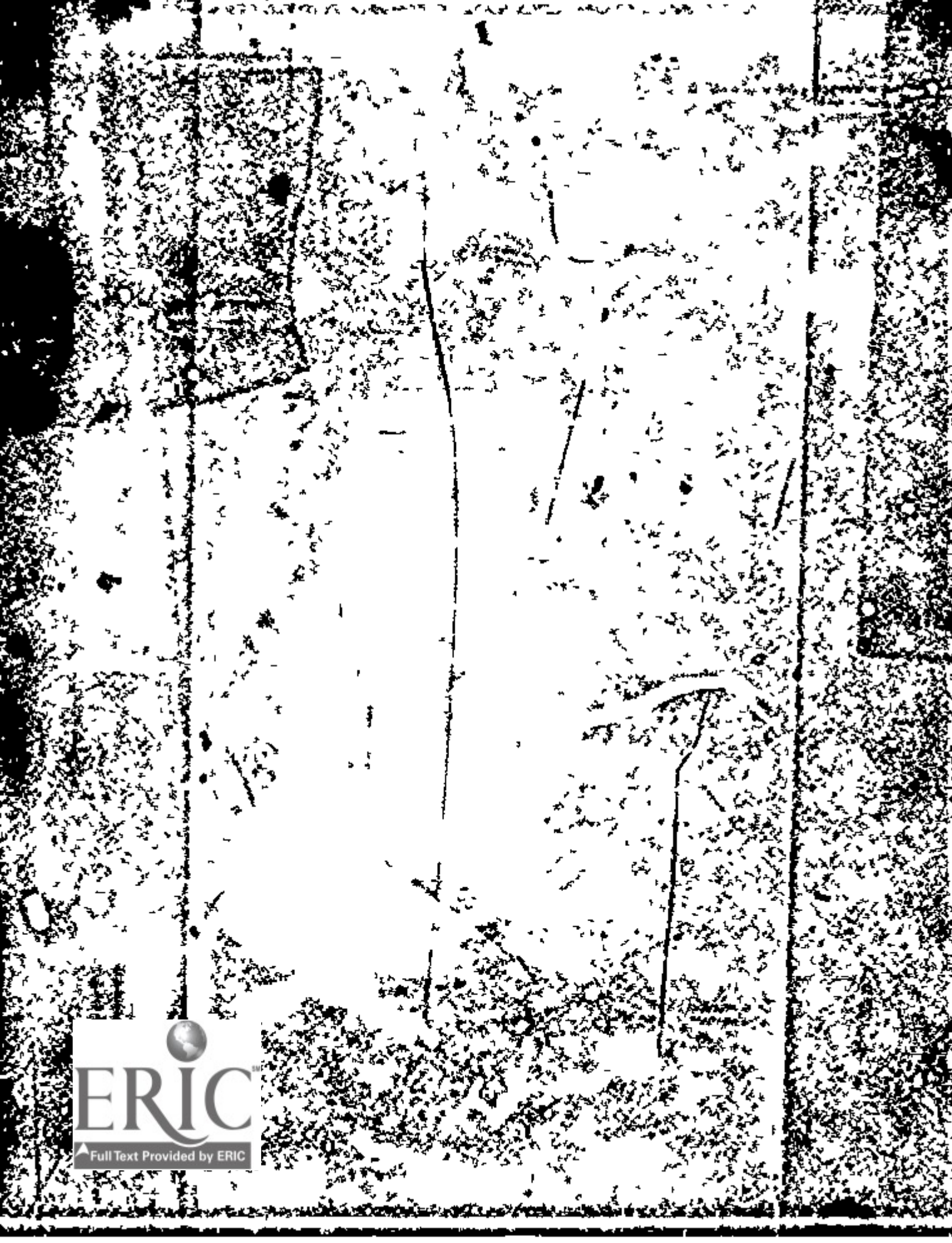

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ABSTRACT

Data from Project Talent and the National Longitudinal Study of the High School Class of 1972 provided comparable data on changes between 1960 to 1972 in reading ability and other characteristics of high school seniors, college entrants, and Scholastic Aptitude Test (SAT) takers. Each group showed a decline in reading ability, but the drop for SAT takers was greater than that for the other two groups. A much greater increase in the proportion of low ability than of high ability students taking the SAT appeared to be the predominant source of the score decline. The decrease in ability level of high school seniors also contributed to the decline. There were appreciable changes in the background characteristics of all groups in terms of age, sex, parental educational and occupational background, family configuration, high school curriculum, and expected college major. However, none of these factors provided a major explanation of the decline among high school seniors and college entrants. A decrease in the percentage of SAT takers entering four-year colleges might help explain the greater decline observed for this group. Some evidence indicated that SAT scores earned in 1960 and 1972 are not precisely comparable; thus, the actual decline was somewhat greater than the SAT scores indicated. (Author/EVH)

Changes in the Verbal Abilities of High School Seniors, College Entrants, and SAT Candidates between 1960 and 1972

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pared for the Advisory Panel on
Scholastic Aptitude Test Score Decline,
ntly sponsored by the
lege Board and Educational Testing Service

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OVERVIEW OF FINDINGS

That the average scores of students who took the Scholastic Aptitude Test (SAT) have been declining steadily and noticeably since 1963-64 is a fact. Because the SAT candidate group is self-selected, however, there is no certainty that a parallel decline in ability occurred for all college entrants or for all high school seniors. This study was initiated in order to obtain directly comparable data on changes between 1960 and 1972 in reading ability and other characteristics for high school seniors, college entrants, and SAT takers. Similarities and differences in the changes for these groups should be useful in evaluating various explanations for the SAT score decline.

The choice of the years 1960 and 1972 for this study was determined by the fact that in each of these years there were extensive data for national probability samples of high school seniors, including follow-

up data on college entrance in the year after high school graduation. For 1960 the data had been collected as part of the massive Project TALENT research effort, and for 1972 the data had been collected by the National Longitudinal Study of the High School Class of 1972 (NLS).

In each of the two studies, reasonably similar tests of reading comprehension had been given to the students. In order to use the results on these tests in comparing performance in the two years, it was necessary to equate the scores on the tests. Data for this equating were obtained by giving both tests to about 1,700 seniors in 88 high schools in 1976. We also searched Educational Testing Service (ETS) files for the SAT scores of more than 20,000 Project TALENT students. Comparable data from the two studies were available for age, sex, father's occupation, mother's occupation, father's education, mother's education, family configuration, high school curriculum, expected college major field, and college attendance.

Our research questions and findings were these:

1. Did the high school senior population change from 1960 to 1972?

The average reading score declined. Comparisons of subgroups from the 1970 and 1972 samples showed that the average 1972 senior was slightly older, more likely to have parents who completed high school and were in professional, managerial, or white collar positions, and less likely to be an only child or a firstborn child. The proportion of boys and girls became more nearly equal. In nearly every subgroup studied, there was a decline in reading score.

From 1960 to 1972, an important phenomenon in American education was a marked increase in the number of students who stayed in school instead of dropping out. A reasonable statistical estimate suggests that this trend made a considerable contribution to the observed decline in reading scores for high school seniors. Less able students who would have been dropouts in the 1960 cohort appeared as seniors in the 1972 cohort.

2. Has the college entrant population changed?

The decline in reading scores is about the same for college entrants as for high school seniors. In both years, 1960 and 1972, college entrants were substantially higher in reading ability than high school seniors. At all ability levels, the percentage of seniors going on to college increased. The 1972 entrants were slightly older, included an increased percentage of women, and were more likely to have parents who attended college and who were engaged in professional or managerial occupations than the 1960 entrants. The variation in the amount of score decline from one subgroup to another may throw some light on the sources of the overall decline, but none of the variables emerged as a major determiner.

3. Has the population taking the SAT changed?

The drop in the average reading score for SAT takers was about twice as large as the drop for college entrants and high school seniors. The percentage of students taking the SAT increased from 1960 to 1972 at all ability levels. In 1972 the SAT population had an increased proportion of women, a decreased proportion of college preparatory students, and more students from large families. As with the college entrant population, we found some variation among subgroups in the amount of decline. Of the characteristics studied, however, only the substantial decrease in the proportion of SAT takers who entered four-year colleges seems to have had an appreciable impact on the SAT score decline.

4. Has the SAT scale shifted?

Our analysis suggests that the SAT-verbal scale shifted somewhat from 1960 to 1972. Consequently, for a given level of ability a student would be expected to earn a somewhat higher SAT-verbal score in 1972 than in 1960. This result suggests that the actual decline in ability was greater than the observed decline in scores would indicate.

The SAT-verbal means for our samples are 474 in 1960 and 453 in 1972, a difference of 21 points. These means were affected by changes in the high school population, changes in the percentage of high school seniors at various ability levels who chose to take the SAT, and some drift in the scale of the SAT-verbal test. We estimate that the change in the high school population ly itself would have reduced the 1960 mean by 12 points to 462, whereas the change in patterns of self-selection by candidates alone would have reduced the mean by 20 points to 454. Thus, the effect of changes in the high school population and SAT-taking patterns together resulted in a decline of 32 points to 442. The effect of scale drift was to add 11 points, resulting in the 1972 average SAT-verbal score of 453.

The largest single component of the decline in average SAT-verbal score was, therefore, changes in the percentage of high school seniors at various ability levels who chose to take the SAT. These changes are reasonable in view of the changing composition of the College Board between 1960 and 1972. Among the various student characteristics that we were able to study, several appeared to be related to the score decline for high school seniors, but much of the change in the distribution of reading ability remains to be explained.

PLAN OF THE STUDY

This study investigated differences between the 1960 and 1972 high school graduating classes--differences that may help to account for the SAT score decline. This report describes certain characteristics of three groups of high school students: all high school seniors, college entrants, and SAT candidates. The characteristics include: (1) age, (2) sex, (3) father's occupation, (4) mother's occupation, (5) father's education, (6) mother's education, (7) family configuration, (8) high school curriculum, and (9) expected college major field. The report includes the reading comprehension scores of high school seniors categorized according to the characteristics listed above, and the SAT scores of members of these subgroups for whom SAT scores were available.

Data Sources

Introduction. This study could be done because extensive data on national probability samples of United States high school seniors had been collected by Project TALENT in 1960 and by the Base-Year Survey of the National Longitudinal Study in 1972. In both studies, a follow-up provided data on college attendance. Data on SAT scores were collected as part of the NLS.

The American Institutes of Research graciously cooperated in working out an arrangement by which SAT score files could be searched for a sample of 20,359 participants in the TALENT survey while the confidentiality of both data files was maintained. The data bases for the two national surveys are well-known and well-documented. A detailed comparison of the two surveys has been made by Schrader and Hilton (1975); therefore, many details of the samples and variables will not be repeated here.

TALENT and the NLS were designed a dozen years apart for quite different purposes, at times of vastly different social emphases. TALENT was conceived in the post-Sputnik era when the nation was greatly concerned with locating talented students and encouraging their development. The National Longitudinal Study was designed to trace the careers of American students, with particular emphasis on equality of opportunity for various minority groups. The questions and the testing batteries administered to the two cohorts differed according to the needs of the study, the ingenuity of the investigators, and judgments regarding the best use of students' time. A formal comparison of the two data bases was never intended. However, when Schrader and Hilton studied these two data sets, they concluded that the reading comprehension tests of each study and a small subset of questionnaire items were sufficiently similar to permit comparisons.

The present study attempted to establish comparable scores on the reading tests used in Project TALENT and NLS and to evaluate the tests' equivalence. Because the test questions were asked and responded to at different times and their meanings to the respondents may have changed, strict comparability cannot be assumed.

Project TALENT Data Base. The Project TALENT data were collected by the American Institute for Research in the late spring of 1960 (Flanagan et al., 1962). The project staff selected a 5 percent sample of all high school students in American public, private, and parochial schools and administered a battery of tests and a questionnaire to them. The total sample was about 400,000. The 81,175 high school seniors in the probability sample of high school seniors were sent a questionnaire during the year following graduation asking about a number of things, including what the students were doing that year. A random sample of the nonrespondents was followed by a field survey. The survey results were weighted in such a way as to make estimates of follow-up information possible for the total sample contacted originally in 1960.

A critical variable in the present study is whether the student took the College Board examinations; a variable not included in the TALENT data but available on microfilm in the ETS files. Because looking up SAT scores for the entire 81,175 sample members would have been time-consuming and expensive, and because such a large sample is statistically unnecessary, we asked the American Institute for Research for a subsample of about 25 percent of the cases (N = 20,359), a subsample comparable in size to the entire NLS sample. The final edited data base, therefore, contains a large number of test scores, questionnaire items, and SAT scores. The data file has no individual identification information. The Project TALENT sample used in this study was selected in such a way as to be self-weighting for high school seniors. Special weights, supplied by the Project TALENT staff, were used for persons included in the sample of nonrespondents selected for special follow-up.

National Longitudinal Study Data Base. Under the aegis of the National Center for Education Statistics, the NLS staff selected a stratified random sample of American public, private, and parochial schools and in each school administered a battery of tests and questionnaires to 18 randomly selected seniors. The present study used the records of 16,683 students. SAT scores were recorded by the schools. A follow-up survey was administered two years later to learn, among other things, about the career choices of these high school graduates. About 95 percent of the sample was located. The data file, including the results of the follow-up, was obtained from the National Center for Education Statistics.

Variables Used

Reading Comprehension. Both Project TALENT and the National Longitudinal Study administered reading comprehension tests to nearly all members of the samples. Project TALENT used a test with 48 items that was scored on a number-right basis. The NLS administered a 20-item test that was scored using formula scores (number right minus 1/4 wrong). Because a comparable general test of intellectual ability is critical to the analyses discussed later, a substudy set about equating these two reading comprehension tests. Usable data were obtained for 1,657 high school seniors enrolled in 88 high schools. A detailed description and discussion of the equating study are presented in Appendix A.

In this study, reading scores were used not only to describe various subgroups but also for stratifying the three main groups on the basis of reading ability. Six strata were defined, using the distribution of reading scores for the 1972 cohort, so as to include the top tenth, the second tenth, and the second, third, fourth, and bottom fifth of the 1972 high school senior group. (In determining the strata, the 90th, 80th, 60th, 40th, and 20th percentiles for high school seniors in 1972 were calculated, expressed in terms of the NLS raw score scale. Then the corresponding TALENT raw scores were determined, using the conversion table developed in the equating study. The resulting values defined the equivalent class intervals for NLS scores and TALENT scores. In using these class intervals, frequencies were prorated between class intervals whenever an interval boundary fell within a particular NLS or TALENT raw score interval. This procedure was used in order to reduce the effect of coarseness of grouping in the raw score data.)

College Entrance. College entrance, necessarily derived from questions on the follow-up questionnaires, was defined as full-time matriculation in a two- or four-year college in the academic year following the senior year of high school. Part-time attendance or attendance in vocational or technical schools was not considered college attendance. By this definition, 39 percent of the high school seniors entered college in 1960 and 43 percent in 1972. Details on the questionnaire items used and their response frequencies are shown in Appendix B.

SAT Taking. As mentioned earlier, the SAT scores for the Project TALENT subjects had to be located in the ETS microfilm files. A search was made to locate these scores, if possible, in the ETS files for the

1958-59 or 1959-60 testing years. Of the sample, 18 percent were found to have taken the SAT at least once. Because College Board statistics were not developed for cohort groups in 1960, there is no directly comparable percentage based on all students from that cohort who took the SAT.

For the NLS sample, taking the SAT was recorded by the participating schools. The accuracy of this procedure was checked in a study by the NLS project staff (Hilton et al., 1973). In the present study, 31 percent of the sample had SAT scores, a figure very close to the 33 percent estimated from the number of persons in the class of 1972 who took the SAT, as reported by the College Board's Admissions Testing Program, divided by the number of high school seniors estimated by the National Center for Education Statistics.

SAT-Verbal and SAT-Mathematical Scores. For the Project TALENT sample, up to five sets of SAT-verbal and SAT-mathematical scores were recorded for each individual, as well as the dates of testing. The analyses used the last scores prior to high school graduation. The mean SAT-verbal score for those for whom SAT scores were available was 473.6; the SAT-mathematical mean was 496.2.

For the NLS sample, the schools were asked to record the last SAT scores before graduation. Thus, the two sets of data are comparable. For the NLS sample, the average SAT-verbal score was 453.3 and the average SAT-mathematical score 485.3, mean scores very close to the comparable figures of 453 and 484 published by the Admissions Testing Program for that year (1971-1972).

Age, Sex. In both surveys, ages were computed in months from date of birth. The average age of the 1960 sample, as of June 30 of the year of graduation, was 18 years and 1/2 month compared with an average age of 18 years and 2 months for the NLS subjects.

Sex was obtained from an item in the student questionnaire administered in each survey.

Socioeconomic Status. We used four variables from the two surveys to determine socioeconomic status and made them roughly comparable by combining categories. (These variables might be called socioeducational rather than socioeconomic.) The four variables are father's education, mother's education, father's occupation, and mother's occupation. Evidence that supports this choice of variables was recently obtained by Stricker (1976).

The four categories for education are:

1. Do not know or did not respond to the item
2. Some high school or less
3. High school graduate
4. Some college, college graduate, and graduate school

The occupational classifications are:

1. Do not know or did not respond to the item
2. Blue collar, which includes skilled workers or craftsmen, semi-skilled workers or operatives, service workers, protective workers, laborers, all classifications of farmer, and household workers
3. White collar, including proprietors, salesmen, clerical workers, and military personnel
4. Professional and managerial, including technicians and officials

For mothers, a fifth category was included:

5. Homemaker or housewife

Family Configuration. Family configuration was obtained from items in each survey that, in effect, asked the respondents to indicate what their ordinal position was. Specifically, the Project TALENT Student Information Blank (SIB) asked the respondents how many living brothers, half brothers, foster brothers, or stepbrothers were older than they were and, in a second question, how many were younger. Parallel questions inquired about sisters. The respondents were instructed to include children "not now living in your home," but not to count their own twin brother or twin sister (if any).

The National Longitudinal Study included the relevant questions in the 2nd Follow-Up Questionnaire. The items asked only about brothers and sisters and gave no instructions about how to count twins, siblings not in the home, or half brothers, and so on. How the absence of these instructions affected the results, if at all, is difficult to estimate.

High School Curriculum. High school curriculum has three categories:

1. General
2. Academic or college preparatory
3. Vocational or technical

For the NLS, this information was obtained from Question 2 of the Student Questionnaire; and for Project TALENT, from Question 9 of the SIB.

Expected College Major. Creating this variable required extensive collapsing of categories. The final categories are as follows:

1. Science and mathematics, including biological sciences
2. Social sciences and humanities, including sociology, prelaw, foreign languages, and fine arts
3. Engineering
4. Other fields, including business administration, education, agriculture, nursing, home economics, and journalism
5. Nonmatching categories (categories included in one of the surveys but not the other; for example, the NLS category of Computer Science)

Analysis Plan

The analysis plan was designed primarily to facilitate key comparisons between student characteristics in 1960 and 1972 for the three main groups: high school seniors, college entrants, and SAT takers. Each of the student characteristic variables served as a basis for dividing each of the three main groups into subgroups. The particular statistics calculated for each subgroup differed for the three main groups. The following discussion of the statistical analyses has been organized on the basis of the main group or groups for which the particular calculation was made. The underlined heading for each result corresponds to the column heading for that statistic in the tables.

