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ABSTRACT

This paper presents the results of a study which examined heritability ratios for the major ethnic and socioeconomic groups in the Los Angeles Unified School District. Scores on three measures (the Cooperative Primary Reading Test, the Comprehensive Test of Basic Skills, and a composite set of intelligence tests) were compared for twins from different populations (upper-middle and lower socioeconomic status black, white, and Spanish-surname). On all of the measures there were significant differences for ethnicity and socioeconomic status. Heritability ratios varied for each population and measure. It was concluded that extrapolating from data on white middle class twins is unwarranted and that for other populations heritability ratios are much lower. (Author/RH)

ESTIMATES OF HERITABILITY IN DIFFERENT POPULATIONS
(A PRELIMINARY REPORT)

Patricia M. Hodges
Professor, Department of Psychology
California State University, Los Angeles

Marge Gardner
California State University, Los Angeles

Adele Juarez
California State University, Los Angeles

ABSTRACT

Scores on three measures (the Cooperative Primary Reading Test, the Comprehensive Test of Basic Skills, and a composite set of intelligence tests) were compared for twins from different populations (upper-middle and lower socioeconomic status black, white, and Spanish-surname). On all of the measures there significant difference for ethnicity and socioeconomic status. Heritability ratios varied for each population and measure. It was concluded that extrapolating from data on white middle class twins (h^2 .80) is unwarranted and that for other populations heritability ratios are much lower.

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CHAPTER I

Introduction

The impact of most psychological studies upon the general public has been minimal with a few notable exceptions. One of the exceptions has been the controversy that has occurred after the publication of articles examining hereditary factors in determining intelligence, and particularly hereditary factors affecting differences in intelligence between racial and social class groups (Jensen, 1968, 1969, 1970). The popular notion of "I.Q." as a fixed factor seems to be made legitimate by studies which have pointed out high heritability ratios thus giving an apparent justification to the existing group differences in opportunity and affluence. New trends in government policy seem to indicate a more fiscally conservative attitude for government spending as well as in the general public view. It takes little imagination to envision studies favoring hereditary explanations for differences in performances being used to justify economic cutbacks in programs aimed at helping the disadvantaged. (If compensatory education failed because 80% of the variance in intelligence is due to genetic factors, why try again and again?) Social scientists have a responsibility to demonstrate any possible errors in such views. One way to do this is to point out that heritability estimates are a population statistic and always refer to a specific population, and thus will vary from group to group. The 80% factor which has often been cited

in the literature reflects the sample selection (usually white and middle-class) rather than a broad based random sample of all ethnic and socio-economic groups.

The impetus for the present study came from two sources varying greatly in their view. The first was Dr. Arthur Jensen's 1968 Harvard Educational Review article, and the second Dr. Sandra Scarr-Salapatek's 1971 Science article describing an empirical study of heritability factors in a black and white population. While the reports differ in their philosophical orientation, methodology, and conclusion, both emphasized the need for additional data from non-white families. The Los Angeles area, with its diverse ethnic population and socioeconomic class distributions seemed to be an ideal area in which to collect such data. Furthermore, school district personnel had indicated that school records for the district contained both achievement and ability test scores for individual pupils (prior to 1971, at which time only group data was available) and a record of zygosity (determination of identical or fraternal twinning). This paper presents the results of a study which examined heritability ratios for the major ethnic and socioeconomic groups in the Los Angeles Unified School District.[1]

All data collection was carried out under the supervision of the District Research and Evaluation Staff.[2] After reviewing the theoretical background, methodology, and the procedures used to guarantee pupil anonymity, the Los Angeles Board of Education approved the study with the stipulation that at least

one other district agree to participate[3] and the Stockton School District[4] was agreeable to this.

Twin Studies

To familiarize the nontechnical reader with the methodology for twin study and the criticisms made of such studies, the remainder of this section briefly reviews some of the current work on twin studies. For a more elaborate discussion of the rationale behind twin studies, the reader is recommended to Vandenberg (1966, Contributions of twin research to psychology, Psychological Bulletin, 1966, Vol. 66, pp. 327-352), and for a comprehensive discussion of differences in ability scores, the reader is referred to Loehlin, Lindzey, and Gardner's (1975), Race, Heredity and Intelligence. This review will not deal with the assumptions implicit in twin studies nor the criticisms that have been made of these assumptions except for one criticism that seems of major importance to the current author - the assumption that environmental conditions are the same for identical and fraternal twins. This does not mean environments are assumed to be the same for all twins, but rather that some twins of each type have the same general environment.

Recent evidence (Maccoby & Jacklin, 1975) in the area of sex differences in achievement scores related to the effect of differential environmental inputs for male and female children would lead us to believe that the environmental differences for opposite sex fraternal twin sets would be greater than environmental differences for same sex fraternal twin sets (and for all monozygotic twin sets who are, by definition, of the same sex). Recently Schwartz & Schwartz (1975) and Gotbun

& Shield (1972) substantiated that the increased variation between opposite sex twins in the group of twins labeled dizygotic causes a distortion in the data and they therefore present separately the data for same sex and opposite sex dizygotic twins. The data in this study were also analyzed separately for same sex and opposite sex dizygotic twins.

Intelligence

The term intelligence has come into everyday use only in the last 76 years and prior to 1905 it's use was very rare. In 1927 Spencer revived the Ciceronian word "intelligence" which he used to designate "the capacity for adaptation". When viewed in this context, the continuing debate about hereditary/environmental factors as determinants of intelligence seems to lose force, for both heredity and environment are necessary for any adaptations to take place. However, in the annals of psychometric testing, intelligence has come to mean that which intelligence tests measure. Jensen has (1969) emphasized that it is this, the general factor common to standard tests of intelligence, and not a general mental ability (referring to the totality of a person's mental capacity) that is at the heart of the current controversy.

Estimates for heritability of intelligence (following the definition of factors common to standard intelligence scores) have been generally determined from studies of related persons. A simplification of the rationale for twin studies would be as follows: Since monozygotic twins (one egg cell twins) have the

same genetic makeup, any variation within twin pairs would be due to environmental factors. Dizygotic twins (two egg twins) have only half of their genes in common and any variation within the twin set would therefore be due to both environmental and genetic factors. By examining the amount of variation between monozygotic twin sets in comparison to the amount of variation between dizygotic twin sets (and examining substantial numbers of twins) an estimation can be made about the relative importance that genetic and environmental factors have for the population under examination. In a 1963 review, Erlenmeyer-Kimling and Jarvik reviewed fifty years of literature dealing with genetics and intelligence and concluded that when all the studies are reviewed, there is an overall orderliness which is impressive. There is a near perfect match between the median correlations and the degree of relatedness of paired individuals, with a .5 correlation for children from the same parents raised together', .75 for monozygotic twins reared apart, unrelated persons reared apart, .01, and unrelated individuals reared together, .3.

A few studies have compared the scores of identical twins reared together and those reared apart on the same measures. Newman, Freeman, & Holzinger (1937) reported a correlation of .77 for identical twins reared apart, whereas scores for fraternal twins reared together correlate at only .63. Burt (1966) reported even greater differences, with a correlation of .93 for identical twins reared apart as compared to a .6 for fraternal

twins reared together. Due to the small number of cases involving twins reared apart, the greater number of studies compare the divergence in scores for large numbers of identical twins to the divergence of scores for fraternal twins.

Heritability of intelligence in the middle class white population has been estimated to account for 80% of the variance in I.Q. scores in many reports. Recent estimates by Schwartz and Schwartz (1974) and Adams, Ghodsian, and Richardson (1976) has offered conflicting evidence for lower and upper limits on heritabilities of mental test performance. These estimates were considerably lower than the value of .80 normally quoted in the literature, with Schwartz's estimating a zero heritability factor. The Adams et. al. study was an unusually complete one in that the data are from a nationally representative sampling of twins in England and Scotland, for whom considerable information on biographic, biometric, social, and psychometric factors had been gathered over a twenty year period. This particular study is of interest because they also found that not separating opposite sex from same sex dizygotic twins produced a source of error in the identical-fraternal twin comparison. Adams et.al. reported correlations for the same sex dizygotic twins as being higher (r.185) than those for the monozygotic twins (r.117) on nonverbal tests.

Scarr-Salapatek (1971) has pointed out the fallacy of asking the heritability of I.Q. as a general question since heritability estimates vary according to what skills are being

measured, at what age they are being measured, according to what measure one uses, and according to the genetic and environmental composition of the population under examination. She has stated there are four possible explanations for the finding of zero heritability (as reported by Schwartz & Schwartz): 1, that the measurement of the phenotype, (the observed characteristic) is invalid or unreliable; 2, that there is no genetic variability underlying the phenotype; 3, that all genotypes (the underlying genetic pattern which may or may not be expressed phenotypically) are functionally equivalent in producing the phenotype; and 4, that other effects overwhelm the genetic variability. She concluded that the first two possibilities do not seem likely as intelligence tests have been shown to have considerable reliability, and considerable variability has been found from group to group. Therefore, possibilities three and four are left: 1, that all genotypes are functionally equivalent in producing the phenotype or 2, that other factors overwhelm the genetic variability. Since an examination of all studies of human familial groups (each of which may be criticized for one or more methodologic reasons) reveals an overall regularity of genetic similarity, i.e., that genetically related persons are more similar intellectually than unrelated persons whether they are reared together or not, this explanation seems unwarranted. Scarr-Salapatek concluded, therefore, the possibility that other factors overwhelm the genetic variance was the stronger argument.

These other effects include environmental conditions, uneven growth patterns, the particular pattern of skills tested, and various unspecified conditions.

Racial Differences

In 1969, Jensen reviewed the major studies on heritability and concluded that the heritability of intelligence in the middle class white population does account for about 80% of the variance in I.Q. scores. Jensen goes on to point out that the heritability ratio of a characteristic (as Scarr-Salapatek has said) is a function of the population in which it is measured, and that social class and racial group can be considered different populations. One would, therefore, predict different heritability ratios for each of these populations. Despite his disclaimer that no adequate study of heritability has been based on samples of black population at that time, Jensen extrapolated from the available white middle class data to conclude that the observed differences between Black/White I.Q. scores probably reflect an underlying genetic difference.

The few studies that deal with non-white populations have been primarily composed of black and white twin populations and there seems to be no comparable data available for the Spanish-surname group in this country. Four fairly current and one older study comparing heritability ratios in United States for black and white twins have been conducted. Thomlinson (1944) found a heritability ratio of .26 for black twins which she attributed to a restriction of the range in the sample rather than to a

lower heritability ratio in black population. Somewhat later Vandenberg (1968) and Osborne (1968) tested black and white identical and same sex fraternal twins and their conclusions were strikingly different. Vandenberg concluded there was good evidence for the thesis that the ratio between hereditary potential and realized ability was lower for the black twins in his sample than for the white twins, whereas Osborne concluded that the differences were not remarkable and he did not support the hypothesis of different heritability ratios for the white and black populations. The fact that these opposite conclusions were reached from examinations of the same data indicates the importance of methodology in twin studies. This discrepancy appears to be related to the rather small sample of black fraternal twins in which the variance again was quite restricted.

