother	4	1181	.31260	1.3254	0.25263
Poverty	2	1181	.31480	0.7547	0.46713

Length of gestation, sex of the infant, and single or multiple births account for nearly all of the variation found in birth weight. Lack of significance of birth complications in this table, though shown elsewhere (see Table 11), is accounted for by the inverse relationship between such complications and other independent variables. As an example, Table 13 shows a greater proportion of "lesser poverty" infants having had birth complications; on the other hand the direction of relationship between poverty and birth weight, though by no means significant, shows "lesser poverty" children as more likely to be normal birth weight.

Though low birth weight is not a strong predictor of school achievement, prevention of low weight births would have considerable value. When a multiple variable analysis of birth weight was made using available social or economic data, however, all correlation disappeared.

Summary

This study was intended as preliminary and used only readily available information. A preferable research technique would be to begin with the births themselves, rather than eliminating all those who do not reach or remain in the educational system. A larger sample of low weight children would allow manipulation of the size deemed "low weight" and would permit separate analysis of the single birth, the small-for-date and other subgroups. More extensive family information would allow a more accurate control on the environmental factors, as well as permitting a contrast of siblings of varying birth weight. Such maternal health factors as smoking,[15, 44, 61] childhood malnourishment,[18] and pre-pregnant

weight[50, 55, 61] could be assessed. A longitudinal study of low and normal weight infants would also allow examination of postnatal nutrition, sometimes felt to be the most important variable, and often presumed to be reflective of the levels of pre-birth nutrition.[11, 60]

Regardless of the data lacks in this project, certain summary statements can be made. Low birth weight children are far above their proportionate share of the classes for the mentally handicapped. Birth weight does persist as a significant variable in school achievement even in an area characterized by poor educational preparation and results. But though this relationship is of research interest in that it does persist beyond infancy and does occur in a generally uniform (and poor) social and economic environment, academic failure cannot be accurately predicted from birth weight nor can one, from this information, predict that a child will be born at low weight.

Originally this study was undertaken with the thought that special education programs for the poor might, in fact, be starting at a point of child development too late for real accomplishment - that improved prenatal care might have more effect. Our data, though generally supportive of the hypotheses that low birth weight is related to intellectual achievement, do not lead to abandonment of these special programs - in fact they support such efforts. Children, with no apparent differences in background characteristics, perform better on standardized achievement tests after experiencing this special curriculum.

Thus, though birth weight is a variable of research significance, educational attainment is found to be related both to other biological circumstances and to social and economic attributes with a considerable residual variation unaccounted for by any studied factors.

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