Statistics Calculated for All Main Groups:

"N." This is the estimated number of students in the designated subgroup and the designated main group. This result was called "Weighted N" for high school seniors, "Estimated N" for college entrants, and "N" for SAT takers. All N's are reported in thousands. Because reported percentages were calculated using N's including all digits, they will tend to differ slightly from percentages calculated from the reported N's.

"% of cohort." This result was obtained by dividing the number of students in a subgroup by the number of students in the corresponding total group. (For college entrants and SAT takers, students with missing data on a student characteristic were excluded in calculating "% of Cohort.")

"Reading mean." This is the mean reading score for members of the designated subgroup. These results make it possible to identify shifts in the composition of each of the three main groups with respect to each of the student characteristics and to determine the amount of change in reading scores from 1960 to 1972 for every subgroup.

Statistics Calculated for College Entrants and SAT Takers:

"% of stratum." This result was obtained by dividing the number of students in a subgroup (stratum) by the number of students in the corresponding subgroup of high school seniors. These results make it possible to discern trends between 1960 and 1972 in college going and in SAT-taking patterns for the subgroups defined on the basis of student characteristics. They describe changes in the patterns of self-selection with respect to college entrance or SAT taking. (To be sure, patterns of self-selection are heavily influenced by college policies, for example, with respect to tests required for admission.) When used along with results on "% of Cohort" for high school seniors they make it possible to assess the relative importance of changes in the high school senior population and of changes in self-selection for various subgroups in producing changes in the college entrant or SAT-taking group.

Statistics Calculated for High School Seniors Only:

"Actual N." This is simply a count of the number of sample students on which the various results for high school seniors were based.

"Reading SD." The standard deviation of reading scores was calculated to provide some information on within-subgroup variability.

Statistics Calculated for SAT Takers Only:

"SAT-verbal mean." Mean of SAT-verbal scores

"SAT-verbal SD." Standard deviation of SAT-verbal scores

"SAT-math. mean." Mean of SAT-mathematical scores

"SAT-math. SD." Standard deviation of SAT-mathematical scores

Results for "SAT-verbal mean" were of decisive importance in estimating the effect of changes in self-selection on the SAT score decline and in providing evidence on a possible shift in the SAT-verbal scale between 1960 and 1972. The other three results, although not of direct concern in this study, were considered to provide useful descriptive information on the various subgroups.

CHANGES IN READING COMPREHENSION SCORES FROM 1960 to 1972

Introduction

In this section of the report we use equated scores on the reading tests taken by Project TALENT participants in 1960 and by National Longitudinal Study participants in 1972 to explore four research questions:

1. Has the reading ability of high school seniors changed?
2. Has the reading ability of college entrants changed?
3. Has the reading ability of SAT candidates changed?
4. Does an SAT-verbal score earned in 1972 represent the same ability level as the same score earned in 1960?

We then address the question of what effect changes in the distribution of reading ability in the high school senior and SAT-taking populations have on the average score of the SAT-verbal test.

Because different reading tests were administered to the 1960 and 1972 student groups, the rigor of the comparisons reported in this chapter depends directly on the use of appropriate statistical methods for developing interchangeable scores on the two tests. Although a number of difficult technical problems were encountered in implementing the equating design,[1] we are confident that the final equating is satisfactory. We must acknowledge, however, that the equated scores do not and cannot achieve the precision that would have been attained had the same test been used in both studies.

Reading Ability of High School Seniors

Reading ability as represented by the mean scores of these two national samples of high school seniors declined between 1960 and 1972. The results may be expressed briefly by stating that the mean score declined from 10.5 to 9.7 on the NLS scale as shown in Figure 1 and Table 1. This decline amounts to about 16 percent of the standard deviation of scores for high school seniors.

Table 1 gives us the opportunity to explore the drop in average reading score further. The rows or "strata" of this table represent levels of reading ability. The six strata were defined as follows: the top tenth of the group tested in 1972 was classified in the highest group, the next tenth was classified in the second group, and the remaining fifths of the class were assigned to correspondingly lower

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1. One problem arose because the reading tests administered in the two studies--although fairly similar--differed in length. The TALENT test was longer than the NLS test (30 minutes vs. 15 minutes). When data collected as part of the present study were used, we found that TALENT scores were more reliable and more highly correlated with SAT-verbal scores than the NLS scores. For this reason, we decided that the initial equating of scores on the two tests was not adequate for the purposes of this study. We proceeded, therefore, to modify the TALENT scores so as to bring the correlation with SAT-verbal to approximately the same level for both tests, and to equate the modified scores. The modified TALENT scores seemed satisfactory and are used throughout this study. (The procedure used is described in more detail in Appendix A.)

Another concern was the accuracy of individual TALENT scores, particularly very low scores. On the basis of marked inconsistency of certain scores with other information in the 1960 data file, it was decided to treat about 2½ percent of the cases in the 1960 sample as having missing data on the reading test. The method by which the cases were identified is described in Appendix C.

Figure 1. Mean Reading Score for High School Seniors, College Entrants, and SAT Takers in 1960 and 1972

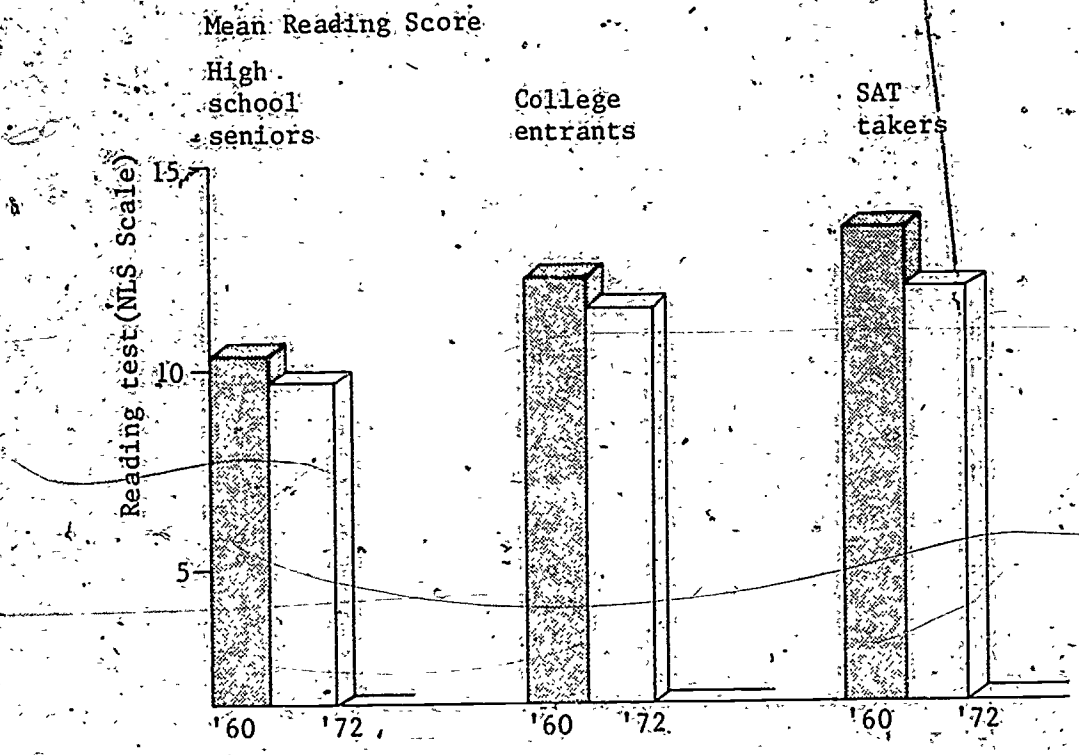


Table 1. Reading Score Levels of High School Seniors

		High School Seniors				
					Reading	
Cohort	Score	Actual N	Weighted N*	% of cohort	Mean	S.D.
TAL 1960	43.65-55	2780	255	14.3	17.8	1.1
NLS 1972	16.19-20	1442	288	10.0	17.6	1.1
TAL 1960	40.46-43.65	2356	216	12.2	15.3	0.5
NLS 1972	14.33-16.19	1504	290	10.1	15.3	0.6
TAL 1960	35.38-40.46	3905	358	20.1	12.9	0.8
NLS 1972	11.43-14.33	2956	575	20.0	12.8	0.9
TAL 1960	29.40-35.38	3683	337	19.0	10.0	0.8
NLS 1972	8.56-11.43	3042	576	20.0	10.0	1.0
TAL 1960	21.77-29.40	3554	325	18.3	6.9	1.0
NLS 1972	5.13- 8.56	3243	577	20.0	7.0	1.1
TAL 1960	(-7)-21.77	3106	284	16.0	2.4	2.4
NLS 1972	(-5)- 5.13	3049	576	20.0	2.4	2.1
TAL 1960	No test	972	89			
NLS 1972	No test	843	133			
TAL 1960	Total	20358	1864	100.0	10.5	5.1
NLS 1972	Total	16681	3015	100.0	9.7	5.0

*In thousands

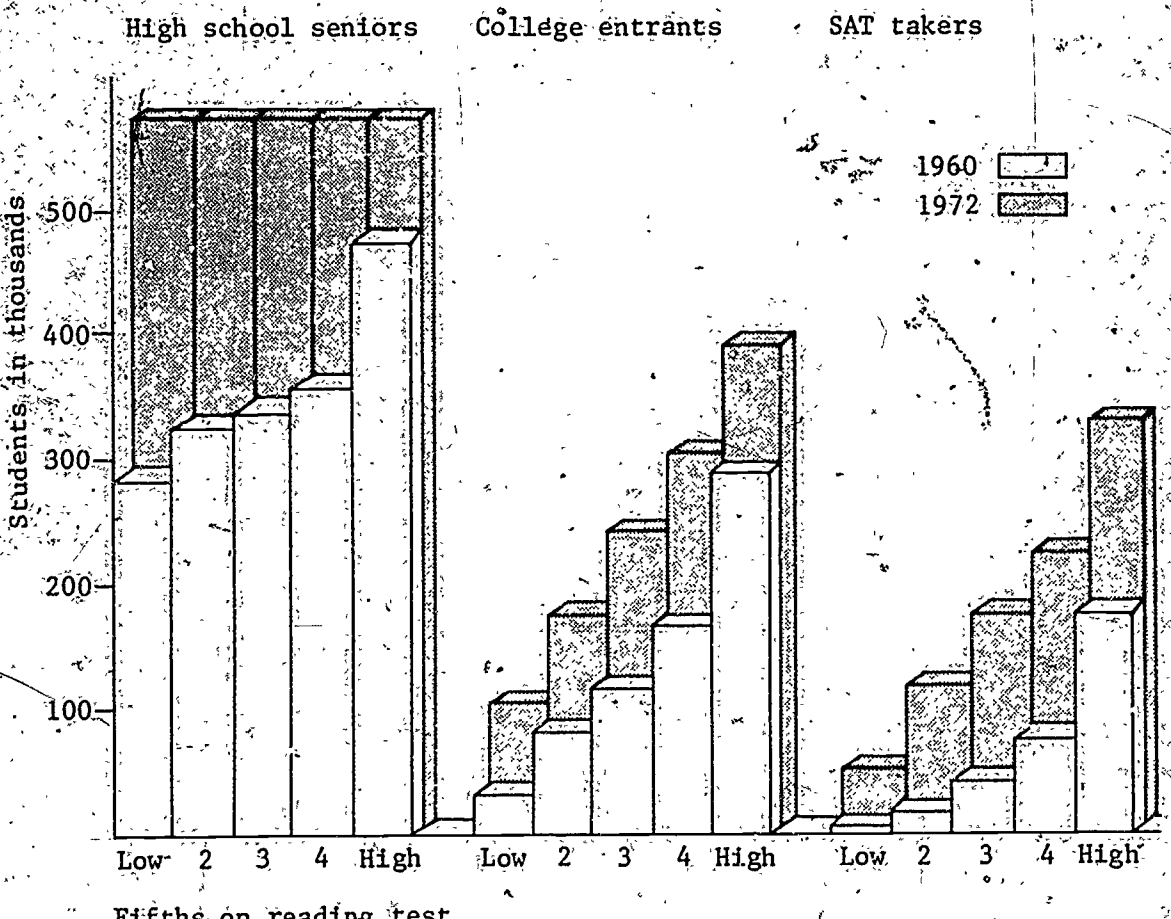
levels. On the basis of the results of the equating of 1960 and 1972 reading scores, the 1960 students were assigned to the level that best described their reading performance. Thus, each row or stratum of the table can be construed as containing students from the two samples who are substantially equal in reading ability.

The column headed "Weighted N" shows the estimated number of high school seniors in each ability stratum for the years 1960 and 1972. The section of Figure 2 headed "High School Seniors" presents the results for "Weighted N" graphically. (In the figure, the results for the two highest strata are combined.) The graph makes it evident that in 1960, the proportions of students in the higher strata are noticeably larger than the proportion of students in the lower strata.

In 1972 (as a consequence of the way in which the strata were defined), each stratum includes one-fifth of the students. Because the strata represent comparable ability levels in the two years, these results indicate that there was a decline in reading ability between 1960 and 1972 for high school seniors.

Between 1960 and 1972 the number of high school graduates increased from 1,864,000 to 3,015,000 (Simon and Frankel, 1973; Frankel and Beamer, 1974). Despite the decline in ability levels, there were actually more seniors even at the highest level, which increased by 13

Figure 2. Number of Students Whose Reading Score Would Place Them in Each Fifth of 1972 High School Seniors



percent from 255,000 to 288,000, as shown in Table 1. But the increase was much greater at the lower levels – the lowest group more than doubled, increasing from 284,000 to 576,000.

The change in the distribution is expressed in percentages in the column labeled "% of cohort." These percentages show that 14 percent of the 1960 cohort did as well or better than the top 10 percent of the 1972 cohort, and only 16 percent did as poorly as or poorer than the bottom 20 percent. This approach may give a clearer idea of the extent to which the ability level has changed than simply comparing mean scores.

The means and standard deviations of the reading scores provide evidence on the average reading ability for each stratum. The small differences between the 1960 and 1972 results indicate that the strata were, indeed, matched on ability level.

We do not know, from the data of this study, why the much larger 1972 cohort has a much larger proportion of students who scored low on the reading test. Some possible factors will be shown in the next section. We note here, however, that the change is consistent with a change in the holding power of the high schools, that is, fewer low-scoring students are dropping out of school. The percentage of the age cohort who reached the senior year of high school increased from 67 percent in 1960 to 79 percent in 1972 (Digest of Education Statistics, 1975 Edition, Table 10). Our tentative opinion is that a substantial fraction of the drop in mean reading score can be attributed to this factor, as described in Appendix E, but further research would be needed to evaluate this effect.

Other data on score changes for high school students (as distinguished from participants in national testing programs) are available from several sources. None of these sources, however, provides data for both the 1960 and the 1972 cohorts of high school graduates. The following brief discussion is concerned only with scores on reading tests and tests considered reasonably similar to reading tests, and only with scores earned by high school juniors or seniors.

Harnischfeger and Wiley (1975) present results for a number of the Iowa Tests of Educational Development for high school students in the Iowa Testing Programs. Vocabulary scores showed an increase for the 1963 through 1966 cohorts and a decline for the 1968 through 1975 cohorts. Composite scores increased for the 1963 through 1966 cohorts and declined for the 1969 through 1975 cohorts. Vocabulary scores were slightly higher, and composite scores slightly lower for the 1972 than for the 1963 cohorts.

Perry and Swanson (1974) report that scores earned by Minnesota high school juniors on the Minnesota Scholastic Aptitude Test showed an upward trend in mean score for students in the graduating classes from 1961 through 1967. A different test not equated to the earlier test was introduced for juniors in the 1968 graduating class. Students in the 1970 cohort earned mean scores somewhat higher than those for the previous two years, but for the 1971 through 1974 cohorts a perceptible and consistent score decline amounted to 14 percent of the standard deviation of the scores earned by the 1970 cohort.

Jackson and Schrader (1976) compared national Preliminary Scholastic Aptitude Test verbal norms for members of the 1962, 1968, and 1976 high school graduating classes tested in the fall of their junior year.

They found that the 1968 cohort scored noticeably higher than the 1962 and 1976 cohorts, a pattern consistent with the Iowa and Minnesota findings. If their 1976 results are adjusted for scale drift, they show a decline between the 1962 and 1976 cohorts amounting to 8 percent of the standard deviation of the 1962 cohort.

Flanagan and Jung (1971) compared the performance of national samples of members of the 1961 and 1971 graduating classes who took the TALENT Reading Test as juniors. They found a small increase in scores (about 4 percent of the standard deviation for the 1961 cohort). Flanagan (1976) also studied score changes on a number of tests between 1960 and 1975, based on a sample of 17 schools from the original TALENT sample. After a small adjustment for changes in community quality during this period, as reported by the school principals, he concluded that there had been a substantial decline on language tests, but that reading scores declined less than did vocabulary and English. Although the study report does not include data on standard deviations, it seems reasonable to assume a within-grade standard deviation of about 10 for the reading test on the basis of the 1960 Project TALENT results (Flanagan et al., 1964). The half-point decline in reading raw scores would amount to about 5 percent of a standard deviation.

Although it cannot be claimed that the foregoing summary provides a rigorous description of score trends during the 1960s and early 1970s, it suggests that scores increased during the early 1960s and that the score decline for high school seniors began a few years later than the score decline for SAT candidates. It suggests also that the score decline for high school seniors found in the present study is, if anything, somewhat greater than the decline found in other related studies.

Reading Ability of College Entrants

The reading ability of college entrants also declined between 1960 and 1972. Expressed as a mean score on the NLS scale, the decline is from 12.8 in 1960 to 11.9 in 1972. The decline in mean score for college entrants is, then, slightly more than that for high school seniors. These means can be seen in Figure 1.

This decline can be examined in some detail in the "% of cohort" column of Table 2. The percentages of college entrants in the higher strata are noticeably greater for the 1960 cohort than for the 1972 cohort. Although the percentage of college entrants in the higher strata has declined, the number (as shown in the "Estimated N" column of Table 2) in these strata has increased markedly, as it did for all high school graduates--and partly for the same reason: the large increase in the number of high school graduates. These changes are shown graphically in Figure 2. There has been a substantial increase in the number of students going to college at each level of reading ability, and these increases in the actual counts of students are more or less similar at each level. However, the net effect of this across-the-board increase in numbers of students is to make the cohort as a whole contain slightly larger percentages of low-scoring students in 1972 than in 1960, with the resulting drop in the mean. (The total in the "Estimated N" column does not equal the sum of the separate values. This discrepancy arises because the total is estimated independently of the estimates for the various strata.)