In another study, Nichols (1970) reported that heritability ratios for intelligence among black twins were lower than heritability ratios for white twins. The largest population of black and white twins for whom data has been reported was that of Scarr-Salapatek (1971). Scores for 506 pairs of black twins and 282 pairs of white twins were compared on a variety of aptitude tests, and in general twin correlation for the white sample tended to be higher than those for the black sample. Scarr-Salapatek also found that correlations for low socioeconomic class were lower than those of the total sample. Her study has received considerable criticism because the zygosity of the twin sets was determined by statistical procedures and her findings, therefore,

have not met with wide acceptance. Jensen (1973) recently studied a substantial number of black and white sibling pairs and reported similar correlations for the black and white sibling population.

In summarizing the results of the above studies, Loehlin, Lindsey, and Spuhler (1975) report that methods relying on within family variation (identical-fraternal twin differences) tend not to show consistent differences in the heritability of I.Q. between the black and white populations, whereas methods that rely primarily on between family variations such as siblings studies sometimes do suggest lower heritability ratios. They also suggest that the lower heritability ratio tends to be associated with a reduced total variance within the black population.

Cross Racial Adoption

In addition to twin studies, Loehlin et al. also reviewed interracial adoptions in this country and in Great Britain. All of these interracial adoption studies occurred in one direction, with white race parents adopting another race child into their family. It is, therefore, not possible to look at the opposite side of this question. The British study cited which reported on intelligence data for white, black, and mixed racial children (who spent a considerable portion of their life in residential nurseries (Tizard, 1974) reported differences in I.Q. scores which tended to favor the non-white children but the differences were not significant.

In recent studies of illegitimate children in Germany fathered by black and white soldiers, there were no overall

significant differences in I.Q. scores between the two groups of offspring. Loehlin also reported on studies comparing extreme populations i.e. black children with I.Q.'s above 140, and stated that these children had no larger proportion of white ancestry than does the average black in the United States.

In an exciting recent American Psychologist (1976) article, Scarr reported on cross-racial adoption patterns in the Minnesota area. In this study, black and interracial children were adopted by advantaged white families, and the effects of an advantaged environment could be evaluated more fully. She found that black children reared in advantaged white homes scored about one standard deviation (15 points) above the average I.Q. (about 90) usually reported for black children, and she describes this increase to the common cultural background of the white middle class and the test items. She concluded that if all black children had environments similar to those provided by the adopting families, their I.Q. scores would average from 16 to 20 points higher than the current quoted scores and thus the existing group differences (about 10 - 15 points) would disappear.

Study of Other Non-White Groups

Early studies of groups of other mixed racial background are those of Garth (1931) who examined Indian and part-Indian subjects, and Paschal and Sullivan (1924) who examined Spanish-surname populations in the Tucson area. Both studies reported a positive correlation in mental ability with the degree of

white blood in the population, and both reported the mixed groups superior to the all Indian groups.

Paschal and Sullivan (1925) studied 9 and 12 year old Spanish-surname children in the public schools of Tucson and reported the Spanish-surname children who had greater Indian origin had lower mental scores, lower socioeconomic status, and lower school standing than the Spanish-surname children who had less Indian blood. They also reported that children from better socioeconomic status excelled those who came from poorer homes in stature, school grades, and mental scores. Reflecting the bias of these earlier years, they do not hypothesize that skin color may have created differential environments for these children, which, in turn, affected test and school scores.

Fitzgerald and Luderin (1929) reported Indian populations as having lower I.Q. scores (87.5) than did the white population in their study. Using the Goodenough Draw-A-Man test with Hopi Indians, Dennis (1972) found no inferiority to white norms with Indian males having an average I.Q. of 116.6 and Indian females averaging 99.5. He attributed the high scores and discrepancy between the sexes as due to the greater involvement of the male Hopi in graphic art.

More recently, Jensen (1974) compared the scores of white, Spanish-surname, and black children on the Peabody Picture Vocabulary (PPVT) and Raven Progressive matrices. There were large mean differences for the three ethnic groups on both tests with scores for PPVT showing some possible cultural bias for

the Spanish-surname group. He concluded a comparison of the results of both tests for the black population did not support a cultural biasing against the black group.

Summary

The studies on related persons reared together and apart and twin studies seem to indicate that a considerable portion of the variance in I.Q. scores is due to genetic factors. This proportion has been estimated as being as low as 0% and as high as 80%, thus, more information seems desirable. Data on black-white differences reflect considerable overlap, but in general, scores for the black population are about 10-15 points below scores for the white population. Various studies examining possible causes (a mixture of race, rearing, and environments) have tended to present contradictory findings. Studies of non-white twin populations seem to be confined primarily to black-white comparisons, and there is no comparable data for the Spanish-surname population. Those studies which have examined heritability ratios for the black and white twin populations have been characterized by small numbers of twins in the sample. It is hoped that this study of a relatively large number of twins from differing socioeconomic and ethnic groups, will aid in interpreting these conflicts.

CHAPTER II

Methodology

Methods For The Los Angeles Sample

The Los Angeles Unified School Board approved this project with the stipulation that all procedures for gathering data would be controlled by the Research and Evaluation Staff of the Los Angeles City Unified School District.[4] With the help of the Research and Evaluation Staff a letter was sent (See Appendix A) to each of the school district's 436 elementary schools requesting their participation in the study. This letter outlined the purpose of the study and asked the school principal to indicate his/her approval on an enclosed form. The letter included a statement that the school personnel who would obtain the data from the individual students' cumulative files and would then be reimbursed on an overtime basis by the study. (This procedure was necessary since the files are not open for examination to anyone who is not an employee of the district). The principals were also asked to determine the number of twins in the school and supply this data to the researchers.[5]

The final sample was derived from the 174 schools in the district for which there were data on twin sets. (See Table 1). Of the total 436 schools, 161 either did not respond or replied they were unwilling to participate, and 101 schools had no usable data (i.e. they had either no twins enrolled or incomplete

data for one of the twins). The distribution of the schools participating in the study and the distribution of the school refusing to participate were compared to see if the non-participating schools represented any particular concentration with the geographic districts of the city, and both samples were distributed non-systematically throughout the district. The ethnic composition, income, and educational levels, and our sample did not differ significantly from the city-wide distribution; and therefore, seems representative of the general school district.[6]

Each of the participating schools was sent a packet (See Appendix B) containing data forms for the twins. The schools were assigned an identification number and each school identified twins only by an assigned number (odd-even numbers equalling one twin set). The schools indicated the sex, birth-date, and all test scores for the twins. As mentioned, each school district was to have data on their records as to the zygosity of each twin set and this was to be included on the form. Many schools reported they did not have the information available, therefore, the check list developed by Nichols and Bilbro (1966) was used in this case.[7] The proportion of twins zygosity determined in this manner was quite high. However, due to an additional problem (to be discussed later) it was necessary to contact individual families and at that time parents were questioned about the zygosity of their twin sets, thus verifying the school's report.

TABLE 1

Number of Schools Contacted
in the Los Angeles Sample

Sample	174
Unwilling to Participate/ No Response	161
No Useable Data[a]	101
TOTAL	436

a. No twins or data missing for one member of the twin set.

The designation of socioeconomic class to be used in the study was the method used by Scarr-Salapatek in her 1968 study. That is, data would be obtained from census tract records for each school district; and all students attending the school would receive the same socioeconomic class designation. Socioeconomic class assignment was made by establishing a median education and income level for the entire district and classifying each individual school district into one of three groups: 1, above the census median for both education and income levels; 2, below the median of both; 3, a mixed group above on one criterion and below on the other. These three groups were then designated as below median, median status, and above median status.

Preliminary breakdown of these data indicated that using school district educational level and income level as criterion resulted in having only 11 sets of white twins fall into the below median group (in proportion to 136 sets of black twins and 72 sets of Spanish-surname twins who fell into this category). While this distribution may well reflect the social bias that race produces in the area of income and educational potential, it seemed unreasonable to assume that in the entire school district there were only 11 sets of white twins whose families were below the median on educational and income levels. It was therefore decided to contact parents of each twin set in order to ask them questions about the educational level, employment status of the family, and to ask them if the family income was above the school district median salary of $11,909. The median

level of education was high school level. The decision was made to contact all twin families in the sample since contacting only the white families would make the data on income, education, job status, and zygosity noncomparable to the rest of the sample.

The contact was made by individuals who had no access to the twin scores and bilingal callers were used for Spanish-surname families when necessary. Each home having a phone listing was contacted, and letters detailing the project were sent to homes for which there was no phone listing (See Appendix C-E for letters). Due to the high mobility level in the Los Angeles Unified School District, this proved to be a cumbersome task and took a prolonged period of time (7 months). About two-thirds of the parents were contacted and were willing to give us the data. Only one parent refused to give the information and most were quite interested in participating and voluntarily gave all information except family income. For the one-third of the cases where we were unable to locate the parents of the twins, i.e. moved out of the school district and left no forwarding address, the twins were assigned the income level and educational level for that particular school district. Table 2 gives a final breakdown of our sample by ethnic and socioeconomic distribution.

It is interesting to note that the highest socioeconomic status school and one of the lowest fell in our sample. In the high socioeconomic status school the average income was $46,553 and the median educational level was three years of college. (This school had both black and white twins). The lowest

TABLE 2

Distribution of the Los Angeles Area Twin Sample
by Ethnicity and Socioeconomic Status

Ethnicity	American Indian	Black	Asian	Spanish surname	Other	White	Total
Socioeconomic Status							
Upper		20	4	6	6	184	220
Middle		154	20	88	18	254	534
Lower	4	262	4	134	4	86	494
TOTAL	4	436	28	228	28	524	1,248

socioeconomic status school in the sample had an average income of $4,724.00 and a median educational level of one-three years of high school.

Stockton Sample

The data for the Stockton sample was obtained in a different manner with the school district assigning one individual to obtain all of the necessary information from all grade levels.[8] Thus, the Stockton data including median levels of education, and income as well as the distribution of ethnic groups was a more complete record for that district. (See Table 3 for Stockton sample). However, the data from the Stockton sample did not include any determination of zygosity and therefore this data was to be analyzed separately using the same method Scarr-Salapatek used for her 1963 study. There were 161 sets of twins in the Stockton area of which 77 were white, 27 were black, 35 were Spanish-surname, and 21 were "other". For both school districts, the twin sample reflects the ethnic distribution and income levels of the school district with the above noted exception of the lower number of Spanish-surname and Oriental twins in the Los Angeles sample.

Los Angeles Twins

The subjects were 1,248 twins identified as twins (from school records by school personnel) who were enrolled in grades 2 through 6 of the Los Angeles Unified School District. No data could be collected on twins in grades Kinderkarten to 2, since district policy concerning testing had changed and no individual

TABLE 3

Distribution of the Stockton Twin Sample
by Ethnicity and School Level

Ethnicity	K - 6	Junior High	Senior High	Total
Black	13	9	5	27
Oriental	0	0	1	1
Spanish-surname	22	9	4	35
Other	4	11	6	21
White	37	27	13	77
TOTAL	76	56	29	161

test scores were available for this group. A total of 203 sets of monozygotic and 421 sets of dizygotic twins composed the sample. (See Table 4 for distribution of the twin sets by ethnic membership and zygosity). There were 218 sets of black twins for whom data were available, 153 of these were fraternal and 65 were identical twins. (This proportionately reflects the higher fraternal twinning rate in the black population). There was data available for 262 sets of white twins of whom 172 were fraternal and 90 were identical twins. There were 114 sets of Spanish-surname twins of which 74 were fraternal and 40 were identical twins. The sample had data for only 14 sets of oriental twins, of whom 4 were identical and 10 were fraternal. There were only two sets of Indian twins (others also include Philippine and children classified as other) for whom data was available in the entire 2 - 6 grade Los Angeles City Unified School District, despite their fairly numerous representation in this population.

Table 4 contains a comparison of the twins sample with the ethnic distribution reported for all of the elementary schools in the Los Angeles Unified School District. (School District Data). As the reader will note, American-Indian, Asian-American, and Spanish-surname twins are somewhat under represented according to the district data while black and white twins are thus overrepresented. This overrepresentation is particularly noticable in the black group. However, the rate of fraternal twinning in the black population is higher than in the white population.

TABLE 4

Distribution of Subjects of Ethnicity and Zygosity

Zygosity	ETHNIC MEMBERSHIP: Black	Asian-American	Spanish surname	White	American Indian & Other	TOTAL
Dizygotic Twins Opposite-Sex	73	2	35	81	5	196
Dizygotic Twins Same Sex (observed)	80	8	39	91	7	225
(predicted)	(73)	(2)	(35)	(81)	(5)	
Monozygotic Twins (predicted)	65 (72)	4 (10)	40 (44)	90 (100)	4 (6)	203
Total Number	218	14	114	262	16	624
Population %	34.9%	2.2%	18.3%	42.0%	2.6%	
Percentage of all pupils in each group in all elementary schools (from district records)	24.7%	4.9%	31.7%	38.4%	.3%	

Also twinning is a comparatively rare factor in the Asian-American population and data from the Bureau of Indian Affairs has indicated that for the population of American Indians living on reservations, twinning is also quite low. The author has been unable to find any comparative data for the Spanish-surname population and can only hazard a guess that the lower number of twins in the sample reflects a true difference in the twinning rate for this population.

Table four also contains a comparison of the expected and observed number of twins. There will be approximately the same number of same-sex as opposite sex pairs of dizygotic twins and the percent of monozygotic twins can then be estimated by taking twice the percent of opposite-sex twins from 100. This would seem that some of our monozygotic twins have been misclassified as same-sex dizygotic twins. While the number is small this would tend to bias the data in leading to a more restricted variance for the dizygotic group which could lead to a slight underestimation of heritability.

Tests Used in This Study

Three different types of test data were available for the twins, two of these were achievement type tests and the third an ability type test. The first test for which data was available was the Cooperative Primary Reading Test (CPRT). The scores for this test were reported in whole percentile and there were three different forms available for each grade level. The means and standard deviations for each form is included in Appendix E.

Some twins had been repeatedly tested on the Cooperative Reading Test and for these twins a separate analysis using a repeated measures design has been used.[9]

A second battery of achievement tests administered to the twins throughout their school years was the Comprehensive Test of Basic Skills (CTBS). Again the score for this test was in whole percentile and there were different forms available for each grade level. The means, standard deviation and for each form of the test were reported in Appendix F.

The ability scores for the twins were from several tests; the Stanford-Binet, Weschler Intelligence Scale for Children, the Otis-Lennon, Kuhlmann-Anderson, and the Leiter International Intelligence Scale.

CHAPTER III

Results

The data were analyzed for only the three major subgroups of twins in the sample since the number of Asian-American, American-Indian and other twins was too small to permit an adequate analysis. While there were differences between the upper and middle socioeconomic status groups, for each of these groups the differences were not as great as were those between the upper-middle combined and the lower socioeconomic status group. The number of twins in the upper socioeconomic status group for the two minority groups was quite small; therefore, in accordance with many other studies (Scarr, 1967; Lesser, Clark, Feiffer, 1967), data for the upper and middle class groups were combined.

Equivalent forms of each test were normed and grouped for analysis and test scores on the achievement measures are given in percentiles. Each set of analysis is presented in a separate section in order to make comparisons easily.

Analysis of Tests by Ethnicity and Socioeconomic Status

Cooperative Primary Reading Test

Data from the Cooperative Primary Reading Test were available for a total of 1,102 twins. Table 5 presents an analysis of the Cooperative Primary Reading Test scores by ethnicity and socioeconomic status. A brief glance at the table reveals white-black score differences similar to those reported in

TABLE 5

Analysis of Cooperative Primary Reading Test Composite Scores for Different Ethnic and Socioeconomic Groups

ETHNICITY

Socioeconomic Status		Black	Spanish-surname	White	Total
Upper-Middle	X	36.02	42.68	55.30	49.01
	SD	22.06	28.13	25.50	26.42
	N	167	89	434	690
Lower	X	29.99	32.37	36.40	31.47
	SD	19.93	21.52	19.37	20.40
	N	242	119	51	412
Total	X	32.45	36.78	53.31	42.45
	SD	21.01	25.03	25.58	25.77
	N	409	208	485	1102

Factor	MS	df	F
Ethnicity (E) (eliminating socioeconomic status)	22799.18	2	41.57***
Socioeconomic status (eliminating E)	20148.79	1	36.74***
E x socioeconomic status Interaction	2587.39	2	4.72**
Residual	548.44	1096	

** p .01
*** p .001

other studies. For all ethnic groups the combined upper-middle socioeconomic class group scores were higher than those of the lower socioeconomic status group. White twins scored higher than the Spanish-surname twins who in turn scored higher than the black twins. The analysis of variance confirms that ethnicity (with socioeconomic status eliminated) and socioeconomic status (with ethnicity eliminated) were significant main effect at the .001 level and the interaction was also significant at the .01 level.

Comprehensive Test of Basic Skills

Data were available for a total of 359 twins on the Comprehensive Test of Basic Skills (Reading Portion). Table 6 presents an analysis of these scores by ethnicity and socioeconomic status. The expected socioeconomic status differences in scores were found with the exception of the black group. For this group the scores of the lower socioeconomic status twins were slightly higher than those of the upper-middle black twins. White twins again scored higher than the Spanish-surname twins who again scored higher than the black twins in each of the socioeconomic status groups. Again there was a significant main effect for ethnicity (eliminating socioeconomic status and for socioeconomic status (eliminating ethnicity) at the .001 level as well as a significant interaction.

The analysis of the Comprehensive Test of Basic Skills, Mathematic scores were computed for a total of 292 twins. Again the upper-middle socioeconomic status group had higher scores than did the lower socioeconomic group. Again the white twins

TABLE 6

Analysis of the Comprehensive Test of Basic Skills (Reading) Scores for Different Socioeconomic Status and Ethnicity Groups

ETHNICITY

Socioeconomic Status		Black	Spanish-surname	White	Total
Upper-Middle	X	24.87	37.45	54.70	47.22
	SD	19.72	21.50	24.05	25.76
	N	41	34	167	242
Lower	X	25.90	27.31	37.75	27.79
	SD	21.40	21.00	20.46	21.31
	N	64	39	14	117
Total	X	25.50	32.03	53.39	40.89
	SD	20.67	21.70	24.17	26.02
	N	105	73	181	359

Factor	MS	df	F
Ethnicity (E) (eliminating socioeconomic status)	15823.39	2	31.40***
Socioeconomic status (eliminating E)	2539.06	1	5.04*
E x socioeconomic status Interaction	1532.53	2	3.04*
Residual	503.88	353	

* p .05
*** p .001

TABLE 7

Analysis of the Comprehensive Test of Basic Skills (Mathematics) Scores for Different Socioeconomic Status and Ethnicity Groups

Socioeconomic Status		ETHNICITY: Black	Spanish-surname	White	Total
Upper-Middle	X	20.22	36.58	53.98	43.43
	SD	17.11	20.82	26.25	27.50
	N	41	26	107	174
Lower	X	21.49	28.86	35.56	25.31
	SD	22.63	26.31	22.44	24.34
	N	64	46	8	118
Total	X	20.99	31.65	52.70	36.11
	SD	20.58	24.60	26.34	27.69
	N	105	72	115	292

Factor	MS	df	F
Ethnicity (E) (eliminating socioeconomic status)	17565.50	2	30.90***
Socioeconomic status (eliminating E)	1113.97	1	1.96
E x socioeconomic status Interaction	1220.37	2	2.15
Residual	568.39	286	

*** p .001

in the sample had higher scores than the Spanish-surname twins who had higher scores than the black twins. Again ethnicity, (eliminating socioeconomic status) was significant at the .001 level. Socioeconomic status (eliminating ethnicity) was not significant, nor was the interaction significant.

An analysis of the combined composite scores on the Comprehensive Test of Basic Skills for the different ethnic and socioeconomic status groups was presented in Table 8. There was a significant main effect for ethnicity (eliminating socioeconomic status) at the .001 level and the interaction of ethnicity and socioeconomic status was significant at the .05 level. Again the white twins had higher scores than the Spanish-surname twins who had higher scores than the black twins. Within the Spanish-surname group and the white group the upper-middle class twins scored higher than the lower socioeconomic status twins.

Ability Tests

All of the ability tests (The Otis-Lennon, Kuhlman-Anderson, Stanford-Binet, Wechsler-Bellvue) were combined by standardizing the scores. Table 9 presents the analysis of the composite ability test scores for the different ethnic and socioeconomic status groups for a total of 348 twins. The upper-middle socioeconomic status twins tend to have scores higher than the lower socioeconomic status twins for all ethnic groups. White twins had scores higher than the Spanish-surname twins who in turn had scores higher than did the black twins. Again a main effect for ethnicity (eliminating socioeconomic status)

TABLE 8

Analysis of Comprehensive Test of Basic Skills Composite Scores for Different Ethnic and Socioeconomic Groups

Socioeconomic Status		ETHNICITY Black	Spanish-surname	White	Total
Upper-Middle	X	21.82	37.68	54.19	46.02
	SD	16.61	20.54	23.53	25.41
	N	49	35	181	265
Lower	X	24.28	30.97	37.54	28.21
	SD	21.19	24.42	19.01	22.53
	N	67	48	14	129
Total	X	23.24	33.80	52.99	40.19
	SD	19.35	22.97	23.59	25.87
	N	116	83	195	394

Factor	MS	df	F
Ethnicity (E) (eliminating socioeconomic status)	21217.46	2	43.42***
SES eliminating E	1295.08	1	2.65
E x SES Interaction	1693.60	2	3.47*
Residual	488.60	388	

* p .05
*** p .001

TABLE 9

Analysis Of Intelligence Tests Composite Scores For Different Ethnic And Socioeconomic Status Groups

ETHNICITY

Socioeconomic Status		Black	Spanish-surname	White	Total
Upper-Middle	X	91.10	102.48	114.36	109.15
	SD	18.30	21.99	17.95	20.47
	N	39	33	177	249
Lower	X	87.82	88.27	90.65	88.46
	SD	18.07	18.39	11.64	17.06
	N	53	28	18	99
Total	X	89.21	95.96	112.18	103.26
	SD	18.14	21.47	18.75	21.65
	N	92	61	195	348

Factor	MS	df	F
Ethnicity (E) (eliminating socioeconomic status)	7540.66	2	22.76***
Socioeconomic status (eliminating E)	8481.82	1	25.60***
E x socioeconomic status Interaction	2004.41	2	6.05**
Residual	331.32	342	

** p .01
*** p .001

and for socioeconomic status (eliminating ethnicity) was found at the .001 level and the interaction was significant at .01 level.