Table 2. Reading Score Levels of College Entrants

Cohort	Score	College entrants: Estimated N*	% of stratum	% of cohort	Reading Mean
TAL 1960	43.65-55	165	64.9	23.8	17.8
NLS 1972	16.19-20	209	72.6	16.8	17.7
TAL 1960	40.46-43.65	128	59.1	18.4	15.3
NLS 1972	14.33-16.19	187	64.7	15.1	15.3
TAL 1960	35.38-40.46	167	46.7	24.1	13.0
NLS 1972	11.43-14.33	306	53.3	24.6	12.9
TAL 1960	29.40-35.38	118	34.9	16.9	10.0
NLS 1972	8.56-11.43	246	42.7	19.8	10.1
TAL 1960	21.77-29.40	84	25.8	12.1	7.1
NLS 1972	5.13- 8.56	177	30.7	14.2	7.1
TAL 1960	(-7)-21.77	33	11.6	4.7	2.8
NLS 1972	(-5)-5.13	108	18.8	8.7	3.0
TAL 1960	No test	26	29.5		
NLS 1972	No test	56	42.0		
TAL 1960	Total	721	38.7	100.0	12.8
NLS 1972	Total	1301	43.1	100.0	11.9

*In thousands

Table 2 also shows, in the column headed "% of stratum," the percentage of high school seniors in each stratum who entered college in the year after high school graduation. Of students in the top stratum, 73 percent entered college in 1972 as compared with 65 percent in 1960. The colleges are, therefore, actually attracting a larger percentage as well as a larger number of the highest scoring students. The increase in percentages of students attending college is fairly similar for all strata.

Reading Ability of SAT Candidates

For SAT candidates the mean score on the NLS scale declined from 14.2 for the 1960 group to 12.4 for the 1972 group. This decline can be seen in Figure 1. The decline in mean score is more than twice as large as the decline for high school seniors, and twice as large as the decline for college entrants.

The column "% of cohort" of Table 3 presents the percentage of students at each ability level from 1960 to 1972. The shift is more marked for students who took the SAT than for college entrants. The percentage of SAT takers in the top stratum decreases from 34 percent

Table 3. Reading Score Levels of Students Who Took the SAT

Cohort	Score	SAT takers N*	% of stratum	% of cohort	Reading mean	Sat-verbal Mean	Sat-verbal S.D.	Sat-math Mean	Sat-math S.D.
TAL 1960	43.65-55	108	42.4	34.2	17.9	547	87	551	103
NLS 1972	16.19-20	177	61.4	19.5	17.7	567	84	573	97
TAL 1960	40.46-43.65	67	31.0	21.2	15.3	499	88	511	101
NLS 1972	14.33-16.19	154	53.1	16.9	15.3	504	80	527	94
TAL 1960	35.38-40.46	75	20.8	23.6	13.0	438	81	474	96
NLS 1972	11.43-14.33	226	39.3	24.9	12.9	453	78	489	96
TAL 1960	29.40-35.38	41	12.1	13.0	10.2	389	76	432	91
NLS 1972	8.56-11.43	176	30.5	19.4	10.1	404	69	446	96
TAL 1960	21.77-29.40	18	5.4	5.6	7.1	341	74	401	84
NLS 1972	5.13-8.56	121	21.0	13.4	7.1	358	68	408	93
TAL 1960	(-7)-21.77	7	2.6	2.3	2.7	337	104	385	94
NLS 1972	(-5)-5.13	54	9.4	5.9	3.2	311	61	361	86
TAL 1960	No test	11	12.7			476	114	490	113
NSL 1972	No test	27	20.7			454	115	484	105
TAL 1960	Total	326	17.5	100.0	14.2	474	108	496	110
NLS 1972	Total	935	31.0	100.0	12.4	453	108	485	113

*In thousands

in 1960 to 20 percent in 1972. In the second stratum, the drop is from 21 percent to 17 percent. The percentage in the two lowest strata (the lowest 40 percent of 1972 high school seniors) increases from about 8 percent to about 19 percent.

The "N" column in Table 3 shows the dramatic increase in the number of students taking SAT between 1960 and 1972. These figures are shown graphically in Figure 2. More students took the SAT at all levels of reading ability. In the top stratum, the number taking the SAT increased from 108,000 for the 1960 cohort to 177,000 for the 1972 cohort, while the bottom fifth increased from 7,000 to 54,000 and the next to the bottom fifth increased by 103,000. These increases at the low end of the reading ability scale result in the larger proportion of SAT takers at the lower ability levels.

The column headed "% of stratum" shows the proportion of each ability stratum taking the SAT. The proportions show increases for all strata, even the top level. In 1960, 42.4 percent of all high school seniors in the top stratum took the SAT, whereas in 1972 61.4% of that stratum did. Very few students in the lower strata took the SAT in 1960, but substantially more did in 1972. The SAT, then, is reaching more college-aspiring students in all strata. But the increase is substantially greater for students in lower ability strata.

SAT Scale Drift

Our data permitted the calculation of mean SAT-verbal and mean SAT-mathematical scores for students taking the SAT in each of the six strata. Means and standard deviations for SAT-mathematical scores are included in this report as a matter of interest. Because this study is focused on changes in verbal ability, no attempt will be made to discuss the results for SAT-mathematical. The primary objective of this phase of the analysis was to find out whether there has been a drift in the SAT-verbal score scale so that a given score represented a higher (or lower) level of ability in 1972 than in 1960.

The interpretation of the observed differences in means, however, presents a number of difficult technical problems. The questions of strict parallelism between the two reading tests and of the accuracy of some of the individual scores were noted earlier in the introduction to this chapter. The mean SAT-verbal scores for each stratum may be considered to represent a regression of SAT-verbal scores on reading scores, and Thorndike (1971) has shown that important problems arise when a regression approach is used to evaluate differences between groups. Thus, although the sample of 1,657 students in the equating study should have provided an adequate basis for equating of the kind used in this study, caution must be exercised in interpreting the differences in mean SAT scores.

A carefully designed and executed study of SAT scale drift between 1963 and 1973 has recently been completed by Modu and Stern (1976) with results relevant to the interpretation of our findings. The following table brings together the data on SAT-verbal means from Table 3 and the Modu-Stern results. The "Adjusted 1972" means apply the Modu-Stern estimates of scale drift from 1963 to 1973 to the 1972 means.

Stratum	1960 (TALENT)	1972 (NLS)	Adjusted 1972 (Based on Modu-Stern)
Highest tenth	547	567	562
Second tenth	499	504	496
Second fifth	438	453	444
Third fifth	389	404	393
Fourth fifth	341	358	345
Lowest fifth	337	311	297
Total	474	453	444

When the SAT-verbal means for 1960 and 1972 are compared, a puzzling reversal occurs. Although the overall mean is 21 points higher for the TALENT sample than for the NLS sample, the means for all strata except the lowest show a substantial difference in the opposite direction. Within strata, the TALENT sample shows consistently lower means than the NLS sample. The column headed "Adjusted 1972," however, indicates that if the scale drift found by Modu and Stern based on the period 1963 to 1973 is used to adjust the NLS (1972) means, the results for the second through the fifth strata become satisfactorily consistent for the two samples, although the present results would suggest that the drift is if anything slightly greater for the period 1960 to 1972 than the shift found by Modu and Stern.

The difference of 15 scaled score points between the 1960 results and the adjusted 1972 results for the highest stratum remains puzzling. The standard error of the difference of the two means can be estimated, with some approximation, as 5.7 scaled score points, large enough to warrant consideration. Although imprecision of equating may have contributed to the difference, it seems probable that the main source of the difference is attributable to differences in the measurement characteristics of the two reading tests. According to this hypothesis, SAT-verbal scores for top stratum students identified by the TALENT test regressed more than did SAT-verbal scores for top stratum students identified by the NLS test.

The difference for the lowest stratum is less difficult to interpret. Multiplying the actual N (3,106) by the percentage of the cohort in the sample (2 percent) indicates that only 81 students in this stratum took the SAT. Clearly, a relatively small number of outliers in the TALENT score distribution that were not rejected by the procedure used could have raised the TALENT mean appreciably. The fact that the SAT-verbal mean score for the lowest stratum is only 4 scaled points lower than the mean for the next higher stratum is consistent with this interpretation. (The corresponding difference for the NLS sample is 47 scaled score points.)

Implications for the SAT-Verbal Score Decline

The fact that reading scores declined more than twice as much for SAT takers as for high school seniors generally makes it clear that changes

in the ability level of the high school seniors can account at best for only part of the SAT-verbal score decline.

Using data already presented, we estimated the extent to which the change in the ability level of high school seniors contributed to the decline, and the extent to which the changed patterns of SAT taking contributed to it. Appendix D provides a full description of the method we used, which is called partitioning analysis. The application of partitioning analysis was based on three sets of data presented in Tables 1 and 3: the estimated number of high school seniors in each of the six ability strata in 1960 and 1972, the percentage of high school seniors in each ability stratum who took the SAT in 1960 and 1972, and the mean 1960 SAT-verbal score for students in each stratum. The results of the partitioning analysis provided answers to three questions as follows:

1. What would the SAT population be like if both the distribution of ability in the high school population and the SAT-verbal scale had remained constant, but the percentage of students at various ability levels who took the SAT changed as they in fact did between 1960 and 1972? Our estimate is that the mean verbal score of an estimated 627,000 SAT takers would be 454. The effect of the change in SAT-taking pattern alone is thus to drop the SAT-verbal mean from 474 to 454, a drop of 20 points.

2. What would the SAT population be like if the percentage of students at various ability levels who took the SAT stayed the same and the SAT-verbal scale remained constant, but the ability level of high school senior populations changed as it in fact did between 1960 and 1972? Our estimate is that the mean verbal score of an estimated 465,000 SAT takers would be 462. The effect of the change in ability level of the high school senior population alone is, therefore, to drop the SAT-verbal mean by 12 points.

3. What would the SAT population be like if the ability level of high school seniors and the percentage of students at various ability levels who took the SAT had changed as they in fact did but the SAT-verbal scale had remained constant? There would have been 935,000 SAT takers (as there were), but the mean score would have been 442 rather than 453. The net effect of scale drift is, therefore, to understate the decline in SAT-verbal mean by 11 points.

The effect of the change in the percentage of students at various ability levels who took the SAT, therefore, reduced the mean from 474, or 20 points on the SAT-verbal scale, whereas the effect of change in the ability level of high school seniors was to drop the mean from 474 to 462, by 12 points. When account is taken of scale drift, the overall decline in SAT-verbal is increased from 21 points to 32 points.

The findings of the partitioning analysis suggest that the question of why SAT scores declined can logically be thought of as two questions: Why did the decline in verbal ability of high school seniors occur? and Why did the patterns of SAT taking change? With respect to the second question, the following statement from the Report of the Commission on Tests (College Entrance Examination Board, 1970) seem remarkably pertinent:

"By 1950 there were under the relaxed [membership] requirements 115 collegiate members; by 1960 there were 350 collegiate members despite the addition of the test-use requirement in 1954; and in 1969 the collegiate membership was over 850.

"Such large increases in membership inevitably changed the character of the College Board, and it has become increasingly representative of the universe of all institutions of postsecondary education."

Further information on the nature of the changes in both the high school population and the SAT-taking population is presented in the next section, with a view to understanding the declines in mean verbal ability.

CHANGES IN OTHER STUDENT CHARACTERISTICS FROM 1960 TO 1972

In the previous section, we described and discussed changes in the measured reading ability of the high school senior population, college entrants, and students who took the SAT. In this section, nine other characteristics of these populations -- age, sex, each parent's education and occupation, family configuration, curriculum, and expected college major (if any)--will be described as a means of probing further into some changes that may help us to understand shifts in ability. In this section, all characteristics will be considered first for high school seniors, then for college entrants, and finally for SAT candidates.

Changes in the High School Senior Population

Age. As shown in Table 4, the period from 1960 to 1972 saw a marked decrease in the percentage of high school seniors in the 17½ and younger age group. This decrease may have arisen because fewer children were entering school at a relatively early age, or because there was less tendency to accelerate rapid learners. An alternative hypothesis is that the reduced percentage of younger students may have resulted, in part, from a reduced tendency for students who were progressing through school at an average or slower rate to drop out. From this viewpoint, the increased holding power of the schools during this period may have contributed to this result.

The fact that the increase in the percentage of high school seniors who are between 18 and 18½ is almost exactly equal to the decrease in the percentage who are under 17½ suggests that changed attitudes toward acceleration of school progress is the main source of the change in the percentage of younger students.

Table 4 also shows that there were small increases in the percentage of students in the two older groups, perhaps reflecting the increase in the holding power of high schools during this period.

Results for mean reading scores show that within the twelfth grade groups in both years, younger students tend to earn higher scores than older students, presumably because abler students progress more rapidly through school than do less able students. Despite the shift in the age distribution between 1960 and 1972, the score decline within each age group is similar to the overall decline.

Table 4. Reading Scores of High School Seniors Grouped by Age

Age	High school seniors				
	Actual N	Weighted N*	% of cohort	Reading Mean	Reading S.D.
17½ or less					
1960	2971	272	14.6	11.7	4.8
1972	927	166	5.5	4.0	5.0
17½+ to 18					
1960	7900	723	38.8	11.3	4.8
1972	6395	1171	38.8	10.5	4.7
18+ to 18½					
1960	6003	550	29.5	10.7	4.9
1972	6246	1162	38.5	10.1	4.8
18½+ to 19					
1960	1824	167	9.0	8.5	5.1
1972	1817	314	10.4	8.0	5.2
Above 19					
1960	1180	108	5.8	6.2	5.0
1972	1173	184	6.1	5.2	4.5
No response					
1960	481	44	2.4	7.8	5.6
1972	125	19	0.6	4.5	4.1
Total					
1960	20359	1864	100.0	10.5	5.1
1972	16683	3015	100.0	9.7	5.0

*In thousands

The role of age changes in the score decline for high school seniors is difficult to assess. The proportion of students belonging to the younger, higher-scoring strata decreased and the proportion of students belonging to the older, lower-scoring strata increased from 1960 to 1972. This result suggests that age changes contributed slightly to the score decline. To the extent that the less rapid progress of the 1972 cohort through school resulted from changed attitudes toward acceleration, however, the effect of age changes may be even smaller than the results indicate.

Sex. The percentage of young men in these samples increased by one point, from 49 percent to 50 percent (see Table 5), perhaps because of a change in the dropout rate--a change that resulted in more young men staying in high school until graduation. The greater increase in the

Table 5. Reading Scores of High School Seniors Grouped by Sex

Sex	High School Seniors: Actual N	Weighted N*	% of cohort	Reading: Mean	S.D.
Males					
1960	9938	910	48.8	10.6	5.2
1972	8275	1502	49.8	9.6	5.0
Females					
1960	10421	954	51.2	10.5	5.0
1972	8395	1511	50.1	9.8	5.0
No response					
1960					
1972	13	2	0.1	8.4	4.5
Total					
1960	20359	1864	100.0	10.5	5.1
1972	16683	3015	100.0	9.7	5.0

*In thousands

number of men in comparison to the number of women may also have resulted in the slightly larger drop in the mean reading score for men, a drop of 1.0 compared to a drop of .7 for women. The suggestion is that in 1972 slightly more low-ability men were graduating than in 1960. However, although even a small change may be socially important, the possible contribution to the overall score decline is negligible.

Parent's Education and Occupation. A general United States population trend has been for parents to be better educated and more likely to be in professional or managerial occupations. The tables on father's and mother's education (Tables 6 and 7) show that in 1972 over 8 percent more students than in 1960 indicated that their father had some college; over 10 percent more indicated that their father graduated from high school; and nearly 14 percent fewer indicated that their father had not graduated from high school. Similarly, over 5 percent more indicated that their mother had some college; over 10 percent more indicated that their mother graduated from high school; and over 13 percent fewer indicated that their mother had not completed high school.

The same is true for almost all occupational groupings (see Tables 8 and 9). The tables show an increase in the percentage of mothers and fathers in professional and white collar jobs and a decrease in the percentage in blue collar jobs. (This comparison is confounded, however, by the fact that Project TALENT instructed students not to check "Housewife" if the mother had worked for pay during the past three years, whereas NLS permitted the student to choose the mother's principal occupation.)

With respect to reading comprehension, a finding of some interest is the relatively large drop of 1.3 in the mean reading score for the students whose fathers did not continue their education beyond high school.

Table 6. Reading Scores of High School Seniors Grouped by Father's Education

Father's Education	High school seniors: Actual N	Weighted N*	% of cohort	Reading: Mean	S.D.
Post high school					
1960	4394	402	21.6	12.6	4.7
1972	4976	896	29.7	11.9	4.6
High school graduate					
1960	4122	377	20.2	11.4	4.7
1972	4378	913	30.3	10.1	4.6
Less than high school graduate					
1960	8205	751	40.3	9.6	4.9
1972	4700	795	26.4	8.8	4.7
Don't know; blank					
1960	3638	333	17.9	9.2	5.5
1972	2629	411	13.6	5.8	4.7
Total					
1960	20359	1864	100.0	10.5	5.1
1972	16683	3015	100.0	9.7	5.0

*In thousands

Also noteworthy is the fact that the percentage of the cohort whose fathers did not complete high school decreased from 40 to 26. Because this was a low-scoring group in both years, this shift would tend to reduce the score decline.

Similarly, for father's occupation, the finding of interest is the increase in holders of higher-level positions whose children show a greater decrease in mean scores than the students with fathers in blue collar jobs.

The major shift for mothers was from blue collar to white collar positions. There was a greater decrease in the mean reading score of students with mothers in "white collar" positions than for those with mothers classified as "blue collar."

Family Configuration. In an article that has received wide attention, Zajonc (1976) proposed that intellectual development is closely related to the configuration of the family in which the individual child matures, since this configuration strongly influences the child's intellectual environment. "Intellectual environment," according to Zajonc, "can be thought of in this context as being some function of the average of the absolute intellectual levels of its members" (p. 227).

Table 7. Reading Scores of High School Seniors Grouped by Mother's Education

Mother's education	High school seniors: Actual N	Weighted N*	% of cohort	Reading: Mean	S.D.
Post high school					
1960	3995	366	19.6	12.5	4.7
1972	4006	745	24.7	11.9	4.5
High school graduate					
1960	5942	544	29.2	11.2	4.8
1972	6123	1194	39.6	10.3	4.6
Less than high school graduate					
1960	7491	686	36.8	9.4	5.0
1972	4245	715	23.7	8.6	4.8
Don't know; blank					
1960	2931	268	14.4	9.1	5.6
1972	2309	361	12.0	5.6	4.7
Total					
1960	20359	1864	100.0	10.5	5.1
1972	16683	3015	100.0	9.7	5.0

*In thousands

In general, the more siblings that children have, the lower the level of their intellectual environment and, thus, the rate of their intellectual development.

Zajonc further hypothesizes that the precise effect of the configuration depends on the time interval between successive siblings. A much older sibling can substantially raise the intellectual level of the environment. A child with a 20-year-old sibling has, in effect, another adult in his or her environment.

The effect is also mediated by the extent to which a young person is responsible for teaching his or her siblings. Zajonc hypothesizes that such teaching accelerates the intellectual development of the teacher. For this reason, only children and last-born children are hypothesized to develop at a lower rate than children in other positions.