Analysis of Test Scores by Socioeconomic Status and Zygosity

Cooperative Primary Reading Test

Table 10 presents the analysis of the Cooperative Primary Reading Test composit scores for the different socioeconomic status and zygosity groups. The upper and middle group had scores higher than did the lower socioeconomic status group (significant main effect at .001 level). Zygosity was not significant nor was the interaction and there was little difference between the performances of monozygotic and dizygotic twins.

Comprehensive Test of Basic Skills

Table 11 presents the results of the analysis of the Comprehensive Test of Basic Skills (Reading) scores for the different socioeconomic status and zygosity groups. There was a significant main effect for socioeconomic status with the upper and middle group having higher scores than the lower socioeconomic group. Zygosity did not have a significant effect nor was the interaction significant. Table 12 present the results of the analysis for its Comprehensive Test of Basic Skills, Mathematics scores for the different socioeconomic status groups. Again there was a significant main effect for socioeconomic status with upper and middle group having higher scores than lower socioeconomic status groups. Again neither zygosity nor the interaction had a significant effect. Table 13 presents the results

TABLE 10

Analysis Of Cooperative Primary Reading Test Composite Scores For Different Socioeconomic And Zygosity Groups

SOCIOECONOMIC STATUS

Zygosity		Upper	Middle	Lower	Total
Mono	X	56.97	45.65	29.99	43.04
	SD	27.74	25.79	20.37	26.48
	N	74	174	114	362
Di	X	60.31	43.30	32.03	42.16
	SD	23.55	25.66	20.41	25.43
	N	148	294	298	740
Total	X	59.20	44.17	31.47	42.45
	SD	25.01	25.71	20:40	25.77
	N	222	468	412	1102

Factor	MS	df	F
Socioeconomic Status (eliminating Zygosity)	56582.24	2	100.61***
ZY (eliminating socio-economic status)	23.82	1	.042
Socioeconomic Status x ZY Interaction	737.03	2	1.31
Residual	562.39		

*** p .001

TABLE 11

Analysis Of The Comprehensive Test Of Basic Skills (Reading) Scores For Different Socioeconomic Status And Zygosity Groups

SOCIOECONOMIC STATUS

Zygosity		Upper	Middle	Lower	Total
Mono	X	60.71	40.59	27.68	39.75
	SD	26.40	25.28	21.92	26.46
	N	19	72	38	129
Di	X	61.20	42.68	27.84	41.53
	SD	22.31	24.33	21.16	25.80
	N	49	102	79	230
Total	X	61.07	41.82	27.79	40.89
	SD	23.32	24.67	21.31	26.02
	N	68	174	117	359

Factor	MS	df	F
Socioeconomic Status (eliminating Zygosity) (Z)	23887.24	2	43.40***
ZY (eliminating socio-economic status)	120.22	1	.22
Socioeconomic status x ZY Interaction	33.80	2	.06
Residual	550.35	353	

*** p .001

TABLE 12

Comprehensive Test Of Basic Skills (Mathematics)
Scores For Different Socioeconomic Status
And Zygosity Groups

SOCIOECONOMIC STATUS

Zygosity		Upper	Middle	Lower	Total
Mono Zygosity	X	67.25	33.76	22.83	34.20
	SD	20.54	26.47	22.86	27.90
	N	12	49	33	94
Di Zygosity	X	62.73	38.71	26.28	37.01
	SD	20.51	26.12	24.95	27.62
	N	30	83	85	198
Total	X	64.02	36.87	25.31	36.11
	SD	20.37	26.26	24.34	27.69
	N	42	132	118	292

Factor	MS	df	F
Socioeconomic status (eliminating ZY)	23328.44	2	38.03***
ZY (eliminating socio-economic status)	607.80	1	.99
Socioeconomic status x ZY Interaction	303.00	2	.49
Residual	613.38	286	

*** p .001

TABLE 13

Analysis Of Comprehensive Test Of Basic Skills Composite Scores From Different Socioeconomic And Zygosity Groups

SOCIOECONOMIC STATUS

Zygosity		Upper	Middle	Lower	Total
Mono Zygosity	X	63.19	38.74	27.24	39.20
	SD	23.64	24.91	22.42	26.40
	N	21	81	39	141
Di Zygosity	X	59.82	41.78	28.63	40.74
	SD	20.46	24.47	22.69	25.60
	N	51	112	90	253
Total	X	60.80	40.51	28.21	40.19
	SD	21.32	24.64	22.53	25.86
	N	72	193	129	394

Factor	MS	df	F
Socioeconomic status (eliminating ZY)	24547.64	2	44.69***
ZY (eliminating socio-economic status)	192.05	1	.35
Socioeconomic status x ZY Interaction	232.54	2	.42
Residual	549.34	388	

*** p .001

of analysis of the Comprehensive Test of Basic Skills composite scores for the different socioeconomic status and zygosity groups. Again there was a significant main effect for socio-economic status with upper and middle group having higher scores than lower socioeconomic status groups. Again the effects of zygosity and the interaction were not significant.

Ability Tests

Table 14 presents the results of the analysis for the different socioeconomic status and zygosity groups. Again there was a significant main effect for socioeconomic status with upper and middle groups having higher scores than the lower socioeconomic status groups. Monozygotic twins had higher test scores than did dizygotic twins within each of the socioeconomic status groups.

Analysis by Sex and Zygotic Groups

Cooperative Primary Reading Test

Table 15 presents the results of the analysis of the Cooperative Primary Reading Test scores for different zygosity groups by sex. Again zygosity did not have a significant effect. However, there was a significant main effect for sex with females having slightly higher scores than males.

Comprehensive Test of Basic Skills

Table 16 presents the results of the analysis for the Comprehensive Test of Basic Skills (Reading) scores for the zygosity groups by sex. Again there was no significant main effect for zygosity and female twins had higher scores than male twins (significant main effect p .01 level). Table 17

TABLE 14

Analysis Of Composite Ability Test Scores For Different Socioeconomic And Zygosity Groups

SOCIOECONOMIC STATUS

Zygosity		Upper	Middle	Lower	Total
Mono	X	123.95	104.72	90.70	108.50
	SD	15.03	21.87	17.07	22.41
	N	39	51	23	113
Di	X	113.12	102.32	87.79	100.74
	SD	19.86	18.29	17.11	20.87
	N	68	91	76	235
Total	X	117.06	103.18	88.46	103.26
	SD	18.91	19.61	17.06	21.65
	N	107	142	99	348

Factor	MS	df	F
Socioeconomic status (eliminating ZY)	19794.90	2	57.67***
ZY (eliminating socio-economic status)	2110.04	1	6.15*
Socioeconomic status x ZY Interaction	567.34	2	1.65
Residual	343.25	342	

* p .05
*** p .001

TABLE 15

Analysis Of Cooperative Primary Reading Test Composite Scores For Different Sex And Zygosity Groups

ZYGOSITY

Sex		Mono Zygosity	Di Zygosity	Total
Male	X	42.92	39.21	40.42
	SD	24.95	24.80	24.89
	N	171	352	523
Female	X	43.14	44.85	44.28
	SD	27.84	25.72	26.43
	N	191	388	579
Total	X	43.04	42.16	42.45
	SD	26.48	25.43	25.77
	N	362	740	1102

Factor	MS	df	F
Sex (S) (eliminating zygosity (Z)	4099.56	1	6.21*
Z (eliminating S)	178.58	1	.27
S x Z Interaction	1779.15	1	2.69
Residual	660.42	1098	

* p .05

TABLE 16

Comprehensive Test Of Basic Skills (Reading) Scores
For Different Sex And Zygosity Groups

Sex		ZYGOSITY Mono Zygosity	Di Zygosity	Total
Male	X	35.60	37.74	37.06
	SD	25.46	25.80	25.63
	N	53	115	168
Female	X	42.65	45.32	44.25
	SD	26.92	25.36	25.96
	N	76	115	191
Total	X	39.75	41.53	40.89
	SD	26.46	25.81	26.02
	N	129	230	359

Factor	MS	df	F
Sex (S) (eliminating zygosity (Z)	4844.14	1	7.25**
Z (eliminating S)	487.12	1	.73
S x Z Interaction	5.47	1	.01
Residual	668.36	355	

** p .01

TABLE 17

Comprehensive Test Of Basic Skills (Mathematics)
Scores For Different Sex And Zygosity Groups

ZYGOSITY

Sex		Mono Zygosity	Di Zygosity	Total
Male	X	28.16	36.13	33.77
	SD	26.89	28.33	28.05
	N	40	95	135
Female	X	38.67	37.83	38.12
	SD	28.03	27.07	27.32
	N	54	103	157
Total	X	34.20	37.01	36.11
	SD	27.90	27.62	27.69
	N	94	198	292

Factor	MS	df	F
Sex (S) (eliminating zygosity (Z)	1462.27	1	1.91
Z (eliminating S)	595.75	1	.78
S x Z Interaction	1217.10	1	1.59
Residual	763.93	288	

presents the results of the analysis for the Comprehensive Test of Basic Skills (Mathematics) scores by sex and zygosity. There were no significant effects though female twins often tended to have higher scores than male twins. Table 18 presents the results for the analysis for the Comprehensive Test of Basic Skills composite scores by sex and zygosity. There was a significant main effect for sex with females again having higher scores than males.

Ability Test

Table 19 presents the results of the analysis of the combined ability test scores by sex and zygosity. There was no significant main effect for sex. However, monozygotic twins of either sex tended to have significantly higher scores than did dizygotic twins and the interaction was also significant.

Analysis by Ethnicity and Zygosity

Cooperative Primary Reading Test

Table 20 presents the results of the analysis of the Cooperative Primary Reading Test scores by ethnicity and zygosity. There was a significant main effect for ethhnicity with white twins having higher scores than Spanish-surname twins who had higher scores than the black twins. Zygosity did not have a significant effect and the interaction was not significant.

Comprehensive Test of Basic Skills

Table 21 presents the results of the Comprehensive Test of Basic Skills (Reading) scores by ethnicity and zygosity. Again there was a significant main effect for ethnicity with white twins having higher scores than Spanish-surname twins who

TABLE 18

Analysis Of Comprehensive Test Of Basic Skills
Composite Scores For Sex And Zygosity

Sex		ZYGOSITY Mono Zygosity	Di Zygosity	Total
Male	X	32.95	37.73	36.22
	SD	25.20	25.49	25.43
	N	57	123	180
Female	X	43.44	43.59	43.53
	SD	26.50	25.47	25.82
	N	84	130	214
Total	X	39.20	40.74	40.19
	SD	26.40	25.60	25.86
	N	141	253	394

Factor	MS	df	F
Sex (S) (eliminating zygosity (Z)	5435.35	1	8.26**
Z (eliminating S)	416.98	1	.63
S x Z Interaction	472.96	1	.72
Residual	658.45	390	

** p .01

TABLE 19

Analysis Of Ability Composite Scores For Sex And Zygosity

ZYGOSITY

Sex		Mono Zygosity	Di Zygosity	Total
Male	X	111.62	98.04	102.38
	SD	22.26	19.01	21.03
	N	56	119	175
Female	X	105.43	103.52	104.15
	SD	22.32	22.36	22.30
	N	57	116	173
Total	X	108.50	100.74	103.26
	SD	22.41	20.87	21.65
	N	113	235	348

Factor	MS	df	F
Sex (S) (eliminating zygosity (Z)	249.08	1	.55
Z (eliminating S)	4568.23	1	10.12**
S x Z Interaction	2602.36	1	5.77*
Residual	451.35	344	

* p .05
** p .01

TABLE 20

Analysis Of Cooperative Primary Reading Test Scores
For Different Ethnic And Zygosity Groups

ETHNICITY

Zygosity		Black	Spanish-surname	White	Total
Mono	X	31.52	38.64	53.45	43.04
	SD	22.13	25.04	26.10	26.48
	N	124	71	167	362
Di	X	32.86	35.81	53.24	42.16
	SD	20.53	25.06	25.34	25.43
	N	285	137	318	740
Total	X	32.45	36.78	53.31	42.45
	SD	21.01	25.03	25.58	25.77
	N	409	208	485	1102

Factor	MS	df	F
Ethnicity (E) (eliminating zygosity (Z)	52307.70	2	91.60***
Z eliminating E	6.48	1	.01
E x Z Interaction	264.22	2	.46
Residual	571.06	1096	

*** p .001

TABLE 21

Comprehensive Test Of Basic Skills (Reading) Scores
For Different Ethnic And Zygosity Groups

ETHNICITY

Zygosity		Black	Spanish surname	White	Total
Mono	X	25.55	36.07	52.06	39.75
	SD	19.92	22.15	25.93	26.46
	N	35	30	64	129
Di	X	25.47	33.40	54.12	41.53
	SD	21.18	21.53	23.23	25.80
	N	70	43	117	230
Total	X	25.50	32.03	53.39	40.89
	SD	20.67	21.70	24.17	26.02
	N	105	73	181	359

Factor	MS	df	F
Ethnicity (E) eliminating zygosity (Z)	29444.17	2	56.77***
Z eliminating E	246.87	1	.48
E x Z Interaction	63.70	2	.12
Residual	518.70	353	

*** p < .001

had higher scores than the black twins. Neither zygosity nor the interaction was significant. Table 22 presents the results of the analysis of the Comprehensive Test of Basic Skills (Mathematics) scores by ethnicity and zygosity. Again there was a significant main effect for ethnicity with white twins having higher scores than Spanish-surname twins who have higher scores than black twins. Neither the interaction nor the effect of zygosity was significant. Table 23 presents the results for the analysis of the Comprehensive Test of Basic Skills composite score by ethnicity and zygosity. Again there was a significant main effect for ethnicity with white twins having higher scores than Spanish-surname twins who had higher scores than black twins. Again the interaction and the effect of zygosity were not significant.

Ability Test

Table 24 presents the results of the analysis for ability test scores by ethnicity and zygosity. Again ethnicity had a significant effect with white twins having higher scores than did Spanish-surname twins who in turn had higher scores than black twins. In each ethnic group monozygotic twins had higher scores than dizygotic twins.

Heritability Ratios

Tables 25-27 present the results of the analysis of heritability ratios by socioeconomic status and ethnicity. In examining Table 25, heritability ratios for the Cooperative Primary Reading Test h^2 varies from a low of .03 in the lower

TABLE 22

Comprehensive Test Of Basic Skills (Mathematics)
Scores For Different Ethnic And Zygosity Groups

ETHNICITY

Zygosity		Black	Spanish-surname	White	Total
Mono	X	18.00	29.64	53.51	34.20
	SD	18.65	23.25	27.31	27.90
	N	35	24	35	94
Di	X	22.49	32.65	52.34	37.01
	SD	21.44	25.43	26.07	27.62
	N	70	48	80	198
Total	X	20.99	31.65	52.70	36.11
	SD	20.58	24.60	26.34	27.69
	N	105	72	115	292

Factor	MS	df	F
Ethnicity (E) eliminating zygosity (Z)	28409.70	2	49.10***
Z eliminating E	242.48	1	.42
E x Z Interaction	202.53	2	.35
Residual	578.55	286	

*** p .001

TABLE 23

Analysis Of Comprehensive Test Of Basic Skills Composite Scores For Different Ethnic And Zygosity Groups

ETHNICITY

Zygosity		Black	Spanish-surname	White	Total
Mono	X	22.62	30.19	52.24	39.20
	SD	20.08	20.93	25.02	26.40
	N	39	31	71	141
Di	X	23.56	35.96	53.42	40.74
	SD	19.10	24.04	22.82	25.60
	N	77	52	124	253
Total	X	23.24	33.80	52.99	40.19
	SD	19.35	22.97	23.59	25.86
	N	116	83	195	394

Factor	MS	df	F
Ethnicity (E) eliminating zygosity (Z)	34420.72	2	69.01***
Z eliminating E	396.15	1	.79
E x Z Interaction	167.41	2	.34
Residual	498.78	388	

*** p .001

TABLE 24

Analysis Of Ability Test Scores For Different Ethnic And Zygosity Groups

Zygosity		ETHNICITY Black	Spanish-surname	White	Total
Mono	X	94.19	102.48	116.26	108.50
	SD	19.83	27.24	18.02	22.41
	N	26	22	65	113
Di	X	87.25	92.29	110.13	100.74
	SD	17.20	16.71	18.84	20.87
	N	66	39	130	235
Total	X	89.21	95.96	112.18	103.26
	SD	18.14	21.47	18.74	21.65
	N	92	61	195	348

Factor	MS	df	F
Ethnicity (E) eliminating zygosity (Z)	18062.86	2	50.71***
Z eliminating E	3812.14	1	10.70***
E x Z Interaction	87.81	2	.25
Residual	356.19	342	

*** p .001

TABLE 25

Heritability Ratios For The Cooperative Primary Reading Test For Different Ethnic And Socioeconomic Status Groups

Ethnicity	Monozygotic		Dizygotic				Vandenbu
Ethnicity	No. of Prs	r_{mz}	No. of Prs	r_{dz}	h^2r	h^2s	F
Black							
Upper Middle SES	29	.52	54	.37	.24	.31	1.45
Lower SES	33	.35	85	.33	.03	-.45	.69
Total	62	.43	139	.36	.11	-.06	.94
Spanish Surname							
Upper Middle SES	17	.91	27	.53*	.81	.78	4.55****
Lower SES	18	.81	41	.62	.50	.59	2.44**
Total	35	.87	68	.59*	.68	.70	3.33***
White							
Upper Middle SES	77	.75	139	.57*	.42	.35	1.54**
Lower SES	6	-.11	18	.05		.75	4.0
Total	83	.75	157	.55*	.44	.42	1.72***

* The difference between r_{imz} and r_{idz} was significant.
** Significant at the .05 level.
*** Significant at the .02 level.
**** Significant at the .01 level.

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TABLE 26

Heritability Ratios For The Comprehensive Test Of Basic Skills Composite Scores For Different Ethnic And Socioeconomic Status Groups

Ethnicity	Monozygotic		Dizygotic				
Ethnicity	No. of Prs	r_{mz}	No. of Prs	r_{dz}	h^2r	h^2s	
Black							
Upper Middle SES	10	.86	12	.24*	.82	.71	5.
Lower SES	8	.89	23	.77	.52	.28	2.
Total	18	.85	35	.63	.59	.53	2.
Spanish Surname							
Upper Middle SES	6	.72	11	.88		-.32	
Lower SES	9	.96	14	.87	.69	.75	3.
Total	15	.90	25	.87	.23	.38	1.
White							
Upper Middle SES	32	.82	55	.60*	.55	.49	2.
Lower SES	2	1.00	4	.74	1.00	-5.76	
Total	34	.77	59	.60	.42	.31	1.

* The difference between r_{imz} and r_{idz} was significant.

TABLE 27

Heritability Ratios For The Ability Test Scores By Ethnicity And Socioeconomic Status

Ethnicity	Monozygotic		Dizygotic				
Ethnicity	No. of Prs	r_{mz}	No. of Prs	r_{dz}	h^2r	h^2s	F
Black							
Upper Middle SES	6	.97	7	.67*	.91	.43	1.
Lower SES	4	.92	11	.92	0	.65	2.
Total	10	.96	18	.87	.69	.58	2.
Spanish Surname							
Upper Middle SES	6	.91	6	.75	.64	-.61	.
Lower SES	2	1.00	7	.81	1.0	.90	10.
Total	8	.93	13	.83	.59	-.66	.
White							
Upper Middle SES	30	.80	47	.69	.35	.19	1.
Lower SES	1		5	-.49			
Total	31	.80	52	.71	.31	.19	1.

* The difference between r_{dz} and r_{mz} was significant.

socioeconomic status black group to a high of .81 in the upper-middle Spanish-surname group. For the Spanish-surname group and the white group there is a significant Vandenberg F. Note that for the lower socioeconomic status white twins the correlation for the dizygotic twins was higher than that for the monozygotic twins, thus making a heritability ratio meaningless.

Heritability ratios on the Comprehensive Test of Basic Skills composite scores (See Table 26) also have a wide range, from a low of .52 for the lower socioeconomic status black group to a high of 1.0 for the lower socioeconomic status white group. (The later score is not a meaningful one since there were only two sets of monozygotic twins in the group). Scores for the upper-middle Spanish-surname dizygotic twins were higher than those for the monozygotic twins thus making a computation of h^2 meaningless.

Heritability ratios for the ability tests were presented on Table 27. They vary from a low of zero in the lower socio-economic status black group to a high of 1.0 in the lower socioeconomic Spanish-surname group. (The later score is not a meaningful one since there were only two sets of twins in the monozygotic group). It was impossible to compute an h^2 for the lower socioeconomic status white group since there was only one set of twins in this group. Note however, that for most of the groups h^2 was considerably below the .80 factor cited in many studies.