These propositions have special relevance to national trends in test scores. Zajonc presents data showing a correspondence between mean SAT scores in the United States from 1963 to 1975 and the average order of live births 18 years earlier. Accordingly, he has proposed that "aggregate family factors are deeply implicated in the declining SAT scores" (p. 227).

Table 8. Reading Scores of High School Seniors Grouped by Father's Occupation

Father's occupation	High school seniors: Actual N	Weighted N*	% of cohort	Reading: Mean	S.D.
Professional, managerial					
1960	3399	311	16.7	12.8	4.6
1972	3769	732	24.3	11.9	4.6
White collar					
1960	2815	258	13.8	12.0	4.5
1972	2342	437	14.5	10.8	4.6
Blue collar					
1960	10666	977	52.4	9.8	4.9
1972	6696	1213	40.2	9.7	4.7
Don't know; blank					
1960	3479	319	17.1	9.3	5.5
1972	3876	634	21.0	6.6	4.7
Total					
1960	20359	1864	100.0	10.5	5.1
1972	16683	3015	100.0	9.7	5.0

*In thousands

The present study provided a unique opportunity to test Zajonc's model (the confluence model) for the period from 1960 to 1972 by means of the family configuration data described in the first section of this paper.

Table 10 presents the results for the high school senior population. Our first observation is that the distribution of family configurations did, indeed, change from 1960 to 1972. The percentage of only children decreased from 8 to 3 and the percentage of first children in families of two decreased from 13 to 7. For the balance of the configurations, the percentages of first-born children consistently decreased and the percentages of all later born children increased.

As for mean reading scores, first consider the Project TALENT results. The correspondence between the TALENT means and the Belmont-Marolla results reported by Zajonc and Markus (1975) is extraordinary. In every important respect the two samples agree: (1) mean scores decline with family size; (2) within each family size, the scores decline with birth order, with the exception of the next to the last child in families of four and five who exhibit a slight quadratic upswing; (3) within each family size the last born has the lowest mean; and (4) those who are

Table 9. Reading Scores of High School Seniors Grouped by Mother's Occupation

Mother's occupation	High school seniors: Actual N	Weighted N*	% of cohort	Reading: Mean	S.D.
Professional, managerial					
1960	1513	139	7.4	11.8	4.9
1972	1557	283	9.4	11.5	4.7
White collar					
1960	2611	239	12.8	12.4	4.4
1972	2672	527	17.5	11.2	4.5
Blue collar					
1960	3604	330	17.7	9.6	5.0
1972	1742	302	10.0	9.8	4.7
Homemaker					
1960	9807	898	48.2	10.5	5.0
1972	7520	1368	45.4	9.9	4.9
Don't know; blank					
1960	2824	259	13.9	9.3	5.6
1972	3192	535	17.7	6.9	4.8
Total					
1960	20359	1864	100.0	10.5	5.1
1972	16683	3015	100.0	9.7	5.0

*In thousands

Table 10. Reading Scores of High School Seniors Grouped by Family Configuration

Birth order and family size	High school seniors: Actual N	Weighted N*	% of cohort	Reading: Mean	S.D.
Only child					
1960	1520	139	7.5	11.5	4.7
1972	495	96	3.2	10.8	4.9
First of two					
1960	2574	236	12.6	12.2	4.5
1972	1193	220	7.3	11.1	4.7

(Continued)

Table 10 (Continued)

Birth order and family size	High school seniors				
	Actual N	Weighted N*	% of cohort	Reading Mean	Reading S.D.
Second of two					
1960	1694	155	8.3	11.3	4.8
1972	1356	262	8.7	10.6	4.6
First of three					
1960	1813	166	8.9	11.8	4.6
1972	1106	214	7.1	11.1	4.7
Second of three					
1960	1210	111	5.9	10.9	4.7
1972	1234	234	7.8	10.3	4.7
Third of three					
1960	837	77	4.1	10.7	4.9
1972	1127	203	6.7	9.9	4.9
First of four					
1960	1028	94	5.0	11.6	4.8
1972	700	131	4.4	10.8	4.8
Second of four					
1960	771	71	3.8	10.4	4.9
1972	800	144	4.8	9.9	4.8
Third of four					
1960	519	48	2.5	10.5	4.9
1972	795	150	5.0	10.1	4.8
Fourth of four					
1960	422	39	2.1	10.3	4.9
1972	512	96	3.2	10.1	4.9
First of five					
1960	522	48	2.6	11.0	5.1
1972	401	71	2.4	10.5	4.3
Second of five					
1960	385	35	1.9	10.1	4.9
1972	406	72	2.4	9.3	5.2
Third of five					
1960	321	29	1.6	9.9	4.7
1972	476	84	2.8	9.0	5.3

(Continued)

Table 10 (Continued)

Birth order and family size	High School seniors				
	Actual N	Weighted N*	% of cohort	Reading	
				Mean	S.D.
Fourth of five					
1960	246	23	1.2	10.2	4.6
1972	325	57	1.9	9.4	4.8
Fifth of five					
1960	241	22	1.2	9.0	5.2
1972	225	38	1.3	9.9	5.0
Six or more children					
1960	3419	313	16.8	8.8	5.1
1972	3383	566	18.8	8.6	5.1
No data					
1960	2837	260	13.9	9.0	5.8
1972	2149	376	12.5	8.0	5.1
Total					
1960	20359	1864	100.0	10.5	5.1
1972	16683	3015	100.0	9.7	5.0

*In thousands

only children score slightly lower than the first born in families of four. In the Belmont-Marolla data, the highest and the lowest scores are separated by about two-thirds of one standard deviation. In the TALENT data, the difference between the highest mean (for the first born of two) and the lowest (the mean for all subjects in families of six or greater) is exactly two-thirds of one standard deviation. The only observable way in which the TALENT sample differs is that, unlike the Belmont-Marolla data, the decline from the next-to-last child to the last child is not in all cases greater than the average difference between other adjacent siblings.

The means for the NLS sample are similar in two respects: they decline with famil, size, and the mean for only children is equal to the mean for the first born in families of four. However, mean scores for the last children in families of four and five do not decline, as do the TALENT and Belmont-Marolla means. In fact, mean scores for the fourth and fifth children in families of five exhibit a marked upswing. In this respect, the NLS means are similar to the Scottish data reported by Zajonc (1976). Although a full investigation of these differences is beyond the scope of the present study, we can speculate that the differences are related to the time interval between the later born children in the NLS families of four and five.

For present purposes, the important question is how much the change in the distribution of family configurations may have contributed to the decline in mean reading scores for high school seniors. There no

doubt was some effect, for in general the higher scoring family configurations declined in number relative to the lower scoring configuration. It is equally clear, however, that the effect accounts for only a fraction of the decline because all configurations except one (children who were fifth in families of five) showed declines in mean reading scores that are similar to the overall decline. In other words, when family configuration is held constant, declines in reading scores are still observed.

Because of the widespread interest in Zajonc's confluence model we attempted to estimate the magnitude of the observed effects. This was done by estimating what the 1972 mean might have been if nothing had changed from 1960 to 1972 except for the percentages of the student cohort falling in each category of family configuration (i.e., the decrease in only children from 8 percent to 3 percent, the decrease of first of two's from 13 percent to 7 percent, the increase of second of two's from 8 percent to 9 percent, and so on). This is provided by the vector product of the 1972 "% of cohort" column and the 1960 "reading mean" column. This product indicates that the 1972 overall mean reading score would have been 10.3, rather than 10.5 as it was in 1960. This shift is about 4 percent of the standard deviation of the reading scale. Since the observed 1972 mean was 9.7, or .8 of a score point less than the 1960 mean, the decline of .2 is about one-fourth as large as the observed decline in the reading scores of the high school seniors.

High School Curriculum. In 1972, somewhat more students were enrolled in academic and general courses and proportionately fewer in the vocational-technical area (see Table 11). However, the students in each category show approximately the same decline in mean scores, suggesting that curriculum is not a significant variable so far as the general decline is concerned.

Expected College Major Field. In each total sample, the number of students who expected to major in science or mathematics declined slightly (from 9 percent to 7 percent); social sciences and humanities increased considerably (from 9 percent to 15 percent); engineering declined (from 7 percent to 3 percent); and "other matching fields" remained approximately constant (see Table 12).

In general, the students who planned to go to college and who had tentatively selected a major either show no decline--the mathematics and science students actually gained in reading comprehension--or le decline than the population of seniors. The percentage of students who were not planning to attend college or were planning to do so but did not report a major field choice, increased from 1960 to 1972, and the mean score for this group dropped from 9.0 to 7.7, a decline appreciably greater than the overall decline. These results raise an important question: Why did students whose future plans showed a clear academic orientation show little or no score decline from 1960 to 1972?

Summary of Changes in High School Senior Population. The second section of this paper reported an appreciable general decline in reading comprehension. Numerous hypotheses could be advanced to explain the decline: for example, a decline in the effectiveness of instruction, the effect of television watching, student disenchantment with education, or a change in the composition of the high school graduating classes. This section has been devoted largely to an investigation of the last hypothesis.

Table 11. Reading Scores of High School Seniors Grouped by High School Curriculum

High school curriculum	High school seniors: Actual N	Weighted N*	% of cohort	Reading: Mean	Reading: S.D.
General					
1960	4194	384	20.6	9.2	4.8
1972	5665	957	31.7	8.3	4.8
Academic					
1960	7825	716	38.4	13.1	4.3
1972	6811	1379	45.7	11.9	4.5
Vocational-technical					
1960	6692	613	32.9	8.4	4.8
1972	4201	678	22.5	7.3	4.6
No response					
1960	1648	151	8.1	10.4	5.4
1972	6	1		5.3	2.3
Total					
1960	20359	1864	100.0	10.5	5.1
1972	16683	3015	100.0	9.7	5.0

*In thousands

Probably the most salient finding is the pervasiveness of the decline. The decline in reading comprehension scores was found in almost every subgroup of the high school population examined. Older students and younger students, boys and girls, students from high SES families and students from low SES families, only children and students with many siblings, college preparatory students, and noncollege students--all showed a decline. This would argue for some general influence on the attainment of all high school seniors. We did, however, observe a number of changes in the composition of senior classes from 1960 to 1972 that may have contributed to the observed decline. In summary, the relevant changes were as follows:

1. A small increase in age
2. An increase in fathers who completed high school but did not continue their education
3. A decrease in the percentage of only children and first-born children
4. An increase in the proportion of students who either did not intend to attend college or intended to attend but did not report a choice of major field

Table 12. Reading Scores of High School Seniors Grouped by College Major Choice

Expected college major	High school seniors: Actual N	Weighted N*	% of cohort	Reading: Mean	Reading: S.D.
Science, mathematics					
1960	1746	160	8.6	12.9	4.8
1972	1099	211	7.0	13.2	3.9
Social sciences, humanities					
1960	1910	175	9.4	13.1	4.6
1972	2359	453	15.0	12.4	4.3
Engineering					
1960	1498	137	7.4	12.2	4.8
1972	413	77	2.6	11.9	4.3
Other matching fields					
1960	5003	458	24.6	11.1	4.8
1972	3546	675	22.4	11.1	4.4
Nonmatching fields**					
1960	1331	122	6.5	10.2	4.9
1972	416	77	2.5	10.1	4.4
No college plans; no response					
1960	8871	812	43.6	9.0	5.0
1972	8850	1522	50.5	7.7	4.8
Total					
1960	20359	1864	100.0	10.5	5.1
1972	16683	3015	100.0	9.7	5.0

*In thousands
**Fields that were listed in one survey but had no counterpart in the other survey

Changes in the College Entrant Population

In what way has the collection of students going to college changed? Certainly, American colleges have made a concerted effort to be more egalitarian in admissions policies and have searched for and welcomed many students of lower socioeconomic background. What effect, if any, has this effort had?

The reader should be reminded that the percentages of college entrants reported here may be lower than the percentages reported elsewhere be-

Table 13. College Entrants Grouped by Age Level

Age	College entrants			
	Estimated N*	% of stratum	% of cohort	Reading mean
17½ or less				
1960	123	45.4	17.3	13.6
1972	89	53.5	6.8	12.8
17½+ to 18				
1960	315	43.6	44.2	13.2
1972	547	46.8	42.1	12.2
18+ to 18½				
1960	213	38.8	30.0	12.6
1972	533	45.9	41.0	11.9
18½+ to 19				
1960	38	22.8	5.3	11.4
1972	97	30.9	7.5	10.8
Above 19				
1960	22	20.7	3.1	9.0
1972	29	15.9	2.2	7.6
No response				
1960	9	20.0		11.9
1972	1	.7		3.6
Total				
1960	721	38.7	100.0	12.8
1972	1301	43.1	100.0	11.9

*In thousands

cause our figures include only those who attended college full-time in the year immediately following their graduation from college. Looking at the bottom row of Table 13, we see that, according to our definition, the percentage of graduating high school seniors who attended college increased from 39 percent in 1960 to 43 percent in 1972.

Age. Except for the 19-years-and-older group, the percentage in each stratum going to college is higher in 1972 than in 1960. In both 1960 and 1972, the percentage of students going to college decreases as age increases. Similarly, the mean reading score decreases as age increases.

As in the high school senior group, the percentage of students 17½ and younger in the college entrant group decreased markedly, from 17 percent to 7 percent, between 1960 and 1972. Also as in the high school senior group, the percentage of students in the 18-to-18½-year group increased by about the same amount, from 30 percent to 41 percent.

The noticeable reduction in the percentage of students in the higher scoring youngest age group and the corresponding increase in the lower scoring 18-to-18½-year group may have contributed slightly to the score decline. For college entrants as for college seniors, however, the contribution of age changes to the score decline is difficult to assess because the age changes may have resulted mainly from changed attitudes toward acceleration.

Sex. Changes in the role of women in our society have resulted in a sharp change in the ratio of sexes in the college entrant group. Males made up 57-percent of the 1960 cohort but only 52 percent of the 1972 cohort (see Table 14). The composition of the college entrant population, therefore, changed substantially over these 12 years. With respect to reading tests, males scored slightly higher in 1960 and females slightly higher in 1972. The changes in the representation of the sexes in the college entrant population and the shift in relative ability support the view that the talent loss among bright girls was greater than that for boys in 1960. By 1972, the difference in college-going percentage between boys and girls has been markedly reduced, a finding of considerable importance. The observed shifts do not seem, however, to help explain the score decline.

Parent's Education and Occupation. The percentages of students entering college have not changed substantially as a function of father's education. About the same percentage of children of college-educated fathers, high-school-educated fathers, and "less-than-high-school"-

Table 14. College Entrants Grouped by Sex

Sex	College entrants			
	Estimated N*	% of stratum	% of cohort	Reading mean
Males				
1960	410	45.1	56.9	12.9
1972	675	45.0	51.9	11.7
Females				
1960	314	32.9	43.5	12.7
1972	626	41.4	48.1	12.0
No response				
1960				
1972		19.2		11.3
Total				
1960	721	38.7	100.0	12.8
1972	1301	43.2	100.0	11.9

* In thousands

Table 15: College Entrants Grouped by Father's Education

Father's education	College entrants: Estimated N*	% of stratum	% of cohort	Reading mean
Post high school				
1960	263	65.3	42.7	13.8
1972	575	64.2	47.7	13.0
High school graduate				
1960	165	43.8	26.9	13.2
1972	400	43.9	33.2	11.6
Less than high school graduate				
1960	196	26.1	31.8	11.8
1972	225	28.3	18.7	11.0
Don't know; blank				
1960	106	31.9		11.9
1972	96	23.4		8.1
Total				
1960	721	38.7	100.0	12.8
1972	300	43.1	100.0	11.9

*In thousands

educated fathers go to college (see Table 15). Also, when students are grouped by mother's education, the percentage going to college is somewhat higher both for students whose mothers attended college and for those whose mothers did not complete high school (see Table 16).

The numbers of students with parents at the various educational levels changed, however, with the result of a change in the distribution of parents of students going to college, as shown in the "% of cohort" column. In 1972, nearly 48 percent of the reporting students had fathers who had at least some college, against 43 percent in 1960; the percentage with fathers who had a high school education went from 27 percent to 33 percent over the 12 years; and the percentage of college entrants who had fathers with less than a full high school education dropped from 32 percent to 19 percent. The change in the distribution of mother's education is similar. A larger percentage of college entrants now have mothers with some college education or a high school diploma, and fewer have mothers who did not graduate from high school.

College entrants whose fathers complete high school but did not attend college showed a noticeably greater score decline than the total group. A similar pattern was found for high school seniors (Table 6). On the other hand, college entrants whose mothers did not graduate from high school showed a relatively large score decline, but this subgroup

Table 16. College Entrants Grouped by Mother's Education

Mother's education	College entrants: Estimated N*	% of stratum	% of cohort	Reading mean
Post high school				
1960	223	60.9	34.8	13.8
1972	489	65.6	40.0	12.9
High school graduate				
1960	244	44.9	38.2	12.9
1972	517	43.3	42.3	12.0
Less than high school graduate				
1960	170	24.8	26.6	12.0
1972	210	29.4	17.2	10.6
Don't know; blank				
1960	82	30.5		11.9
1972	79	22.0		7.8
Total				
1960	721	38.7	100.0	12.8
1972	1301	43.1	100.0	11.9

*In thousands

did not show an unusually large decline in the analysis of high school seniors (Table 7). Thus, the results for mother's education suggest that factors in self-selection for college attendance may have changed for this subgroup between 1960 and 1972.

The effect of the change in parent's occupation is not so clear. Actually, a smaller percentage of the high school students who reported that their fathers were in professional or managerial positions entered college, and a slightly smaller percentage of students with fathers in white collar jobs entered college (see Table 17). A larger percentage of students with fathers in blue collar jobs entered college. For all four groups of students who reported mother's education, there was an increase in the percentage who entered college, the largest increase occurring for students whose mothers held blue collar jobs (see Table 18).

The change in the general distribution of parent's occupational status has also had an effect on the total composition of college classes. The percentage of college freshmen with fathers in professional or managerial jobs increased from 35 percent to 41 percent, and the proportion whose fathers have white or blue collar jobs decreased slightly--as did the proportion who have mothers in blue collar jobs or at home.

Table 17. College Entrants Grouped by Father's Occupation

Father's occupation	College entrants			
	Estimated N*	% of stratum	% of cohort	Reading mean
Professional, managerial				
1960	218	70.1	34.8	13.5
1972	461	63.0	40.8	13.1
White collar				
1960	139	53.9	22.2	13.5
1972	224	51.2	19.8	12.3
Blue collar				
1960	267	27.3	42.6	12.2
1972	441	36.4	39.0	11.6
Don't know; blank				
1960	95	29.7		12.1
1972	170	26.8		8.8
Total				
1960	721	38.7	100.0	12.8
1972	1301	43.1	100.0	11.9

*In thousands

College entrants whose fathers were professionals or managers showed a noticeably smaller score decline than the overall group. Because the proportion of the college entrant cohort belonging to this subgroup increased from 1960 to 1972, the trends for this group would tend to reduce the score decline. That the percentage of high school seniors in this subgroup who entered college declined from 70 percent in 1960 to 63 percent in 1972 suggests that self-selection may have contributed to this result.