Table 28 presents an analysis of heritability for the

TABLE 28

Heritability Ratios For The Three Groups Of Tests
By Socioeconomic Status

Socioeconomic Status	Monozygotic		Dizygotic				Vandenberg
Cooperative Primary Reading Test	No. of Prs	r_{mz}	No. of Prs	r_{dz}	h^2r	h^2s	F
Upper	38	.73	77	.41*	.54	.36	1.56
Middle	91	.76	160	.61*	.38	.40	1.67***
Lower	58	.47	149	.42	.09	.07	1.08
(Combination) (Upper Middle)	(129)	.76	(237)	.60*	.40	.39	1.64****
CPAT Overall	187	.73	386	.59	.34	.29	1.41***
Comprehensive Test Of Basic Skills							
Upper	11	.86	25	.38*	.77	.74	3.85
Middle	38	.84	57	.74	.38	.39	1.64
Lower	19	.80	43	.79	.05	.06	1.06
(Combination) (Upper Middle)	49	.87	82	.69*	.58	.51	2.04
CTBS Overall	68	.87	125	.75	.48	.41	1.69
Ability Test							
Upper	21	.75	28	.77	---	.28	1.4
Middle	23	.89	36	.79	.48	.25	1.34
Lower	7	.81	24	.73	.30	.43	1.75
(Combined) (Upper Middle)	44	.86	64	.78	.36	.26	1.36
Ability Overall	51	.87	88	.81	.32	.30	1.43

* The difference between r_{dz} and r_{mz} were significant.
** .01
*** .005

three groups of tests by socioeconomic status when combining all ethnic groups. Because of the larger N it was possible to look at both upper and middle groups in this analysis. For all of the tests the h^2 ratios are considerably lower than would be expected and the overall h^2 for the ability tests is considerably below that usually cited in the literature.

In examining the correlation for the same sex and opposite sex dizygotic twins for the Cooperative Primary Reading Test, the same sex dizygotic twins have scores correlating .65 (N=203) while opposite sex twins have scores correlating .52 (N=103). The same pattern is found for the Comprehensive Test of Basic Skills with same-sex dizygotic twins having scores correlating at .79 (N=73) and opposite sex dizygotic twins having scores correlating at .69 (N=52). For ability tests the pattern is again found with same sex dizygotic twins having an r of .85 (N=45) and opposite sex dizygotic twins having an r of .75 (N=43).

CHAPTER IV
Discussion

There has been general consensus that the Los Angeles Basin represents a socially mobile group and there is every reason to believe that this geographical area has less overt and institutionalized prejudice than do many other areas of the country. It is therefore particularly distressing to find the disproportionate number of minority group twins in the lower socioeconomic status groups and to find so very few minority twins in the upper socioeconomic status group. In contrast there were very few white twins in the lower socioeconomic status group. It still appears if one wishes to be in the upper socioeconomic status group one had better pick white parents.

Analysis by Ethnicity and Socioeconomic Status

In examined scores for the three sets of tests we find that for every one of the tests there were significant main effects for ethnicity with white twins consistantly scoring higher than Spanish-surnamed twins who in turn scored higher than black twins. This was true for all of the measures (The two achievement measures and the ability measure). It is also important to note that for all of the white upper middle class group the scores tended to fall below the 50% the one would expect on the achievement tests.

In examining the analysis of the Cooperative Primary Reading Test for ethnicity and socioeconomic status the ranking

of the groups is quite clear with the ordering being the upper middle class white group scoring higher than the Spanish-surname middle class group, and the Spanish-surname middle class group scoring higher than the black middle class group. This group had scores about as high as the white lower class group who score higher than the Spanish-surname group who in turn scored higher than the black group. The differences between the upper middle class (mean 49.01) and the lower socioeconomic class (mean 31.47) is quite large. The difference between the average performance of the black group of twins and the Spanish-surnamed was not great; however, the difference between the white twins and the other two minority groups continued to be high. The Achievement Test data differed in no respect from any data that had been presented before and it tends to reflect the general pattern that has been presented in the literature with socioeconomic status having a great impact on performance scores as does ethnic membership.

When we examine the scores for the Comprehensive Test of Basic Skills there was a difference in the pattern for the mathematics and combined Comprehensive Test of Basic Skills scores. Again the entire group tended to score somewhat below what would be expected (average 50%). We find that for the reading portion of this test, both ethnicity and socioeconomic status were significant main effects and again the white twins tended to out-perform the Spanish-surnamed twins who in turn out-perform the black twins. However, when we look at the

difference across socioeconomic status and ethnicity we see that the white lower class twins had scores which, on the average, were higher than those of the Spanish-surname upper class and the black upper middle class group.

On the test the differences between the ethnic groups were again quite large as were the differences between the socioeconomic status groups. Again the reading tests reflect the standard pattern that has been presented in the literature. Socioeconomic status had a great influence upon scores and the white group out-performed the black group.

Mathematic scores and composite score for the Comprehensive Test of Basic Skills revealed a somewhat different pattern. Again ethnicity had a significant main effect with white twins out-performing black twins. However, the white lower class twins scored above the black upper class twins on the mathematics score. The discrepancy between the black upper middle group and lower group is in the favor of the lower socioeconomic status group, although the difference was quite small and not significant. In examining the analysis for the composite scores of the Comprehensive Test of Basic Skills again there was a significant ethnic main effect with the white twins scoring higher than the Spanish-surname twins and the white lower socioeconomic class twins scoring higher than the upper middle black group. Again the black lower socioeconomic status twins had somewhat higher score than those of the black upper middle socioeconomic status group and again this difference was not significant.

In examining Table 9, the analysis of the ability (composite) scores for all the different ethnic and socioeconomic status groups we again find the same pattern. The white twins scored higher than did the Spanish-surname twins who scored higher than the black twins within each socioeconomic status group with the order being white upper middle class, Spanish-surname upper middle class, black upper middle class, white lower class, Spanish-surname lower class, black lower class. The differences on the ability tests tended to be much smaller both between the ethnicity group and socioeconomic status group. Thus the pattern revealed by analysis of all of the three groups of tests is the same that has been reported in the literature with strong effects for both ethnic membership and socioeconomic status.

Socioeconomic Status and Zygosity

For all of the achievement tests there was a strong effect for socioeconomic status and no effect for zygosity. Monozygotic twins and dizygotic twins did not vary in any systematic way on the achievement tests. There was however, the now familar socioeconomic status group difference with the upper class performing higher than the middle socioeconomic status class which performed higher than the lower socioeconomic status group.

When we examine the scores on the ability test the pattern was somewhat different. Again socioeconomic status had a main effect with the upper group out-performing the middle group out-performing the lower group. However, for each of the socioeconomic status groups the monozygotic twins tended to score higher on the intelligence test than did the dizygotic

twins. This difference being particularly apparent in the upper socioeconomic status group where the mean for the monozygotic twins was 123.95 and the mean for the dizygotic twins was 113.12. (This difference is significant at the .05 level). There is as far as I know, no theoretical rational in the literature to explain the observed difference.

Sex and Zygosity

Analysis of the scores by sex and zygosity revealed an interesting pattern with sex being a significant main effect for all of the achievement scores (except the mathematic tests) with females having higher scores than males. For the ability tests the pattern was somewhat reversed as there was no significant sex difference with males and females having approximately the same score. There was however, a significant effect for zygosity with monozygotic twins having significantly higher scores than dizygotic twins.

The analysis of the scores by ethnicity and zygosity revealed a significant main effect for ethnicity for all of the achievement tests and no significant effect for zygosity. On the Cooperative Primary Reading Test the white twins (monozygotic and dizygotic) had higher scores than did the Spanish-surname twins who in turn had higher scores than the black twins. The same pattern was found in the Comprehensive Test of Basic Skills scores with the white monozygotic and dizygotic twins having higher scores than the Spanish-surname twins who in turn had higher scores than the black twins.

Heritability

It is interesting to note that out of the eighteen possible heritability ratios we were able to compute only fifteen. In two cases the correlations for the dizygotic twins were higher than those for the monozygotic twins thus making an interpretation of a heritability co-efficiently meaningless. (See Table 28). In one case,(the lower socioeconomic status white group) there was only one set of monozygotic twins thus making any comparison impossible. In addition, there were two cases in which there were only two sets of twins in one of the groups (white lower socioeconomic status group) thus making the comparisons meaningless. We were therefore left with fifteen comparisons, four of them on the ability tests. In general the variation in h^2 was quite large. For the achievement tests heritability ratios vary from a .03 to a high of .82 for the black group on the Comprehensive Test of Basic Skills. Both the highest and lowest heritability ratios were found within the black group. (The .03 on the Cooperative Primary Reading Test the lower socioeconomic status black group and the .82 on the Comprehensive Test of Basic Skills found for the upper middle calss black group). This sample thus does not show the restriction of variance that has characterized other studies, having a wide variety of heritability ratios. On the ability tests the black group tended to show the highest heritability ratio for the upper middle group and the lowest for the lower group. The number of twins involved in each of these samples was quite low and therefore these results must be looked at with some caution. The heritability

A repeated measures analysis of variance was done for each of the cases where twins had received forms 1 and 2 of the same test. The resulting sample was quite small (about 5%) and may therefore not be representative of the population. The results of these analyses are presented in Table 29. Overall gains in mean scores are indicated as positive mean differences and losses are indicated as negative mean differences. There was no significant increase or decrease for any of the tests and in some cases gains had been made.

Bearing in mind the possible nonrepresentativeness of the sample, the results are interesting in view of the cumulative deficit hypothesis. For the small number of Black twins for whom repeated test scores were available there were decreases in scores (on the average) from test time one to test time two for the CPRT 12A, the CTBS Q Reading, the CTBS Q Math, and the CTBS R Read. However there were increases in scores on the average from time one to time two for the CPRT 23A at the CTBS R-Math tests. None of these changes were significant though the numbers involved were sometimes small. If there is a cumulative deficit effect that occurs, the effect was not demonstrated by the twins in this sample over a one year school period.

TABLE 29

Repeated Measures Analysis of Variance

Test Form	CPRT								CTBS			
	12A		23A		B-Read		Q-Math		R-Read		R-Math	
	Mean Diff	N	Mean Diff	N	Mean Diff	N	Mean Diff	N	Mean Diff	N	Mean Diff	N
Total Population	9.37	38	9.53	17	-5.63	30	-4.17	23	-4.34	73	-1.76	59
By SES												
Upper Middle	12.58	19	12.0	11	.25	12	-1.00	5	-.79	19	-3.57	14
20W SES	6.16	19	5.0	6	-9.56	18	-5.06	18	-5.59	54	-1.20	45
By Ethnic Membership												
Black	-12.17	6	3.12	8	-7.64	14	-7.00	11	-4.55	38	.94	34
Spanish Surname	15.82	11	8.0	1	-4.10	10	-1.44	9	-3.52	27	-6.43	21
White	9.75	20	16.12	8	-3.50	14	-10.00	1	-7.25	4	2.00	2
Zygosity												
Mono	20.64	14	-10.00	5	-2.22	9	1.66	6	-4.30	24	-4.48	21
Dizygotic	2.79	24	17.67	12	-7.10	21	-6.24	17	-4.33	49	-.26	30

ratios for socioeconomic status also tended to vary considerably with a low .05 to a high of .77. For the ability test, heritability ratios computed were considerably lower than those previously reported in literature and also tended to vary considerably. It is particularly important to note that this variability in the heritability ratios does not co-exist with a restricted range of variance that has been given as an explanation in many previous studies.

Univariet analysis for 149 twins for whom we have complete data was done. Significant main effect for ethnicity (eliminating socioeconomic status was found). On the ability test the interaction was also significant.

Conclusions

In general terms, what is meaningful about the results of this study? The study confirmed that extrapolating from heritability scores for one population to heritability scores for another population is an extremely risky business. As you will note from the various tests, heritability ratios varied with the tests used (note the differences both between the achievement tests and within the achievement test battery, the ability tests for each of the groups). The general difference of ten to fifteen points for the intelligence scores that has been reported between the black and white population seems in this study, to be as ascribable to socioeconomic status factor as to ethnic membership. The number of minority group members in the lower socioeconomic status group would tend to bias the

observed difference in favor of white groups.

In an interesting article in Science, (1977) Harrington pointed out that intelligence tests may be biased in favor of the majority groups in the population and he concluded there is a test bias which is inversely proportional to the groups representation in the base population. Since minority groups were included, but did not form an equal proportion of the population tested in norming ability tests, the observed differences in scores may be due to this systematic type of bias. On the basis of this tudy, one can see it is dangerous to extrapolate from an overall population statistic of .80 heritability (for the white middle class group) to any other ethnic group or socioeconomic status group. Even the white middle class group in this study did not tend to show the same high level of heritability that has been cited in other studies (having a high heritability .35). Also note that the number of white twins was numerous, monozygotic twin pairs numbering thirty and dizygotic twin pairs numbering forty seven.

In a study of cross racially adopted children in the Minnesota area Scarr (1976) found black children adopted into white middle calss home, tended to have intelligence quotient scores up to ten points higher than would be predicted on the basis of their own natural parent ethnic and socioeconomic status group. These children thus, were closer to the white average than to the black average and Scarr concluded that black children have not been adequately tested on the skills in

their areas of knowledge and that the black population may have a suppressive environment in relationship to school tests and intelligence quotient scores.

It should be noted that knowing a persons ethnic membership reduces your error in estimation of their intelligence quotient score by only 6%. This shows the inappropriateness of attempting to apply population statistics to an individual. Heritability ratios show only the phenotypic estimate of intelligence and not the underlying genetic ability for intelligence. It is erroneous to assume that even if h^2 was 1.0, there would be no environmental effect. As an example, consider the situation cited by Lesser (1976). Mark Twain had said boys under twelve should be raised in a barrel and fed through a bunghole on the side. One could easily imagine such a group of boys who would have the genetic variation of intelligence along the continuum of 40 to 100 intelligent quotient points. However, being raised in this restricted environment with little stimulation, it is easy to see that the scores for all the boys would be clustered at the lower end of the ability continuum and show a phenotypic score of approximately 40. Since there would be little variation among the scores due to environmental input, it would be erroneously concluded that environment had no effect upon the scores. This was obviously false since it was the environment which produced this extreme effect. The effect was so uniform and suppressive that it reduced all variability.

What then is the purpose of doing studies on heritability

of intellectual traits in the human population? To quote Scarr, (1977), one purpose is to gain a fuller understanding of human behavior; second purpose is to give us diagnostic clues and a respect for individual differences; a third is to examine implications for intervention systems with environmental implications, rather than laying a guilt trip upon lower socio-economic status families as to a lack of environmental stimulation or repressive environment. Emphasis should shift to more specific effects such as the effects of child abuse, hunger, number of siblings, etc., and it is important to determine which aspects of these are important. Recent work by Zajonc (1976) would indicate that the number of prior siblings in the family has has a direct influence upon the intelligence scores of children in that family, so that in large families intelligent quotient scores tend to be somewhat lower than in smaller families. Populations within the lower socioeconomic class tend to have higher numbers of siblings than do those in the upper and middle socioeconomic class.

Criticisms of the Study

Despite the high promise of the area, data were collected on comparably few sets of twins - a total of 1,248 twins. Data were not complete for all of these twins for each of the tests. A more comprehensive study would have entailed examining the junior high school and high school population for whom there is a considerably greater body of information available. The Los Angeles Unified School District testing programs has

mandated recommended scholastic appitude tests in 6th, 7th, and 10th grades. In 1970-3 the Lorge-Thorndike was administered to grades 6 and 12 in most of the school districts. Therefore, academic records for the children in the 1979 school year would contain more data on ability tests as well as on achievement tests.

Another criticism that could be leveled at this study was use of zygosity as determined by parental information or the Nichols' scale. If zygosity had been determined by other than blood smaples it would be advisable to offer this service to parents in any future study. An additional recommendation would be that parents be contacted initially requesting their permission to utilize scores for their children annonymously. Despite the small number of Oriental, American Indian, and other twins found in this sample, a larger sample reflecting the total school population might contain an adequate number of these twins to permit analysis. On the plus side, this study is one of the few that makes a comparison between groups other than black-white groups and it contains data for both achievement and ability tests.

The study could and should be continued. Data from the Stockton area should be analyzed. A repeated measure analysis of variances for the CPRT is in progress and will become an addendum to this report.[9]

The results of the study vary strikingly from previous studies of heritability but confirm the often reported ethnic

and socioeconomic class difference in achievement and ability scores. The later finding, tends to lend support to the validity of the former finding that heritability varies for each population according to the measure used.

(1) Preparation of this research for this paper was supported by a grant from the Spencer Foundation.

(2) The authors are grateful to the members of the Los Angeles City School Board (Dr. Julian Nava, Dr. Robert Docter, Dr. Donald Newman, Dr. J.C. Chambers, Dr. Georgia Hardy, Mr. Richard Ferrero) for allowing the study. Dr. William Johnston, Superintendant of Schools and Mr. James Tayler were most helpful in contacting the board.

(3) Our thanks to Dr. William Carey, Superintendant of Schools in Stockton and Ms. Joanne Miller for their aid.

(4) Mr. Frank Jost and Dr. Robert Sallander were of great help in this area.

(5) The use of a computer generated list of children having the same last name, birthdate, and home address has been discussed. However, this information was not currently available in the district office.

(6) This statement was not quite accurate. The black and white twin groups were proportional to the number of persons of these groups in the district. However, Oriental and Mexican American groups were under-represented in the twin sample, probably due to the lower rate of twining in these populations.

(7) Statement about the zygosity of twin sets was supplied by the schools when it was a part of their record. In other cases, a questionaire method of determining zygosity was used either by twin parents or by the school personnel to determine zygosity. The questionaire which concerned physical similarity, was developed by Nichols and Brobro (1966) and they reported that about 95% of all cases can be diagnosed by their rules with greater than 90% accuracy. (See Appendix C for copy of the questionaire).

(8) Stockton data was collected but has not been analyzed due to some problems in programing.

(9) A repeated measure analysis of variance has been completed and will be appended.

BIBLIOGRAPHY

Adams, B., Ghodesian, M., & Richardson, K. Evidence for a low upper limit of heritability of mental test performance on a national sample of twins. Nature 1976, Vol. 263, pages 314-6.

Berry, J.W., Psychological research in the north. Anthropolgica 1971, Vol. 13, pages 143-157.

Burt, Cyril, The genetic determination of differences in intelligence. A study of monozygotic twins reared together & apart. British Journal of Psychology, 1966, Vol. 57, pages 137-153.

Dawes, R.M. I.Q. Methodology and other issues. Science, 1972, Vol. 178, pages 229-230.

Dennis, Wayne. The performance of Hopi children on the Goodenough Draw-A-Man Test. Psychological Reports, 1942, pages 341-349.

Erlenmeyer-Kimling, L. & Jarrich, L. Genetics and intelligence; a review, Science, 1963, Vol. 142, pages 1477-1479.

Fitzgerald, J.A., & Ludeman, W. The intelligence of Indian children. Journal of Comparative Psychology, 1926, Vol. 6, pages 319-328.

Garth, T.A. Race Psychology: A study of racial mental difference, N.Y., Whittlesey-House, McGraw-Hill, 1931.

Harrington, G.M. Intelligence tests may favor the majority group in a population. Nature, 1975, Vol. 258, pages 707-708.

Jensen, A.R. How much can we boost I.Q. and scholastic achievement? Harvard Education Review, 1969, Vol. 39, pages 1-123.

Jensen, A.R. I.Q.'s of identical twins reared apart. Behavior Genetics, 1970, Vol 1, pages 133-148.

Jensen, A.R. How biased are culture-loaded tests? Genetic Psychology Monographs, 1974, Vol. 90, pages 185-244.

Lesser, G.F., Fifer, G. & Clark, D. Mental abilities of children from different social-class and cultural group. Monographs of the Society for Research in Child Development 1965, Vol. 30, #4.

Loehlin, J.C., Lindzey, G., & Spuhler, J.N. Race differences in intelligence, San Francisco, W.H. Freeman & Co., 1975.

Maccoby, E. and Jacklin, C. The psychology of sex differences. Stanford, Ca. Stanford U. press, 1974

Newman, H.H., Freeman, F.N., & Holzinger, K.J. Twins: A study of heredity and environment. Chicago, U. of Chicago Press, 1937.

Nichols, R.C., & Bilbro, W.C. Jr. The diagnosis of twin zygosity. Acta Genet. Basel. 1966, Vol. 16, pages 265-275.

Pasehal, F.C., & Sullivan, E. Racial influences in the mental and physical development of Mexican children. Baltimore, Williams & Williams, 1925.

Scarr-Salapatek, S. Review of environment, heredity, and intelligence; H.J. Eysenck, The I.Q. Argument; and R. Herrenstein, I.Q. Science, 1971, Vol. 174, pages 1223-1221.

Scarr-Salapatek, S. Race, Social Class, & I.Q. Science, 1971, Vol. 179, pages 1285-1295.

Scarr, S. I.Q. Test performance of black children adopted by white families, American Psychologist, 1976, Vol. 31, pages 726-739.

Schwartz, M. & Schwartz, J. Evidence against a genetical component to performance on I.Q. tests. Nature, 1974, Vol. 248, pages 84-85.

Schwartz, M. & Schwartz, J. No evidence for heritability of social attitudes. Nature, 1975, Vol. 255, page 429.

Tizard, B. I.Q. and Race. Nature, 1974, Vol. 247, page 316.

Tomlinson, H. Differences between pre-school negro children and their older siblings on the Stanford-Binet scales. Journal of Negro Education, 1944, Vol. 13, pages 474-479.

Vandenberg, S.G. Contributions of twin research to psychology. Psychological Bulletin, 1966, Vol. 66, pages 327-352.

Zajonc, R.B. Family configurations and intelligence: Variation in scholastic apptitude scores parallel trends in family size and the spacing of children. Science, 1976, Vol. 192, pages 227-239.

APPENDIX A

Letter To The Principals
In Regard To Participation On The Study

CALIFORNIA STATE UNIVERSITY • LOS ANGELES

5151 STATE UNIVERSITY DRIVE, LOS ANGELES, CALIFORNIA 90032

TO: Administrators of Elementary Schools March 5, 1975

FROM: Dr. Patricia M. Hodges, Professor
Department of Psychology

SUBJECT: STUDY OF TWINS SPONSORED BY THE SPENCER FOUNDATION

The Los Angeles Unified School District has been asked to participate in a study of all twins (identical and fraternal) enrolled in the 436 elementary schools in grades 2 to 6. This study has been approved by the District Committee on Research Studies; and the Board of Education has taken action which will permit the school district to accept a portion of a grant from the Spencer Foundation supporting this research. As in all research studies of this nature, school participation is voluntary. All schools and participants are anonymous.