With respect to mother's occupation, college entrants whose mothers were employed as blue collar workers showed a somewhat greater score decline than the total group. This presumably reflects a changed pattern of self-selection, in light of the fact that the reading score of the high school seniors in this subgroup increased slightly.

To sum up parental changes, about the same percentage of students of each parental group attended college, but the change in the distribution of parent's occupation resulted in a moderate change in the composition of the student body. The parents of college entrants would seem to be, as a whole, slightly better educated and slightly more likely to be engaged in professional and managerial occupations in 1972 than in 1960.

Family Configuration. In general, the relationship between family configuration and college entrance is what would be predicted on the

Table 18. College Entrants Grouped by Mother's Occupation

Mother's occupation	College entrants			
	Estimated N*	% of stratum	% of cohort	Reading mean
Professional, managerial				
1960	77	55.7	12.1	13.4
1972	175	61.9	15.3	12.8
White collar				
1960	119	49.7	18.6	13.5
1972	266	50.5	23.2	12.5
Blue collar				
1960	82	24.8	12.8	12.8
1972	104	34.5	9.1	11.6
Homemaker				
1960	362	40.3	56.6	12.6
1972	596	43.6	52.1	12.1
Don't know; blank				
1960	82	31.8		12.5
1972	156	29.2		9.2
Total				
1960	721	38.7	100.0	12.8
1972	1301	43.1	100.0	11.9

*In thousands

basis of the relationship between family configuration and developed ability. The students in configurations with higher means exhibit a higher probability of entering college. As shown in Table 19, the first children in families of two, the group among the high school senior population with the highest mean, have the highest percentages attending college (52 percent for Project TALENT and 58 percent for the NLS). In both samples, the larger the family, the lower the average percentage entering college. The differences are less for NLS subjects, perhaps reflecting increased opportunity for higher education in 1972.

Within families, college entrance declines with increasing ordinal position except for an upswing in college entrance for the third and fourth child in families of four and the last child in families of five.

From 1960 to 1972 the percentage of college entrants in all configurations increased, but by different degrees. The increases range from 3 percent for the "Fourth of four" stratum to 18 percent for the "Fourth of five" stratum. No pattern in the increases emerges except, possibly, for generally larger increases for students in larger families. Again,

Table 19. College Entrants Grouped by Family Configuration

	College entrants			
	Estimated N*	% of stratum	% of cohort	Reading mean
Only child				
1960	67	48.4	10.5	13.0
1972	55	56.9	4.6	12.4
First of two				
1960	123	52.3	19.2	13.4
1972	129	58.5	10.7	12.5
Second of two				
1960	76	48.7	11.8	12.8
1972	140	53.4	11.6	11.8
First of three				
1960	79	47.8	12.4	13.6
1972	112	52.4	9.3	12.7
Second of three				
1960	50	45.5	7.9	12.7
1972	114	48.7	9.5	12.2
Third of three				
1960	30	38.9	4.6	13.2
1972	93	45.6	7.7	11.8
First of four				
1960	40	42.7	6.3	13.9
1972	61	46.5	5.1	12.5
Second of four				
1960	21	29.2	3.2	12.9
1972	61	42.6	5.1	11.4
Third of four				
1960	17	36.2	2.7	12.3
1972	68	45.3	5.7	12.3
Fourth of four				
1960	16	40.3	2.4	12.2
1972	41	43.0	3.4	12.1
First of five				
1960	14	30.0	2.2	14.2
1972	30	41.8	2.5	11.8

(Continued)

Table 19. (Continued)

	College entrants			
	Estimated N*	% of stratum	% of cohort	Reading mean
Second of five				
1960	9	25.5	1.4	14.1
1972	27	36.7	2.2	11.8
Third of five				
1960	7	25.4	1.2	12.1
1972	31	36.5	2.5	11.9
Fourth of five				
1960	4	18.7	0.7	13.1
1972	21	36.8	1.7	11.8
Fifth of five				
1960	8	36.3	1.2	12.8
1972	15	39.3	1.2	11.5
Six or more children				
1960	80	25.4	12.4	11.1
1972	192	33.8	15.9	11.0
No data				
1960	79	30.6	0.0	12.2
1972	111	29.6	0.0	10.5
Total				
1960	721	38.7	100.0	12.8
1972	1314	43.6	100.0	11.9

*In thousands

this may reflect expanded educational opportunities. The mean reading scores for each stratum of college entrants are consistent with this speculation. In the 1960 sample, the mean scores for college entrants in the larger families were generally high. It is plausible that these relatively high means were the result of more stringent selection on ability for college entrants in the larger families. But this pat ern disappears in the NLS means--a change that would seem to represent ocial progress.

High School Curriculum. About the same percentage of students in the general, academic, and vocational-technical curriculums attended college in 1972 as in 1960 (see Table 20). However, the change in attendance in different high school courses has resulted in modest changes in the academic background of the college population. Just over 73 percent of the college students were enrolled in the academic course in high school.

Table 20. College Entrants Grouped by High School Curriculum

High school curriculum	College entrants			
	Estimated N*	% of stratum	% of cohort	Reading mean
General				
1960	95	24.8	14.3	10.4
1972	267	27.9	20.5	10.2
Academic				
1960	487	68.0	73.4	13.7
1972	937	68.0	72.0	12.6
Vocational-technical				
1960	83	13.5	12.5	10.6
1972	90	13.3	6.9	9.1
No response				
1960	57	38.1		12.3
1972				
Total				
1960	721	38.7	100.0	12.8
1972	1301	43.1	100.0	11.9

*In thousands

Those from general curriculums increased slightly at the expense of vocational-technical curriculums.

The reading test scores for college entrants who were enrolled in the general curriculum in high school showed very little decline from 1960 to 1972. College entrants who had taken vocational-technical curriculums showed a relatively large decline. On the whole, the results do not appear to contribute to an understanding of the score decline.

Expected College Major. Both in 1960 and 1972, students who expected to major in science or mathematics showed a higher proportion who actually entered college than any other group (see Table 21). In 1972, the percentage reached 86 percent. They were followed by students who expected to major in engineering (80 percent), then social sciences and humanities (77 percent), "other matching fields" (75 percent), and the students whose major fields could not be matched in the two studies (55 percent). The increases in the percentages from 1960 to 1972 followed a roughly reverse pattern. The subgroups with the highest 1960 percentages (science, mathematics, social sciences, and humanities) display the least increase, whereas engineering, other fields, and the "no matching field" group show greater gain. This may reflect in part a kind of ceiling effect: other things being equal, if nearly all

Table 21. College Entrants Grouped by College Major Choice

Expected college major	College entrants			
	Estimated N*	% of stratum	% of cohort	Reading mean
Science, mathematics				
1960	121	75.9	19.3	13.9
1972	181	85.6	15.6	13.5
Social sciences, humanities				
1960	130	74.3	20.6	13.6
1972	349	76.9	30.2	12.8
Engineering				
1960	87	63.2	13.8	13.9
1972	61	79.7	5.3	12.3
Other matching fields				
1960	246	53.6	39.0	12.2
1972	506	74.9	43.8	11.6
Nonmatching fields**				
1960	49	40.0	7.8	11.8
1972	42	55.1	3.6	10.9
No college plans; no response				
1960	92	11.3		12.0
1972	145	9.5		8.7
Total				
1960	721	38.7	100.0	12.8
1972	1301	43.1	100.0	11.9

*In thousands
**Fields that were listed in one survey but had no counterpart in the other survey

members of a subgroup go on to college, an increase in the percentage is less likely than it is for the groups with smaller percentages.

College entrants who expected to major in science or mathematics showed a relatively small score decline, but those who expected to enroll in engineering showed a relatively large decline. The latter decline was accompanied by a marked reduction in the percentage of students choosing engineering (14 percent of the cohort in 1960 and 5 percent in 1972). Although these results cannot readily be related to the score decline, it may be more than coincidental that engineering careers enjoyed great prominence during the post-Sputnik period when talent searching and talent loss were of great concern to higher education.

Summary of Changes for College Entrants. We conclude, therefore, that colleges are attracting more women students and students from nearly all types of families, particularly students from lower socio-

economic levels. This shift is more than offset, however, by changes in the educational and occupational status of parents, so that the colleges are even more heavily populated by high socioeconomic groups. As for the reading scores, the most striking finding, again, is the uniformity with which nearly all subgroups display a decline. A few exceptions were noted, but it appears likely that their combined effect would account for only a fraction of the observed decline.

Changes in the SAT Candidate Group

SAT scores have been widely used as a kind of social indicator, and some writers have interpreted the decline in SAT means as the consequence of a general decline in the scholastic ability of high school students. Such an interpretation need not be correct, because the decline in average SAT scores could simply represent a change in the population taking the SAT examinations.

As shown in Table 22, the most obvious change in the SAT population is the great increase in the proportion of students taking the test. In 1960, only 18 percent of the high school population took the SAT, whereas 31 percent were tested in 1972, an increase far greater than the increase in college attendance.

Two points that may affect the interpretation of the results deserve consideration. First, the actual number of students who took the SAT is approximately 3,500 for TALENT and approximately 4,500 for NLS. Although these samples are quite large, sampling error clearly plays a larger role, particularly in differences between means, for students who took the SAT than for high school seniors or college entrants.

The second complication in interpreting SAT-verbal means arises if the shift in the SAT score scale between 1960 and 1972 is taken into account. The results obtained in the Modu and Stern study (1976) and in the present study indicate that such a shift has occurred. Although the figures shown for SAT-verbal means are actual rather than adjusted, the Modu and Stern results will be taken into account when necessary in discussing the results. The reader who wishes to adjust 1972 means in order to obtain a more precise evaluation of particular 1972 means will find the following table useful.

If SAT score for 1972 group is	Subtract
563 - 587	5
538 - 562	6
513 - 537	7
476 - 512	8
438 - 475	9
413 - 437	10
388 - 412	11
363 - 387	12
350 - 362	13

Table 22. Students Who Took the SAT Grouped by Age

Age	SAT takers				SAT-verbal		SAT-mathematical	
	N*	% of stratum	% of cohort	Reading mean	Mean	S.D.	Mean	S.D.
17½ or less								
1960	74	27.2	22.8	14.7	487	107	509	109
1972	74	44.8	7.9	13.2	480	115	503	119
17½+ to 18								
1960	139	19.3	43.0	14.4	478	108	498	112
1972	404	34.5	43.3	12.6	457	104	492	110
18+ to 18½								
1960	91	16.5	27.9	14.0	467	107	490	111
1972	374	32.2	40.0	12.4	454	107	485	112
18½+ to 19								
1960	14	8.4	4.3	12.6	437	109	474	99
1972	63	20.2	6.8	11.3	424	110	455	113
Above 19								
1960	6	5.9	2.0	11.1	428	114	445	102
1972	18	10.0	2.0	8.4	353	104	393	109
No response								
1960	2	5.4		12.4	469	109	485	84
1972	1	5.7		7.3	342	42	337	57
Total								
1960	326	17.5	100.0	14.2	474	108	496	110
1972	936	31.0	100.0	12.4	453	108	485	113

*In thousands

Age. There has been a marked increase in the percentage of students taking the SAT at all age levels (see Table 22). In both the 1960 and 1972 data, increasing age is associated with a reduced probability of taking the SAT. All age groups declined in mean reading ability and in SAT means.

For SAT candidates, as for high school seniors and for college entrants, there has been a marked reduction in the percentage of students less than 17½ years old and a roughly corresponding increase in the percentage of students in the 18-to-18½-year-old group. In 1960, 23 percent of the SAT candidates were 17½ or younger; in 1972, only 8 percent were in this age group. This shift may have made a minor contribution to the score decline. If the reduction in the percentage of young SAT takers resulted from changed attitudes toward acceleration, however, the explanatory value of age shifts is weakened, as noted in the discussion of results for high school seniors.

For SAT-verbal scores, the youngest group shows an unusually small score decline—7 points as compared with 21 points for the overall group. The difference for reading scores is less pronounced--1.5 points as compared with 1.8 points.

Sex. Given a substantial increase for both sexes in the proportion taking the SAT, the increase for women is markedly greater. Women constitute 50 percent of the 1972 group as compared with 43 percent of the 1960 group (see Table 23). Although both males and females dropped in reading ability and in SAT means, the declines for females are somewhat larger. In 1960 the women had higher reading and SAT-verbal scores, presumably because of higher selectivity.

Interestingly, for high school seniors and college entrants the males showed somewhat greater score declines than females.

Parent's Education and Occupation. The SAT is taken by a larger proportion of students for every breakdown of education and occupation for both parents. The increase is especially noticeable at the lower socio-economic levels where, for example, students whose fathers did not graduate from high school jumped from 10 percent to 21 percent (see Table 24), and the proportion for students whose father had a blue collar job jumped from 10 percent to 26 percent (see Table 26). Clearly, more students of all backgrounds are taking the SAT. As it happens, however, the distribution of parents of students who took the SAT has not changed very much. The proportion of SAT candidates whose fathers went to college stayed at about 50 percent of the fathers whose educational background was reported (see Table 24), while the proportion with fathers who did not graduate from high school declined from 25 percent in 1960 to 19 percent in 1972.

For parent's education, a similar pattern occurs for both the reading test and the verbal sections of the SAT. Students whose fathers had post-high-school education showed less than the average amount of decline, and students whose fathers had not attended college showed greater than average declines on both tests. A similar pattern holds for mother's education (see Table 25). For both fathers and mothers, the increase in the percentage who were high school graduates, and the corresponding decrease in the percentage without high school diplomas, might be expected to diminish rather than increase the extent of score decline.

Table 23. Students Who Took the SAT Grouped by Sex

Sex	SAT takers N*	% of stratum	% of cohort	Reading mean	SAT-verbal Mean	SAT-verbal S.D.	SAT-mathematical Mean	SAT-mathematical S.D.
Males								
1960	187	20.5	57.3	14.1	471	109	520	111
1972	472	31.4	50.5	12.3	454	106	506	114
Females								
1960	140	14.6	42.7	14.4	478	107	465	102
1972	463	30.7	49.5	12.4	452	110	464	108
No response								
1960								
1972		10.8		15.0	600		520	
Total								
1960	326	17.5	100.0	14.2	474	108	496	110
1972	936	31.0	100.0	12.4	453	108	485	113

*In thousands

Table 24. Students Who Took the SAT Grouped by Father's Education

Father's education	SAT takers N*	% of stratum	% of cohort	Reading mean	SAT-verbal Mean	SAT-verbal S.D.	SAT-mathematical Mean	SAT-mathematical S.D.
Post high school								
1960	143	35.5	50.3	14.8	495	107	511	111
1972	435	48.5	49.3	13.3	484	106	517	109
High school graduate								
1960	70	18.5	24.5	14.1	462	105	492	109
1972	280	30.7	31.8	12.0	438	101	463	106
Less than high school graduate								
1960	72	9.6	25.2	13.5	449	107	481	110
1972	167	21.0	18.9	11.5	423	99	466	109
Don't know; blank								
1960	42	12.6		13.7	466	110	478	106
1972	53	12.9		9.7	379	100	402	108
Total								
1960	326	17.5	100.0	14.2	474	108	496	110
1972	935	31.0	100.0	12.4	453	108	485	113

*In thousands

Table 25. Students Who Took the SAT Grouped by Mother's Education

Mother's education	SAT takers N*	% of stratum	% of cohort	Reading mean	SAT-verbal Mean	SAT-verbal S.D.	SAT-mathematical Mean	SAT-mathematical S.D.
Post high school								
1960	127	34.6	43.5	14.8	496	107	513	112
1972	367	49.3	41.3	13.2	485	108	517	111
High school graduate								
1960	100	18.4	34.3	14.1	465	105	494	107
1972	383	32.1	43.0	12.3	443	101	477	108
Less than high school graduate								
1960	65	9.5	22.2	13.5	443	103	474	108
1972	140	19.6	15.7	11.4	421	101	450	106
Don't know; blank								
1960	35	13.1		13.9	476	112	484	109
1972	45	12.5		9.4	385	104	404	112
Total								
1960	326	17.5	100.0	14.2	474	108	496	110
1972	935	31.0	100.0	12.4	453	108	485	113

*In thousands

For father's occupation (see Table 26), there seems to be little difference among the three major groups on the verbal sections of the SAT, but students whose fathers held white collar positions show a slightly greater decline. Students in the "Don't know; blank" category show a decidedly greater than average decline on both tests. For mother's occupation (see Table 27), students whose mothers were engaged in professional or managerial occupations or who were homemakers showed a slightly greater score decline than students whose mothers were engaged in white collar or blue collar occupations, again on both tests. Although the differences on the verbal sections of the SAT are reduced when the NLS means are adjusted for scale drift, the pattern remains the same.

The interpretation of the result for homemakers is complicated by the fact that, in the TALENT questionnaire, students were told not to check "Housewife" if their mother had worked for pay in the last three years, while NLS imposed no such restriction.

Family Configuration. In general, most of our observations in regard to the families of all college entrants are applicable to students who took the SAT. As shown in Table 28, in 1960 a higher proportion of the higher ability configurations took the SAT, and similarly, but to a lesser extent, in 1972. In other words, family configuration became, in 1972, a less important determinant of taking the SAT, although we still find a somewhat smaller proportion of students from large families doing so.

For the TALENT subjects, the mean reading scores of the various strata of students who took the SAT follow the pattern predicted by the confluence model in three ways: (1) within families the first-born children have scores equal to or higher than the scores of later born children; (2) only children have a mean that is less than the mean for the first born in families of four; and (3) the lowest mean is the mean for all children in families of six or more. The separation of the various configurations is, however, substantially less than it is for the high school senior population. This suggests that self-selection strongly attenuated the effect of family configuration. In any case, the effects in question are small, for again we find that within each stratum the mean reading scores decreased by an amount that in most cases approximates the overall decline.

The SAT-verbal means exhibit patterns similar to the reading score means. For both TALENT and NLS, those who are only children have lower SAT means (both verbal and mathematical) than the first born of families of two, three, and four and, by and large, the subjects in larger families have lower scores. There are many exceptions to the expected patterns, however, possibly because of sampling error. (In one case the mean is based on only 56 actual cases.) Furthermore, we find the same attenuation of the effect that seems to exist for the reading score; the means for the various configurations simply do not display the same spread as those found for the reading scores of the high school population.