The purpose of this study is to investigate the relationship between heritability and environment as they relate to intelligence. Currently, some major figures in the area have stated that the greater portion of intelligence is determined by genetic factors (80%) and that environmental factors have much less influence (20%). Recent work has led us to conclude that this figure underestimates the influence of the environment.

This study is a replication of the Scarr-Salapatek study conducted in the Philadelphia public schools. The Scarr-Salapatek study was the only one which has produced evidence to contrast with the research of Arthur Jensen (University of California, Berkeley) and William Shockley (Stanford University). This proposed study has major significance to the research community in that no twin data have been reported for some of the populations that will be studied.

Pupil information will be gathered from each pupil's cumulative record using a form which will be provided by the researchers. Principals may wish to have only the school's clerical staff search the records for the data. This data is to be collected anonymously, and thus each individual child is protected. The Spencer Foundation is prepared to reimburse the school clerical staff on an overtime basis for time spent in obtaining this data. Necessary materials for this study are scheduled to arrive in the schools the week of March 31, 1975.

Your participation is entirely voluntary. We hope that you will consider the subject matter of sufficient importance to warrant your support and active participation. Questions regarding this twin study should be directed to Dr. Patricia Hodges, 224-3841.

Please return the enclosed form in the pre-addressed envelope by MONDAY, MARCH 17, 1975.

CALIFORNIA STATE UNIVERSITY • LOS ANGELES

5151 STATE UNIVERSITY DRIVE LOS ANGELES CALIFORNIA 90032

TO: Administrators of Elementary Schools

FROM: Dr. Patricia M. Hodges
Department of Psychology

SUBJECT: ~~STUDY~~ OF TWINS ~~SPONSORED~~ BY THE SPENCER FOUNDATION

[ ] I will participate in this study.

[ ] There are no twins enrolled in this school.

[ ] I do not wish to participate in this study.

[ ] Check here if you need additional information prior to making a decision.

If you are participating in this study, please indicate how many sets of twins are enrolled in your school.

_____ sets of twins

Principal's Signature _____

Date _____

School _____ Area _____

APPENDIX B

Data Collection Forms

IMPORTANT: READ FIRST

PLEASE FILL IN THE DATA SHEETS AS ACGURATELY AS POSSIBLE. USE THE LETTER "I" TO INDICATE IDENTICAL TWINS AND THE LETTER "N" TO INDICATE NON-IDENTICAL TWINS. IF THE CUMULATIVE RECORDS FOR A TWIN SET DO NOT HAVE A DECLARATION OF ZYGOSITY (IDENTICAL OR NON-IDENTICAL TWINS) USE A "?" -- USE THE LETTER "M" TO INDICATE A MALE TWIN AND THE LETTER "F" TO INDICATE A FEMALE TWIN.

USE THE FOLLOWING CODE TO INDICATE ETHNICITY:

(1) AMERICAN INDIAN
(2) BLACK
(3) ORIENTAL
(4) SPANISH SURNAME
(5) FILIPINO & OTHER MINORITIES
(6) WHITE (OTHER THAN SPANISH SURNAME)

PLEASE LIST TWIN SETS STARTING WITH LOWEST GRADE FIRST. TEST DATES ARE LISTED IN A MOST RECENT TO MOST DISTANT ORDER. THUS FOR YOUNGER PUPILS IT WILL BE NECESSARY TO USE ONLY THE FIRST SHEETS. PLEASE GIVE RAW SCORES NOT PERCENTILES FOR ALL TESTS.

> For example: Data recorded in the cummulatiye file for the Cooperative Primary Reading Test in 1973 for a student would read: 23ARS13. This means Form 23A, Reading Score 13. The 13 would be recorded on the Data Sheet under 1973 Group Test Reading.

INDIVIDUAL INTELLIGENCE TEST SCORES SHOULD BE ENTERED ON THE LAST PAGE. IF THE TWINS HAVE BEEN TESTED MANY TIMES, ENTER THESE DATA ON THE REVERSE SIDE AND GIVE THE NAME OF THE TEST AND THE SCORES.

THE PRINCIPAL MUST CHECK ONE OF THE BOXES ON THE LAST SHEET AND SIGN HIS OR HER NAME.

THANK YOU FOR ALL YOUR HELP!

DATA SHEETS FOR TWIN STUDY

DEMOGRAPHIC INFORMATION

1974-75 GROUP TESTS

TWIN SETS	BIRTH DATE			GRADE	SEX	ETHNICITY	TWINS	TRANSFERRED FROM	TRANSFER DATE	NAME OF TEST	GRADE AT TIME OF TESTING	READ	MATH	LANG
	Day	Mo.	Yr.	2-6	M-F	1-6	T-N							
1A														
1B														
2A														
2B														
3A														
3B														
4A														
4B														
5A														
5B														
6A														
6B														
7A														
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8A														
8B														
9A														
9B														
10A														
10B														
11A														
11B														
12A														
12B														
13A														
13B														
14A														
14B														

APPENDIX C

The Nichols & Bilbro Questionaire

CALIFORNIA STATE UNIVERSITY • LOS ANGELES

5151 STATE UNIVERSITY DRIVE LOS ANGELES CALIFORNIA 90032

May 12, 1975

Dear Principal:

We want to take this opportunity to thank you for your participation in the research study of twins conducted in the Los Angeles Unified School District. Many of the pupil data forms were returned without indicating whether the twins are identical or non-identical; therefore, we are asking your cooperation in determining this information.

Two suggested methods for determining this infomation are:

1. Phone and ask the parent if the twins are identical.

2. Ask the school nurse to complete the form after examining the twins.

The form containing the suggested questions is enclosed. Please indicate on this form the method by which this data was collected.

Thank you for your cooperation in this research study. We will appreciate your returning this form in the pre-addressed envelope.

Sincerely,

Patricia M. Hodges, Ph.D.
Associate Professor
Department of Psychology
Telephone: 224-3810

:dms
Enclosure

1) Do the twins have hair that is
distinctly different in color? Y___ N___
slightly " " " Y___ N___

2) Do the twins have hair that is
distinctly different in curliness? Y___ N___
slightly " " " Y___ N___

3) Do the twins have hair that is
distinctly different in texture? Y___ N___
slightly " " " Y___ N___

4) Do the twins have
distinctly different eye color? Y___ N___
slightly " " " Y___ N___

5) Do the twins have a
height difference of 3 inches or more? Y___ N___
" " " 1½ " " " Y___ N___

6) Do the twins differ in weight by 15 pounds or more? Y___ N___

7) Do you frequently mistake the twins for one another? Y___ N___

8) Do close friends frequently mistake the twins for one another? Y___ N___

9) Have the twins commented that the parents frequently mistake them for one another? Y___ N___

APPENDIX D

Letter To The Principal In Regard To Contacting Twin Parents

CALIFORNIA STATE UNIVERSITY • LOS ANGELES

5151 STATE UNIVERSITY DRIVE LOS ANGELES CALIFORNIA 90032

September 22, 1975

Dear Principal and Staff:

As you may remember, we conducted a study of all twins enrolled in the Los Angeles City Unified School Districts in grades 2 to 6. The study was approved by the District Committee on Research Studies. Each participating school was to be reimbursed for time spent in obtaining the data. The amount that each school would receive was determined by the business office of the Los Angeles City School District to be $5.00 per twin set. If you have not already received this money, you should receive it soon.

Since we used census tract data for the school district to assign socio-economic status, we have run into a problem. We apparently have only 11 sets of white twins who attend school in below average socio-economic class areas. If this is not correct, a biased sample would result. For this reason, we now have to contact individual homes of twins and ask the occupation and number of years of schooling for the parents. Under the Family Educational Rights and Privacy Act of 1974 (identified as PL-93-380 and amended by PL-93-568), directory information for the district may be released after the District has publicly identified the categories of such information and provided the parent with a reasonable opportunity to reply. The District has recommended (but not required) that each school have such a directory list. (See the form from District Superintendent Taylor's office.) This form is reproduced on the reverse side of this letter. Since the District has indicated that such information is to be available to the public, we would appreciate your giving us the following information for each twin set: Parents' name, address and telephone number.

If you have any questions about this, please call me (224-3810) or ask the District Office.

We would appreciate your filling in the enclosed form at your earliest convenience and we assure you that all data we collect is confidential and is reported anonymously.

Sincerely,

Patricia M. Hodges, Ph. D.
Associate Professor
Department of Psychology

Enclosure
PMH/eb

APPENDIX E

Letters Sent To Parents

Date

Dear Parent:

I am currently engaged in a study of twins and I would like to obtain some information about your twins. The purpose of the study is to demonstrate that the heritability of intelligence varies in different populations. Currently, some major figures in the area have stated that the greater portion of intelligence is determined by genetic factors (80%) and that environmental factors have much less influence (20%). Recent work has lead us to conclude that this figure underestimates the influence of the environment. In order to support this view, it is necessary to examine school records for twins and I am asking your aid in obtaining this data. Please fill in the enclosed postcard which asks if you know if your twins are identical or non-identical and how this was decided. If you do not know, would you please answer the two questions on the card.

Thank you for your help in this study. This study has major significance in that the 80% figure is used to support the argument that differences in IQ scores in racial groups are caused by genetic factors and that environmental depriviations have little effect.

Sincerely,

Patricia M. Hodges

Patricia M. Hodges
Associate Professor
Department of Psychology
California State University, L.A.

1) Do you frequently mistake the twins for one another? Y___ N___

2) Do the twins report that the parents frequently mistake them for one another? Y___ N___

3) Do the twins have a:
Height difference of 3 inches or more? Y___ N___
Height difference of 1-1/2 inches or more? Y___ N___

4) Do the twins differ in weight by 15 pounds or more? Y___ N___

5) Do the twins have:
Distincely different eye color? Y___ N___
Slightly different eye color? Y___ N___

6) Do the twins have hair that is,
Distinctly different in color? Y___ N___
Slightly different in color? Y___ N___

7) Do the twins have hair that is:
Distinctly different in curliness? Y___ N___
Slightly different in curliness? Y___ N___

8) Do the twins have hair that is:
Distinctly different in texture? Y___ N___
Slightly different in texture? Y___ N___

Birth Date of twins: _____ _____

Grade of each twin: _____ _____

School: _____

Parent response if contacted: Twins are identical _____

Twins nonidentical _____

APPENDIX F

Description Of The Achievement Tests

Cooperative Primary
Reading Test (CPRT)

Form 12A	Mean 24.5	SD 9.1
Form 23A	Mean 27.7	SD 9.5
Form 23B	Mean 36.1	SD 8.6

Scores for the Comprehensive Test of Basic Skills (CTBS) are all reported in percentile ranks.