In order to estimate the magnitude of the effect of the change in family configuration from 1960 to 1972, we asked what the 1972 mean SAT-verbal score would have been if nothing changed from 1960 to 1972 except for the composition of the SAT cohort. The weighting of each

Table 26. Students Who Took the SAT Grouped by Father's Occupation

Father's occupation	SAT takers N*	% of stratum	% of cohort	Reading mean	SAT-verbal Mean	SAT-verbal S.D.	SAT-mathematical Mean	SAT-mathematical S.D.
Professional, managerial								
1960	118	37.8	41.8	14.8	497	107	514	111
1972	361	49.3	42.9	13.3	482	107	516	109
White collar								
1960	70	27.1	24.8	14.4	470	104	493	109
1972	170	39.0	20.2	12.4	455	106	487	110
Blue collar								
1960	94	9.6	33.4	13.6	449	106	485	108
1972	310	25.6	36.9	12.0	437	99	472	107
Don't know; blank								
1960	45	14.2		13.8	472	111	480	109
1972	94	14.8		10.0	391	106	409	106
Total								
1960	326	17.5	100.0	14.2	474	108	496	110
1972	935	31.0	100.0	12.4	453	108	485	113

*In thousands

Table 27. Students Who Took the SAT Grouped by Mother's Occupation

Mother's occupation	SAT takers N*	% of stratum	% of cohort	Reading mean	SAT-verbal Mean	SAT-verbal S.D.	SAT-mathematical Mean	SAT-mathematical S.D.
Professional, managerial								
1960	38	27.6	13.1	14.9	503	111	516	107
1972	132	46.6	15.7	13.1	485	111	510	111
White collar								
1960	60	25.2	20.7	14.4	476	106	498	114
1972	201	38.2	23.9	12.8	464	99	498	107
Blue collar								
1960	32	9.7	11.0	13.5	444	106	471	106
1972	79	26.2	9.4	12.2	436	100	478	109
Homemaker								
1960	161	17.9	55.2	14.2	473	107	499	111
1972	429	31.4	51.0	12.5	455	107	488	113
Don't know; blank								
1960	35	13.5		13.9	471	109	482	105
1972	94	17.6		10.0	394	107	417	106
Total								
1960	326	17.5	100.0	14.2	474	108	496	110
1972	936	31.0	100.0	12.4	453	108	485	113

*In thousands

Table 28. Students Who Took the SAT Grouped by Family Configuration

	SAT takers							
					SAT-verbal		SAT-mathematical	
	N*	% of stratum	% of cohort	Reading mean	Mean	S.D.	Mean	S.D.
Only child								
1960	34	24.6	11.7	14.2	471	109	489	113
1972	43	44.7	5.0	12.9	463	111	487	111
First of two								
1960	66	27.9	22.6	14.5	476	106	497	113
1972	93	42.0	10.8	12.8	467	105	491	111
Second of two								
1960	36	23.1	12.3	14.3	478	108	500	112
1972	109	41.5	12.7	12.5	457	102	485	115
First of three								
1960	36	21.5	12.3	14.7	478	110	501	110
1972	84	39.2	9.8	12.9	468	111	497	109
Second of three								
1960	21	18.8	7.1	14.2	466	101	503	107
1972	89	37.8	10.3	12.5	457	111	494	113
Third of three								
1960	15	17.4	4.6	14.3	479	111	504	109
1972	71	34.7	8.2	12.1	448	106	478	111
First of four								
1960	19	20.3	6.6	14.4	491	106	511	111
1972	43	32.8	5.0	12.7	466	112	497	114

(Continued)

Table 28 (Continued)

	SAT takers							
					SAT-verbal		SAT-mathematical	
	N*	% of stratum	% of cohort	Reading mean	Mean	S.D.	Mean	S.D.
Second of four								
1960	11	15.7	3.8	13.9	461	105	503	120
1972	43	30.1	5.1	12.4	451	107	495	110
Third of four								
1960	7	14.8	2.4	14.4	474	98	494	92
1972	49	32.6	5.7	12.7	460	100	491	112
Fourth of four								
1960	5	13.3	1.8	14.2	470	107	488	89
1972	25	26.1	2.9	12.7	476	112	506	125
First of five								
1960	7	15.3	2.5	14.3	483	114	517	120
1972	19	27.2	2.3	11.9	444	103	508	107
Second of five								
1960	5	13.0	1.6	14.3	459	112	493	99
1972	22	29.9	2.5	12.3	446	108	490	108
Third of five								
1960	3	11.2	1.1	13.9	476	122	496	92
1972	22	25.9	2.5	12.3	443	102	492	102
Fourth of five								
1960	2	7.3	0.6	13.7	450	92	485	95
1972	14	24.9	1.6	12.3	432	98	482	108

Table 28 (Continued)

	SAT takers							
					SAT-verbal		SAT-mathematical	
	N*	% of stratum	% of cohort	Reading mean	Mean	S.D.	Mean	S.D.
Fifth of five								
1960	2	10.0	0.8	13.8	456	92	483	89
1972	11	28.8	1.3	13.3	464	96	482	117
Six or more children								
1960	24	7.8	8.3	12.8	453	116	478	112
1972	121	21.3	14.1	12.1	437	108	476	112
No data								
1960	35	13.5	0.0	14.2	480	108	487	105
1972	79	21.1	0.0	10.9	428	109	447	114
Total								
1960	326	17.5	100.0	14.2	474	108	496	110
1972	935	31.0	100.0	12.4	453	108	485	113

*In thousands

Table 29. Students Who Took the SAT Grouped by High School Curriculum

High school curriculum	SAT-takers N*	% of stratum	% of cohort	Reading mean	SAT-verbal Mean	SAT-verbal S.D.	SAT-mathematical Mean	SAT-mathematical S.D.
General								
1960	19	4.9	6.2	11.9	423	109	442	106
1972	110	11.5	11.8	10.7	397	97	434	104
Academic								
1960	267	37.3	88.3	14.5	480	106	504	109
1972	783	56.8	83.7	12.8	466	105	498	110
Vocational-technical								
1960	17	2.7	5.5	11.5	410	105	428	98
1972	43	6.3	4.6	9.3	359	82	379	89
No response								
1960	24	16.0		14.5	495	109	497	108
1972								
Total								
1960	326	17.5	100.0	14.2	474	108	496	110
1972	936	31.0	100.0	12.4	453	108	485	113

*In thousands

1960 mean by the 1972 "% of cohort" produced a new overall mean of 472. This is the best estimate of the change in SAT-verbal scores that would have occurred if the mean scores within groups had remained the same but the distribution of SAT candidates with respect to family configuration types had changed (as they did). The estimated mean is 2 scale points less than the 1960 overall mean of 474. Thus, this particular statistical technique suggests that changes in family configuration contributed only a small amount to the decline in SAT-verbal scores from 1960 to 1972.

High School Curriculum. Although the percentages of students in different curriculums who went on to college remained unusually stable from 1960 to 1972, the percentages who took the SAT consistently increased (see Table 29). The percentage of general students taking the SAT increased markedly, from 5 percent to 12 percent, as did the percentage of vocational-technical students, from 3 percent to 6 percent. When the changes in the total numbers enrolled in the various curriculums are considered, we find that the composition of students who took the SAT changed from 6 percent to 12 percent for general students, from 88 percent to 84 percent for college preparatory students, with almost no change for vocational-technical students.

When students are grouped by curriculum, the academic group showed a noticeably smaller score decline than students in vocational-technical curriculums among students who took the SAT, both on that test and on the reading test.

Expected College Major. As with high school curriculum, the increase in the percentage of each college major group taking the SAT increased much more than the percentage entering college (see Table 30). The most dramatic increase was in the case of the students who expected to major in "Other matching fields" (for example, business, education, and nursing). The number of such students increased from 98,000 to 319,000, or from 22 percent to 47 percent of the cohort. The other subgroups increased also but not to the same degree. When changes in the number in each subgroup are considered, we find the following substantial changes in the composition of students taking the SAT: (1) an increase of 10 percent in the students planning to major in social sciences and the humanities, (2) a decrease of 11 percent in engineering majors, and (3) an increase of 8 percent in other majors.

Prospective science and mathematics majors showed a slight gain in SAT-verbal scores and a relatively small loss in reading scores. Students whose major field was classified in "Other matching fields" showed relatively small losses in SAT-verbal and reading scores.

College Attendance. A question of considerable interest concerns changing patterns of college attendance among test takers. Table 31 indicates a substantial change. In 1960, 77 percent of students who took the SAT attended four-year colleges; in 1972, the percentage was only 60 percent. Part of this difference is attributable to the increase in two-year college attendance, which increased from 6 percent of the students who took the SAT to 15 percent. Rather surprisingly, the percentage who were not attending college increased from 8 percent to 16 percent. Because the four-year college group was substantially higher in test performance than the groups that increased in their proportion of the population (about 67 scaled score points higher in 1960 and about 70 points higher in 1972 on the verbal sections of the

Table 30. Students Who Took the SAT Grouped by College Major Choice

Expected college major	SAT takers N*	% of stratum	% of cohort	Reading mean	SAT-verbal Mean	SAT-verbal S.D.	SAT-mathematical Mean	SAT-mathematical S.D.
Science, mathematics								
1960	60	37.3	20.8	14.9	499	109	544	113
1972	137	64.9	17.9	13.9	503	106	560	106
Social sciences, humanities								
1960	64	36.9	22.5	15.1	509	106	492	101
1972	245	54.0	32.0	13.3	486	105	496	106
Engineering								
1960	46	33.4	16.0	14.8	485	100	566	99
1972	40	52.2	5.3	13.1	470	118	558	108
Other matching fields								
1960	98	21.5	34.3	13.3	437	101	450	96
1972	319	47.2	41.8	12.0	436	96	471	100
Nonmatching fields								
1960	18	14.8	6.3	13.5	438	98	464	94
1972	23	29.4	3.0	11.2	424	81	487	104
No college plans; blank								
1960	40	4.9		13.7	474	110	479	105
1972	172	11.3		10.6	399	102	420	106
Total								
1960	326	17.5	100.0	14.2	474	108	496	110
1972	936	31.0	100.0	12.4	453	108	485	113

*In thousands

Table 31. Students Who Took the SAT Grouped by College Attendance

College attendance	SAT takers N*	% of stratum	% of cohort	Reading mean	SAT-verbal Mean	SAT-verbal S.D.	SAT-mathematical Mean	SAT-mathematical S.D.
Four-year college, full-time student								
1960	197	44.2	77.1	14.9	495	104	516	108
1972	539	64.5	60.2	13.2	483	106	520	108
Two-year college, full-time student								
1960	15	18.0	6.0	12.9	426	92	443	100
1972	134	35.5	15.0	11.1	411	88	438	95
Vocational or other school								
1960	22	10.4	8.6	13.5	430	104	464	106
1972	74	22.5	8.3	11.2	412	96	435	103
Not in school**								
1960	21	4.8	8.4	13.0	434	99	457	103
1972	148	11.6	16.5	11.3	412	101	434	102
Unclassified								
1960	71	10.4		13.2	451	113	474	108
1972	40	19.9		11.1	425	109	460	121
Total								
1960	326	17.5	100.0	14.2	474	108	496	110
1972	936	31.0	100.0	12.4	453	108	485	113

*In thousands
**Includes part-time college students

SAT), these results describe a population change that does contribute appreciably to the decline in SAT scores.

SUMMARY

In general, we observe a great increase in the proportion of high school seniors who take the SAT, as a result of the more rapid growth in the SAT candidate volume from 1960 to 1972 than the growth in the number of high school graduates. Of greater interest are the results involving changes in the composition of the SAT population brought about by the increases and decreases reported above. When shifts in the number of students in each subgroup are considered, we find the following changes in the SAT population:

1. A marked increase in the proportion of women candidates
2. A small increase (5 percent) in the proportion of "general" students and an equal decrease in the proportion of college preparatory students
3. An increase in the proportion of students from larger families
4. Increases in the proportion of students planning to major in the social sciences and humanities and certain undergraduate career programs (for example, business, education, and nursing) and a decrease in engineering majors
5. A substantial decrease in the proportion of SAT takers who attended four-year colleges

On both tests, almost every subgroup of students who took the SAT showed some decline in scores. Among the groups that showed a slight increase or a relatively small decline were students younger than 17½ years, students whose parents had education beyond high school, students who expected to major in science or mathematics in college, or in some field other than liberal arts and engineering, students whose mothers were employed in white collar or blue collar occupations, and students who entered four-year colleges. Almost without exception, the decline in scores for these group was more than half as large as the average decline. One change appears to have made an appreciable contribution to the SAT score decline: a substantial decrease in the proportion of candidates who enter four-year colleges.

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APPENDIX A. EQUATING THE PROJECT TALENT AND NATIONAL LONGITUDINAL STUDY READING TESTS

Intfoduction

A careful survey of the extensive battery of tests used in Project TALENT in 1960 and the tests used in the NLS survey in 1972 indicated that the tests of reading comprehension and the mathematical tests were sufficiently similar to warrant formal study of their equivalence (Schrader and Hilton, 1975, pp. 68-70). When the available evidence on the tests was reviewed in the light of the present study design, however, the probability that the two mathematical tests could be properly equated seemed to us not high enough to warrant their inclusion. Accordingly, we focused our attention on the reading tests.

Equating Design

The equating design was based on Angoff's Design II (Angoff, 1971, pp. 573-576). In this design, the two tests to be equated are administered so that one random half of the equating sample takes the tests in one order and the other random half tal them in the reverse order.

Each participating school was asked to test only one class (preferably an English class composed mainly of seniors) and to administer the two tests at different class sessions. The order in which the tests were to be administered was specified in the instructions sent to each school.

Sample Design

For public schools in the 50 states and the District of Columbia, stratification was based on (1) geographical region and (2) whether or not the school was located in a Standard Metropolitan Statistical Area (SMSA). All private schools were included in a single stratum.

Enrollment data for public high school students (grades 9-12) for SMSAs and non-SMSAs by state were obtained from reports of the 1970 census (U.S. Bureau of the Census, 1972). In all, 11 strata approximately equal in high school enrollment were developed, as follows:

Stratum	Approximate enrollment (in thousands)
Metropolitan public schools:	
New England, New York	1,352
Other North Atlantic	1,125
Indiana, Ohio, Michigan	1,201
Other Great Lakes and Plains	1,178
Southeast	1,339
California	1,229
Other West and Southwest	1,250

(Continued)

Stratum	Approximate enrollment (in thousands)
Nonmetropolitan-public schools:	
North Atlantic, East North Central	1,438
Southeast	1,492
West North Central, West, Southwest	1,461
Private schools	
All regions	1,411

Because the schedule for the study did not permit replacement of schools unable or unwilling to participate, we invited 176 schools (16 from each stratum) to administer the tests. Assuming that about half would participate, we expected to obtain data for about 88 schools for our actual equating.

The College Board/ETS Secondary School Master File, which includes more than 25,000 schools, constituted our basic list for school selection. The master file, reviewed monthly, includes public, independent, and parochial schools and is as comprehensive as possible. From this list we selected a random sample of 1,000 schools and assigned a random sequence number to each of them. Data needed for assigning schools to strata and to confirm that the school had a twelfth grade were obtained from various sources, particularly the SMSA list in the 1972 County and City Data Book (U.S. Bureau of the Census, 1972) and the five volumes of the directory of secondary schools, 1968-69 (National Center for Education Statistics, 1970). Within each stratum, we selected the 16 schools having the lowest sequence numbers. Two schools invited to participate in the 1974 PSAT/NMSQT Norms Study were replaced by schools in the same stratum having the next following sequence numbers. Altogether, we invited a total of 176 schools to participate. (Because of an error in assigning schools to strata, one of the 176 schools should have been replaced by a different school. However, the error was discovered too late to permit inviting a replacement school. The school that should not have been invited did not participate.)

Test Administration

Because the study was initiated relatively late in the academic year, we mailed invitations to participate on March 29 and asked the schools to test in late April or early May. All but one of the schools that did not reply were reached by telephone, and a total of 91 schools administered the tests.

We reproduced the tests from copies of the tests printed for the original survey. Insofar as possible, we left the directions to the students unchanged, but we prepared special directions for each order of testing, to minimize the risk that they would be given in the wrong order. We designated the TALENT test Form 1 and the NLS test Form 2 in schools that were to give TALENT first. For schools giving NLS first, we designated the NLS test Form A and the TALENT test Form B. We allowed schools to give makeup tests to absentees but did not use the scores for these students in the equating.

Each school was given a set of guidelines designed to provide an objective basis for selecting the class to be tested--guidelines based on the first letter of the last name of the teacher and on the time the class met. We did not collect data on how precisely the schools followed the guidelines.

Following the testing, we reviewed supervisors' reports and answer sheets. One school reported a serious mistiming and was excluded from the equating sample. Two schools had reversed the order of administration; their data were analyzed on the basis of the order in which the tests were actually given. We excluded a number of students whose testing date indicated that they had been given makeup tests.

Equating Sample

Our equating sample included only students who had taken both tests and who reported that they were in the twelfth grade. We excluded from the study two schools that had no usable data for twelfth-grade students. Table A1 shows the distribution of schools and students by strata and by testing orders. In the final equating sample, there were 47 schools that administered TALENT first and 41 that administered NLS first. In part, this difference in the number of schools for the two testing

Table A1. Distribution of Participating Schools and Students by Stratum and Testing Order

Stratum	TALENT-NLS No. of schools	Sequence No. of students[a]	NLS-TALENT No. of schools	Sequence No. of students[a]
Metropolitan public schools:				
New England, New York	6	94 (9)	4	75
Other North Atlantic	4	86 (2)	4	84 (3)
Indiana, Ohio, Michigan	5	73 (1)	5	81 (6)
Other Great Lakes and Plains	3	49 (2)	3	51
Southeast	3	43 (3)	4	51 (1)
California	5	97 (1)	3	59 (3)
Other West and Southwest	2	33	4	89 (1)
Nonmetropolitan public schools:				
North Atlantic, East North Central	7	139	5	98 (1)
Southeast	4	75 (1)	3	65 (2)
West North Central, West, Southwest	4	141 (6)	2	34 (4)
Private schools:				
All regions	4	94 (3)	4	96 (1)
Total	47	924 (28)	41	783 (??)

a. Numbers in parentheses indicate the number of students excluded on the basis of robust regression analysis from the final equating sample.

orders arose because testing orders were assigned alternately within strata using a random start, after each school agreed to participate. As it turned out, each of the four strata that had an odd number of participants was assigned the TALENT-NLS sequence.

Each school was assigned a predetermined weight, so that the weighted sample would have the following characteristics:

1. The sum of the weighted frequencies for each stratum would be proportional to the number of students in that stratum in grades 9-12 in the 1970 census data.
2. Within each stratum, the sum of the weighted frequencies would be equal for each school.

Weights were determined separately for each testing order.

Characteristics of the Equating Sample

As part of the data collection for the equating study, we asked each student to complete a 10-item questionnaire, primarily to provide us with a means of comparing the characteristics of our equating sample with those of Project TALENT and NLS. From 98 percent to 100 percent of the twelfth-grade students in the sample completed the questionnaire, depending upon the item. Table A2 shows the percentage of the sample that responded to each item and also, when comparable data existed, the distribution of percentages for three other samples:

1 The 1960 TALENT sample of twelfth graders, as reported in the American High School Student (Flanagan et al., 1964)

2. The 1970 TALENT Sample Resurvey (Flanagan and Jung, 1971)

3. The Base-Year Survey of the National Longitudinal Study of the High School Class of 1972, as reported in Hilton et al., 1973

These results are discussed in the following paragraphs.

First, the 100 percent figure for the twelfth-grade students in the equating sample merely reflects the fact that for equating and for these comparisons all students below grade 12 were excluded from the sample.

The appreciably smaller proportion of males in the equating sample probably resulted from the instruction to the schools to select the participating classrooms from those taught by "teachers of twelfth-grade English (or closely related subjects like communications or journalism)." We assume that a somewhat smaller proportion of men than women are enrolled in senior English courses. Also, although schools were permitted to conduct makeup test administrations for students who were absent on either or both testing days, results from these optional administrations were not included in the analyses. More boys than girls may have been absent.

The third item (question 23) indicates that the equating sample contained a disproportionately large number of academic or college preparatory students. This, again, probably resulted from selecting the sample classrooms from English classes. Although most seniors take one subject taught by the English department, the probability of a student's taking more than one such subject is no doubt higher for students in academic or college preparatory programs. Even if one assumes tendency for students to overstate their standing, question 24 suggests that the sample students tended to be above average. Fourteen percent reported they were in the top 5 percent of their class, and only 3 percent acknowledged they were in the low quarter.

Table A2. Percentages for Equating Study Questionnaire Responses and Comparisons with Project TALENT and NLS Survey Results

	% TALENT 1960[a]	% TALENT 1970[b]	% NLS 1972[c]	% Equating sample[d]
21. What grade are you now in?				
(A) 12	100.0		100.0	100.0
(B) 11		100.0		
(C) 10 or lower				
	100.0	100.0	100.0	100.0
22. What is your sex?				
(A) Male	49.3	47.7	49.7	43.6
(B) Female	50.7	52.3	50.4	55.9
Omitted				.5
	100.0	100.0	100.1	100.0
23. Which of the following best describes your present high school program?				
(A) General	20.6	25.9	30.6	32.2
(B) Academic or college preparatory	38.4	44.3	45.9	54.3
(C) Commercial or business (including distributive education), vocational or technical (including health occupations and home economics occupations), agriculture or a program very different from above	32.9	29.9	23.5	13.0
Omitted or no data	8.1			.6
	100.0	100.1	100.0	100.1
24. How would you compare your academic achievement, as measured by grades or rank, with that of the other students in your high school class?				
(A) Top 5%		No comparable items		14.1
(B) Top quarter but not top 5%				34.5
(C) Second quarter (from the top)				35.9
(D) Third quarter (from the top)				10.8
(E) Low quarter				3.1
Omitted				1.6
				100.0

(Continued)

Table A2. (Continued)

	% TALENT 1960[a]	% TALENT 1970[b]	% NLS 1972[c]	% Equating sample[d]
25. Which of the following best describes your plans for next year?				
(A) Get a full-time job or join the military service.			29.2	18.1
(B) Attend a 4-year college. .	42.0[e]		33.6	49.3
(C) Attend a 2-year college. .	10.0		16.3	19.9
(D) Become a full-time homemaker.			2.8	.9
(E) Other.			18.2	11.0
Omitted.				.7
			100.1	99.9
26. Did you take the College Board Scholastic Aptitude Test?				
(A) Yes.			29.8	45.2
(B) No			70.2	54.1
Omitted.				.7
			100.0	100.0
27. Did you take the American College Test (ACT)?				
(A) Yes.			19.8	42.3
(B) No			80.2	56.8
Omitted.				.9
			100.0	100.0
28. How many books have you read (not including those required for school) in the past 12 months? Don't count magazines or comic books.				
(A) None	11.7	9.6		8.5
(B) 1-5.	40.4	39.6		42.6
(C) 6-10	19.6	22.4		23.5
(D) 11-15.	10.2	11.5		10.4
(E) 16 or more	18.2	16.9		14.4
Omitted.				.6
	100.1	100.0		100.0
29. Did your father attend college?				
(A) Yes.	19.1[f]		30.5	40.0
(B) No			69.5	58.7
Omitted.				1.3
			100.0	100.0

(Continued)

Table A2. (Continued)

	% TALENT 1960[a]	% TALENT 1970[b]	% NLS 1972[c]	% Equating sample[d]
30. Did your mother attend college?				
(A) Yes.	15.0[g]		21.9	32.1
(B) No			78.1	66.9
Omitted.				1.0
			100.0	100.0

a. Both TALENT samples are weighted.
b. From Flanagan and Jung (1971).
c. Weighted by means of base-year weights for students completing the student questionnaire.
d. Weighted in accordance with sample design.
e. From item 302 of the TALENT student questionnaire. Other responses were not relevant.
f. From item 218 of the TALENT student questionnaire. Other responses were not relevant.
g. From item 219 of the TALENT student questionnaire. Other responses were not relevant.

As one might expect from the relatively high proportion of sample subjects in the college preparatory program, the proportion who reported that they planned to attend college exceeds by about 20 percent the proportion of NLS subjects who planned to attend college, and again, as would be expected, a higher proportion of the sample subjects took either the SAT or ACT.

Regarding the number of books that the sample subjects had read in the past 12 months (question 28), the distribution of frequencies is remarkably similar to that in the 1960 and 1970 TALENT samples. Why these results should be so invariant is not clear.

Lastly, approximately 10 percent more of the students reported that their fathers attended college than did the students in the NLS sample and, similarly, for college attendance by mothers.

Another relevant descriptor is the performance of the equating sample on the two reading tests in question. The equating sample was clearly superior. The students who took NLS first had a mean of 11.71 and a standard deviation of 4.80, compared with a mean of 9.65 and a standard deviation of 5.05 for the 1972 NLS sample (Hilton et al., 1973). Similarly, the students in the equating sample who took TALENT first had a mean of 34.5 and a standard deviation of 9.9, compared with a mean of 33.3 and a standard deviation of 10.1 for the twelfth-grade sample of TALENT students (Flanagan et al., 1964). Thus, it appears that the equating sample subjects are an above average group of students in ability, educational aspirations, and socioeconomic background.

Equating Method

Essentially, the equating method used called for equipercentile equating of TALENT and NLS scores for each testing order separately and for averaging the results. It was decided to express TALENT scores on the NLS scale in this study, so that for each TALENT raw score the average of the two NLS equivalent scores defined the line or relation. This method of equating was found to be effective in the Anchor Test Study (Bianchini and Loret, 1972).

The program used for the equipercentile equating is based on linear interpolation, using the midpercentile for each raw score on each test as the basis for interpolating. Results are calculated to one decimal place. A special problem in the present study arose because NLS scores were calculated by the conventional formula for correcting for chance success. After some exploration of ways to deal with this problem, it was decided to use the alternative scoring formula: rights plus one-fifth omits, and round the result to the nearest integer. After the equating had been completed, each NLS score was transformed to the corresponding score for conventional formula scoring. For a 20-item test composed of 5-choice items, scores on the alternative scale can be expressed on the conventional scale by multiplying the score by 1.25 and subtracting 5. For example, a student who had 11 questions right, 4 wrong, and 5 omitted would receive a score of 12 on the "rights plus 1/5 omits" scale and a score of 10 on the "rights minus 1/4 wrong" scale.

One other point about the equating process deserves mention. As it turned out, data were insufficient to determine the equating line for the lowest TALENT raw scores. It was decided to define the scale in this range by a linear extrapolation based on the NLS equivalent scores for the seven lowest scores for which equivalent scores could be calculated.

Equating of Attenuated Scores

Any attempt to equate scores on two tests must take into account the extent to which the tests differ in what they measure, in their reliability, and in their difficulty level. When the tests whose scores are to be equated are designed by the same authors to measure the same abilities and when they are matched with respect to format and difficulty level, appropriate equating methods are likely to produce interchangeable scores. On the other hand, when the tests differ in format and difficulty level and are prepared by different authors for somewhat different purposes, the problem of parallelism is formidable. Because the tests differed in difficulty level, it was recognized that the line of relation should be curvilinear. As Angoff (1971, pp. 567-568) makes clear, there are serious logical and statistical problems in equating tests that differ in reliability. There were definite reasons for believing that the TALENT and NLS reading tests differed in reliability, because the TALENT test included 48 items with a 30-minute time limit and the NLS test included 20 items with a 15-minute time limit. Data from the equating sample confirmed the expectation that the TALENT scores were substantially more reliable. An exploratory study was made

of the possible use of Lord's Item Characteristic Curve approach to equating, but because item data were not available for the TALENT sample, it was concluded that an alternative approach would be needed. It was finally decided to attenuate the TALENT scores by adding random normal deviates to the observed scores. Because the equating was done solely to provide as accurate a comparison as possible between the TALENT and NLS scores for the present study, the modification of TALENT scores by introducing random error appeared to be an acceptable method for balancing out the difference in test reliability.

The correlation coefficients of TALENT scores and of NLS scores with SAT-verbal scores and the standard deviations of TALENT scores for 643 students in the 1976 equating sample who had taken the SAT were used in determining the amount of additional error variance to be included in the TALENT scores. The following equation provided the basis for determining the standard deviation of the random deviates to be added to TALENT scores:

$$r_{01} = \frac{\Sigma_{x_0 x_2}}{\sigma_0 \sqrt{\sigma_2^2 + \sigma_r^2}}$$

In this equation,

0 = SAT-verbal
1 = NLS reading
2 = TALENT reading
σ_r^2 = variance of the random digits

The foregoing equation assumes that the covariance of the random digits with SAT-verbal and TALENT scores equals zero. The numerator may be written

$$r_{02}\sigma_0\sigma_2.$$

When the resulting equation is solved for σ_r^2, the result is:

$$\sigma_r^2 = \left(\frac{r_{02}^2}{r_{01}^2} - 1 \right) \sigma_2^2.$$

When observed values for the sample of 643 students are substituted in this equation, the following equation is obtained:

$$\sigma_r^2 = \left(\frac{.7869^2}{.7357^2} - 1 \right) (7.2571)^2$$

and

$$\sigma_r = 2.75$$

Accordingly, the TALENT scores were modified by adding a random normal deviate to each. Normal deviates for this purpose were obtained by using random normal deviates with a mean of zero and a standard deviation of 1, multiplying each deviate by 2.75, and curtailing the distribution by limiting the range to values between -7 and +7. The modified TALENT scores were expressed as integers by discarding figures to the right of the decimal point.

As part of the exploratory study of the Item Characteristic Curve approach to equating, the combined equating sample was analyzed and 50 students whose performance on the two tests was markedly inconsistent were removed by means of the so-called robust regression procedure (Beaton and Tukey, 1974). The final equating used in the main analysis was based on the reduced sample. Table A3 shows the NLS score corresponding to each modified TALENT score. It should be noted that 20.0 is the highest and -5.0 is the lowest NLS equivalent. These limits correspond to the highest and lowest scores attainable on the NLS test.

Inspection of a scatter diagram of the NLS and TALENT Reading scores for the 50 students who were dropped from the equating sample revealed that 13 earned TALENT scores that were unusually high relative to their NLS scores and that 37 earned NLS scores that were unusually high relative to their TALENT scores. The mean and standard deviation of NLS and TALENT scores for the two groups and for all 50 students were as follows:

	NLS			TALENT		
Group	Mean	SD	N	Mean	SD	N
TALENT Higher	3.8	3.1	13	36.5	7.2	13
NLS Higher	9.9	3.7	37	15.7	5.9	37
Total	8.3	4.5	50	21.1	11.1	50

As noted earlier, the students in the basic equating sample who took NLS first had a mean of 11.71 on that test and a standard deviation of 4.80, and the students who took TALENT first had a mean of 34.5 on that test and a standard deviation of 9.9. Thus, the excluded cases earned mean scores near the total group mean on the test for which their score was relatively high. When students were classified on the basis of the order in which they took the tests, it turned out that 28 of the 924 students who took TALENT first were excluded and 22 of the 783 students who took NLS first were excluded by the data cleaning analysis.

The effect of modifying the TALENT scores b adding random deviates can be observed by comparing the SAT-verbal means for members of the equating sample who had SAT scores stratified on the basis of each TALENT score with corresponding means for student stratified on the basis of their NLS score. The strata are defined in terms of relative standing among high school seniors in the NLS (1972) sample.

Table A3. Equivalent NLS Formula Score Corresponding to Each Modified TALENT Score

Modified TALENT score	Equivalent NLS score	Modified TALENT score	Equivalent NLS score
55	20.0	24	6.1
		23	5.7
54	20.0	22	5.2
53	20.0	21	4.9
52	20.0	20	4.6
51	20.0		
50	19.8	19	4.2
		18	3.8
49	19.4	17	3.1
48	18.9	16	2.4
47	18.2	5	1.9
46	17.6		
45	17.1	14	1.5
		13	0.9
44	16.4	12	0.4
43	15.8	11	-0.2
42	15.2	10	-1.0
41	14.6		
40	14.1	9	-1.6
		8	-1.9
39	13.5	7	-2.6
38	12.9	6	-2.9
37	12.4	5	-3.5
36	11.8	4	-4.0
35	11.2	3	-4.6
		2	-5.0
34	10.7	1	-5.0
33	10.2	(-7)-0	-5.0
32	9.7		
31	9.2		
30	8.8		
29	8.4		
28	7.9		
27	7.4		
26	6.9		
25	6.4		

Results of Subtracting SAT-Verbal Mean Based on NLS Stratification from SAT-Verbal Mean Based on Stratification by:

Stratum	Original TALENT score	Modified TALENT score
Highest tenth	+14	- 5
Second tenth	- 3	- 4
Second fifth	- 7	+ 9
Third fifth	-13	- 8
Fourth fifth	-11	+11
Lowest fifth	- 7	- 7

Because all members of the equating sample were high school seniors in 1976, the question of scale drift in SAT scores does not complicate comparisons of SAT-verbal means when students are stratified on the two reading tests, as is true in the main study. In preparing the table, each student was classified on the basis of his or her reading test scores into the appropriate ability stratum defined by 1972 high school seniors. Mean SAT-verbal scores were calculated for each subgroup so defined. Then the SAT-verbal mean for students assigned to a particular stratum using NLS scores was subtracted from the corresponding mean for students classified using TALENT scores. For example, students classified in the top stratum on original TALENT scores had an SAT-verbal mean of 566; the mean for the corresponding NLS group was 552. When modified TALENT scores were used, the SAT-verbal mean was 547. Although the pattern of results is obscured by sampling fluctuations, it appears that when students are assigned on the basis of the original TALENT scores, students in the top stratum earn higher SAT-verbal scores than students assigned to the top stratum on the basis of NLS scores. For the lower ability strata, the difference is in the opposite direction and is fairly substantial for the third and fourth fifths. A systematic difference is to be expected because the original TALENT scores are more highly correlated with SAT-verbal scores than are NLS scores. On the other hand, there seems to be no observable trend in the differences when the TALENT stratification is based on modified scores. These findings support the decision to modify the TALENT scores to make them more comparable to NLS scores.

Estimation of Equating Error

The method used for evaluating the sampling error of equating is based on the method of balanced repeated replication described by McCarthy (1969), and by Kish and Frankel (1970, 1974). For this purpose, schools were classified on the basis of stratum and testing order, making 22 groups in all, and the number of schools in each group was determined. Next, it was necessary to define two sets of subgroups, balanced as closely as possible. It was decided to include all schools in the analysis, and to allocate schools to the two sets of subgroups so that the number of schools in each set would be balanced as closely

as possible with respect to group, stratum, and testing order. When the allocation process was completed, each set included 44 schools, and the number of schools assigned to one set did not exceed the number of schools assigned to the other set by more than one for any of the 22 groups, for any of the 11 strata, or either of the two testing orders. When necessary, the extra school was allocated at random to one set or the other. After the number of schools to be included in each of the 22 pairs of subgroups was determined, the assignment of schools to one or the other set was determined using random numbers. To take account of differences from school to school in the number of students in the equating sample and differences in the number of schools assigned to each of the 22 pairs of subgroups, weights were calculated so that the weighted frequencies for each subgroup would be equal. Finally, the weights for the 11 strata were adjusted to take account of the differences in the 1970 high school enrollments.

If one or the other member of a subgroup pair is chosen from each of the 22 groups, a very large number of different combinations of half-samples can be defined. For greatest efficiency in using the data, a systematic balanced design for the definition of half-samples is desirable. The necessary design principles have been developed by Plackett and Burman (1943-1945). The design appropriate to the present study is shown in Table 4A. In Table 4A, each subgroup for the TALENT-NLS testing order has a corresponding subgroup for the NLS-TALENT testing order. (Odd-numbered subgroups may be considered to have a minus sign, and even-numbered subgroups may be considered to have a plus sign, in Burman and Plackett's notation.) It will be noted that each of the 12 half-samples includes one of the two subgroups from each stratum and each testing order. The half-samples so constituted were then used to perform an equipercentile equating. This process resulted in 12 equipercentile lines of relation between NLS and TALENT Reading scores.

In order to determine the standard error of equating for a particular TALENT score, the deviations of the 12 equating results for that score from the value obtained by the equating based on the total equating were calculated. The standard error of equating is then equal to

$$\sqrt{\frac{\Sigma d^2}{12}}$$

in which "d" stands for deviation. Two decimal places were used in calculating the deviations.

The following table shows the NLS equivalent and the standard error of equating (in NLS scale units) for selected points in the TALENT scale:

Modified TALENT score	NLS equivalent	Standard error of equating
48	18.9	.15
44	16.4	.17
40	14.1	.11
36	11.8	.13

(Continued)

(Continued)

Modified TALENT score	NLS equivalent	Standard error of equating
32	9.7	.12
28	7.9	.17
24	6.1	.30
20	4.6	.32
16	2.4	.28
12	0.4	.21

For NLS scores from 7.9 through 18.9, the standard errors of equating are below .2, or about percent of the standard deviation of NLS scores for high school seniors. The fact that standard errors for lower scores are larger is probably attributable to the fact, discussed earlier, that the equating sample earned relatively high scores both on TALENT and NLS.

Although Kish and Frankel (1974) concluded, on the basis of extensive empirical studies, that balanced repeated replication designs provide the best available method for evaluating sampling error for complex statistics, it should be noted that an approximation is introduced in the results by the fact that the paired subsamples were not exactly balanced with respect to the number of schools and students.

Table A4. Assignment of Subgroups to Half-Samples

Half-sample											
1	2	3	4	5	6	7	8	9	10	11	12
Subgroup											
2	2	1	2	2	2	1	1	1	2	1	1
3	4	4	3	4	4	4	3	3	3	4	3
6	5	6	6	5	6	6	6	5	5	5	5
7	8	7	8	8	7	8	8	8	7	7	7
9	9	10	9	10	10	9	10	10	10	9	9
11	11	11	12	11	12	12	11	12	12	12	11
14	13	13	13	14	13	14	14	13	14	14	13
16	16	15	15	15	16	15	16	16	15	16	15
18	18	18	17	17	17	18	17	18	18	17	17
19	20	20	20	19	19	19	20	19	20	20	19
22	21	22	22	22	21	21	21	22	21	22	21

APPENDIX B. DEFINITION OF COLLEGE ATTENDANCE

As mentioned earlier, defining college attendance posed several problems, the resolution of which resulted in attendance estimates that differ appreciably from other published estimates. The estimates we report are not necessarily incorrect; it is important, however, that our method of arriving at them be described in detail for the purposes of comparisons with other research results.

Project TALENT

For Project TALENT, college attendance was defined by means of items 2 and 5 of the first follow-up mail questionnaire, as shown in Figure B1. Only students checking boxes AZ (college offering bachelor's degree) or BZ (a junior or community college) of item 5 were considered college attendees, and then only if they did not check box 2 of item 2 (part-time student). In other word , only students who attended a two- or four-year college full time at some time during the first year following high school graduation were defined as college attendees. They may have dropped out after attending only briefly. Figure B2 is a flow diagram for the complete categorizing.

NLS

In the first follow-up questionnaire of the NLS, no less than four questionnaire items are required to categorize the students with respect to college attendance, and the respondents are directed from one item to the next by instructions that many respondents found difficult to understand, judging from the relatively large number of either omitted items or incompatible responses (Personal communication from NLS project staff). Accordingly, the project staff at Research Triangle Institute created a number of new activity state variables by pooling information from all relevant items. In addition, by examining individual questionnaires, the project staff was able to resolve discrepancies and to impute some of the missing data through logical inference. The new activity state variables were added to the NLS data release file, which includes the first follow-up data, and additional variables were later added to the file that includes the second follow-up data. For the present study, the authors used Activity State Variables 2 and 3 from the file, which include the first follow-up data (the only file available when the analysis was undertaken). These state variables were supplemented by examination of first follow-up questionnaire items 23 and 29A, in accordance with the flow diagram shown in Figure B4. This procedure produced a set of categories that to the best of our knowledge is maximally comparable to the Project TALENT categories. There are, however, some differences. For example, as shown in Figure B3, the NLS questionnaire asks about the student's educational status in the month of October 1972. Students who postponed the start of their college career until later in the year would not be included, although they would have been classified as college attendees by Project TALENT. In

Figure B1. Page 2 of Project TALENT First Follow-up Mail Questionnaire

THERE ARE FOUR PARTS TO THIS BOOKLET. IF YOU HAVE NEVER ATTENDED COLLEGE YOU NEED ANSWER ONLY THE FIRST THREE PARTS, PRINTED IN BROWN.

YOU CAN PROBABLY FILL OUT THIS FORM IN ABOUT 15 MINUTES

PLEASE DO NOT WRITE IN THIS AREA

Today's Date _____ Month _____ Day _____ Year

Date of Birth _____ Month _____ Day _____ Year

Check one:

1 ☐ Male
2 ☐ Female
9

In the spaces below, please print the name and address of someone who is most likely to know your address at any time:

Name _____

Address _____

City _____ State _____

DIRECTIONS:
Please be sure to answer every question below. Most of the questions can be answered by just marking an X in the box to the left of the answer you choose. Do not skip any questions. Mark only one answer to each question except where instructed to mark more than one.

PART 1. EDUCATION

1 1. Did you graduate from high school?
0 ☐ Yes
9 ☐ No

PLEASE DO NOT WRITE IN THIS AREA

2. Have you attended college since leaving high school?
1 ☐ Yes, as a full-time student.
2 ☐ Yes, as a part-time student.
3 ☐ Yes, I entered but have dropped out temporarily.
4 ☐ Yes, I entered but dropped out and do not plan to return.
5 ☐ No, but I plan to enter college within a year or two.
6 ☐ No, but I plan to enter college eventually; I have no idea when.
7 ☐ No, and I have no plans to do so.
9

3. Since leaving high school have you attended a school other than a college?
1 ☐ Yes, as a full-time student.
2 ☐ Yes, as a part-time student.
3 ☐ No, and I have no plans to do so.
4 ☐ No, but I plan to get some more non-college schooling.
9

4. Which of the following kinds of school diploma or certificate do you plan to obtain? (Mark as many as apply.)
0 ☐ No further schooling planned
1 ☐ A college degree (4 years or more of college)
2 ☐ A junior college diploma or degree
3 ☐ R N. (Registered Nurse Certificate)
4 ☐ Practical nursing certificate
5 ☐ A business school or secretarial diploma
6 ☐ Diploma or certificate based upon apprenticeship training, on-the-job training, or technical or trade school. Please describe: _____
(__) 9 ☐ Other. Please specify: _____
0

PLEASE DO NOT WRITE IN THIS AREA

5. What kinds of school have you attended since leaving high school? (Mark as many as apply.) Please fill in name and location below.
Z ☐ None
AZ ☐ A college offering bachelor's degree or higher
CZ ☐ A junior or community college
C ☐ A technical institute
D ☐ A school of nursing (3-yr. program)
J ☐ A school of practical nursing
K ☐ A business school
L ☐ A trade school
M ☐ An armed forces enlisted school
R ☐ Other (please specify) _____
Z

Name and location of present or most recent school attended since leaving high school.

School _____

City _____ State _____

6. Answer this question if you have never attended college; otherwise omit it.
Did you WANT to go to college?

NO
A ☐ No, I wanted to earn money.
B ☐ No, I wanted to get married.
C ☐ No, I wanted to go into the military service at once.
D ☐ No, I was more interested in going to some other kind of school.
I ☐ No, for some other reason than above. Please specify: _____

PLEASE DO NOT WRITE IN THIS AREA

YES
J ☐ Yes, but I couldn't afford it.
K ☐ Yes, but I couldn't because of a family emergency.
L ☐ Yes, but I couldn't because I was married.
M ☐ Yes, but I wasn't qualified because I hadn't taken college preparatory courses required for admission.
N ☐ Yes, but I didn't apply because my grades weren't good enough.
O ☐ Yes, I applied but wasn't accepted.
R ☐ Yes, but I didn't go for some other reason. Please specify: _____
Z

Figure B2. Flow Diagram for Categorizing Project TALENT Students

College Attendance: TALENT

Final Groups:
1. 4-year college, full-time
2. 2-year college, full-time
3. Vocational or other
4. No full-time school
5. Unclassified

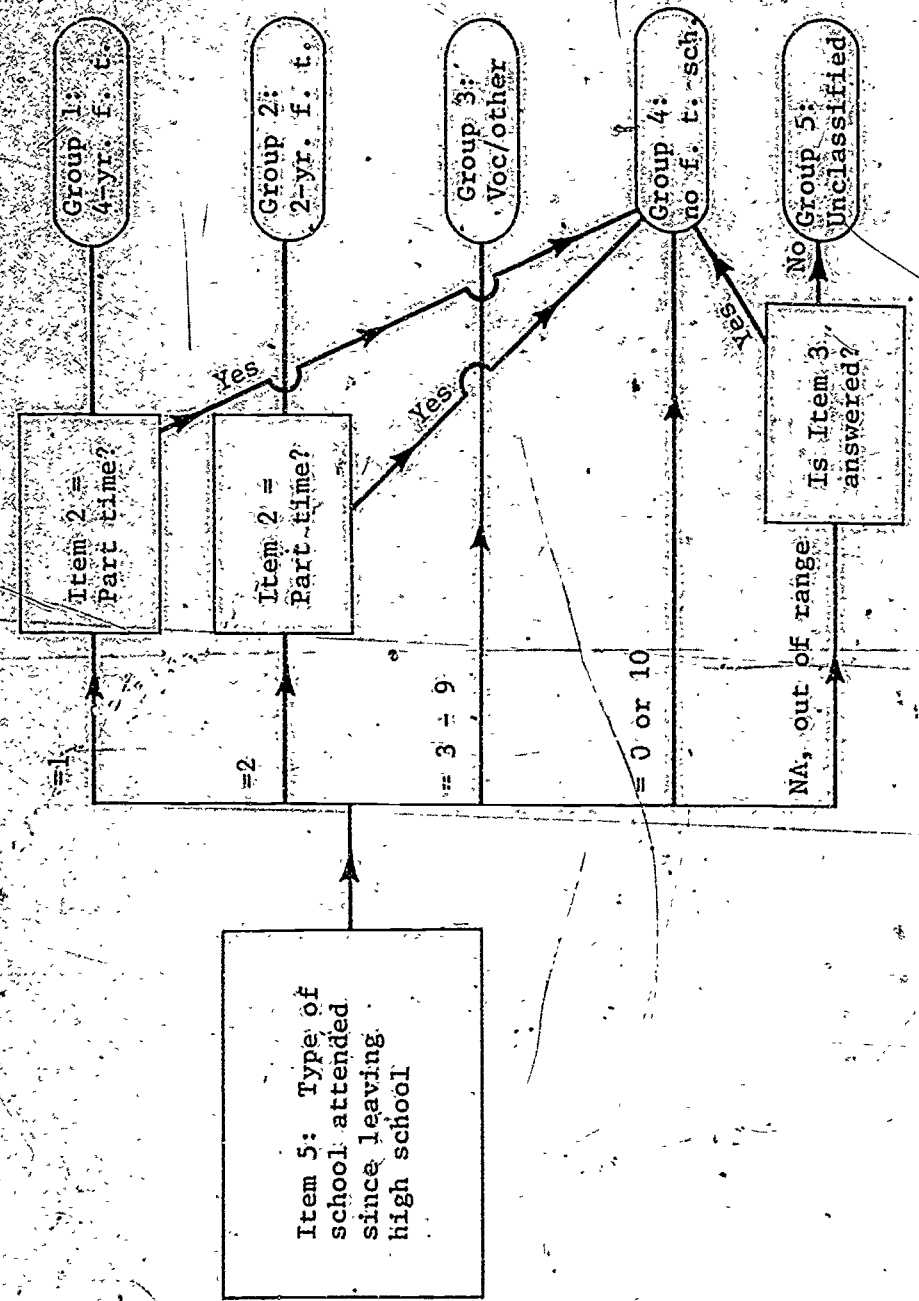


Figure B3. Relevant Items from NLS First Follow-up Mail Questionnaire

23. Since leaving high school, have you attended any school like a college or university, service academy, business school, trade school, technical institute, vocational school, community college, and so forth?

Yes ..... 1 — *(SKIP to q. 25)*
No 2

SCHOOL ATTENDANCE IN OCTOBER 1973

25. Were you taking classes or courses at any school during the first week of October 1973?

No ..... 1 — *(SKIP to q. 29a, page 9)*
Yes 2

26a. What is the exact name and location of the school you were attending in the first week of October 1973? (Please print and do not abbreviate.)

School Name: _____
City: _____ State _____

26b. What kind of school is this? (Circle one.)

Vocational, trade, business or other career training school 1
Junior or community college (two-year) 2
Four-year college or university 3
Other (please describe _____) 4

27a. When did you first attend this school? _____ (month) _____ (year)

27b. During the first week of October 1973, were you classified by this school as a full-time student?

Yes 1
No 2

SCHOOL ATTENDANCE IN OCTOBER 1972

29a. Now please think back a year to the Fall of 1972. Were you taking classes or courses at any school during the month of October 1972?

Yes ..... 1 — *(SKIP to q. 30)*
No 2

29b. Here are some reasons others have given for NOT continuing their formal education right after leaving high school. Which of these reasons apply to you?

30. Was the school you attended in October 1972 the same school you attended in the first week of October 1973? (Circle one.)

Yes ..... 1 — *(SKIP to q. 33b)*
No, not enrolled in October 1973 ..... 2 — *(SKIP to q. 32a)* } *Next page*
No, enrolled in different school 3

32a. What is the exact name and location of the school you were attending in the month of October 1972? (Please print and do not abbreviate.)

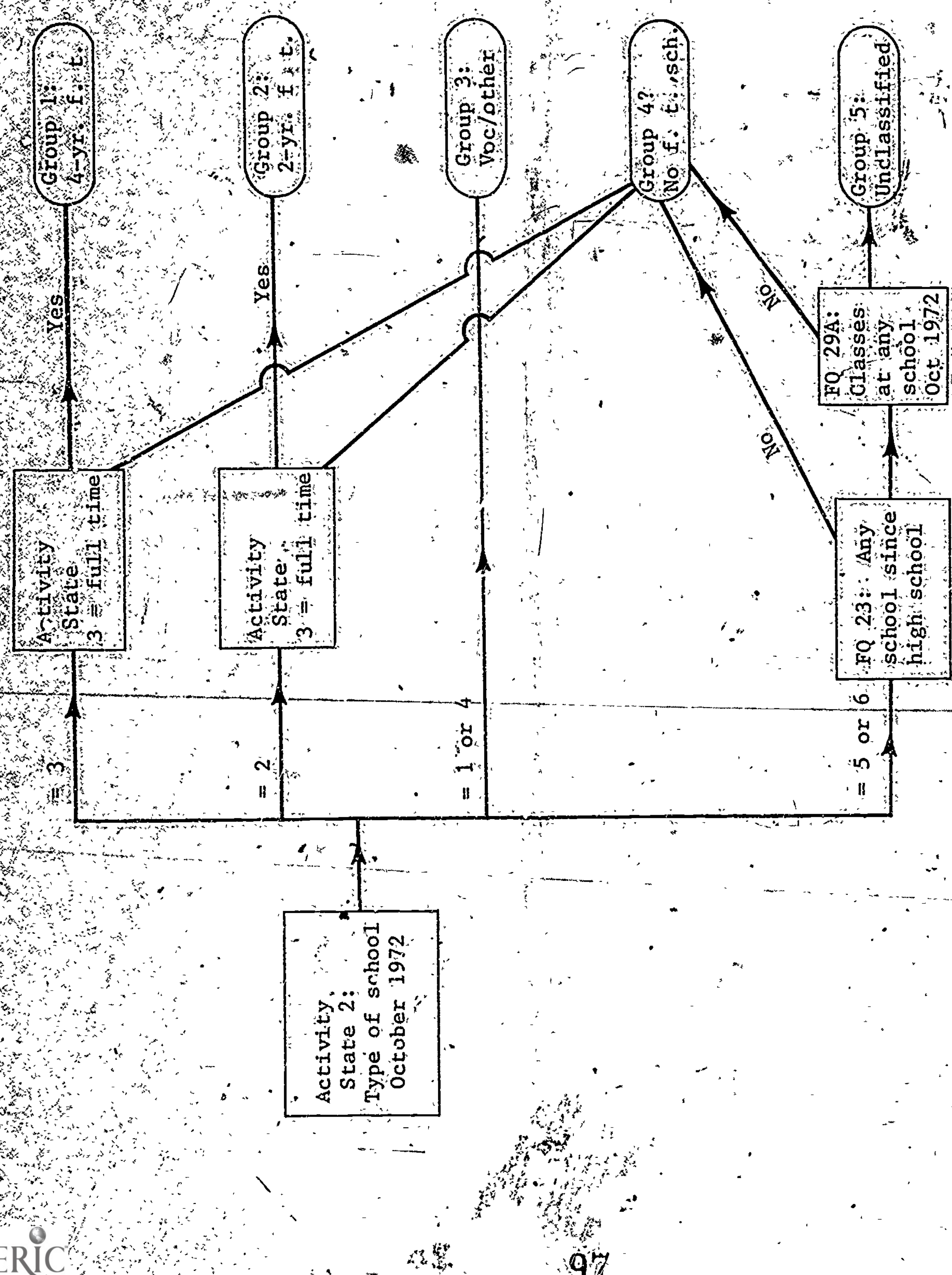
School Name: _____
City _____ State _____

32b. What kind of school is this? (Circle one.)

Vocational, trade, business or other career training school 1
Junior or community college (two-year) 2
Four-year college or university 3
Other (please describe _____) 4

Figure B4. Flow Diagram for Categorizing NLS Subjects

College Attendance: NLS



general, the comparability was judged to be quite adequate for present purposes. The reader should keep in mind, however, that both surveys define college attendees in a restrictive way, namely, as students who attended a two- or four-year college full time in the year immediately following graduation.

APPENDIX C. IDENTIFICATION OF INCONSISTENT DATA CASES

Talent Sample

Early in our analyses of the 1960 Project TALENT data, we discovered an anomaly. Many students who scored very low or zero on the TALENT Reading Comprehension Test received average or above average SAT-verbal scores. In all, 54 students received reading scores in the 1-4 range, while 152 had a score of 0. Further investigation revealed that test scores were reported for Project TALENT if the test was administered, whether or not it was attempted by the student. We could not judge whether a score was valid by looking at the number of items attempted because these data were not available. (No such problem existed in the 1972 National Longitudinal Study data; in the construction of its data base, reading scores were reported only if at least one item was answered. In fact, examination of the NLS data revealed neither the cluster of low scores nor the inconsistency with the verbal sections of the SAT reported above.)

We attempted to identify and reject Project TALENT reading comprehension scores that were implausible when compared with other information about the student. Items known to be highly correlated with reading ability were chosen as predictors and are listed below under "Background Variables." Two types of comparisons, using regression analysis, were made. One used 14 criterion-scaled background and self-reported reading-related background items, the second used the other eight English tests in the test battery.

For the criterion-scaling method, we obtained the mean reading comprehension score for students choosing each option of each general background item. We also computed means for nonrespondents on each item. The actual reading comprehension score was regressed on the vector of 14 item/option means, and the regression weights were used to obtain a predicted reading score. If the difference between the actual and predicted reading scores was greater than 2.5 times the standard error, the test score was considered invalid. This eliminated 327 students of whom 35 had SAT scores.

Similarly, the reading comprehension score was regressed on the other eight English tests, a predicted score was computed, and the test rejected if a difference of more than 2.5 standard errors was found. If missing data were encountered on any of the eight tests, the same procedure was applied using each one of the first three tests, in turn. In this way, 365 students were eliminated, of whom 42 had SAT scores.

Because of considerable overlap in rejections made by the two approaches, the total number of reading test scores rejected was only 507. Of these subjects, 52 had SAT scores. All 152 of the zero scores were found to be inconsistent with the other data, thus confirming the hypothesis that a zero score really indicated a test not taken.

Background Variables

Item

56. How many books have you read in the past 12 months?
59. How many science books have you read in the past 12 months?
66. I have a difficult time expressing myself in written reports, examinations, and assignments.
73. Failure to pay attention in class has caused my marks to be lowered.
83. Slow reading holds me back in my schoolwork.
90. I read material over and over again without really understanding what I have read.
97. Number of hours studying per week.
110. My grades in English courses have been ____.
173. Estimate of your family's total income for last year.
176. How many books are in your home?
221. What is the total number of living children in your family?
237. Which one of the following best describes the college you expect to attend?
304. What is the greatest amount of education you expect to have during your life?
338. How much education are most of your friends planning to obtain?

English Tests

Vocabulary r-172
Vocabulary r-102
English
Spelling
Capitalization
Punctuation
English Usage
Effective Expression

Equating Sample

Anomalies similar to those found in the 1960 Project TALENT data also appeared in the data for the 1976 equating sample. Some students scored very high on one of the two reading tests and very low on the other. We attempted to identify and reject those students.

We performed two types of regression analyses. The first consisted of two robust regressions (Beaton and Tukey, 1974): Project TALENT Reading Test on the National Longitudinal Study Reading Test, and the NLS Reading Test on the Project TALENT Reading Test. We noted all students whose scores received weights of zero in one or both robust regressions. There were 50 such students.

The results of the robust regression were confirmed by repeating the same two regressions using least squares regression techniques. We noted all students whose scores deviated by more than 2.5 standard errors from one or both regression lines. There were 42 such cases, 40 of whom had been discovered by the robust regression.

We excluded from further analysis the 50 students identified by the robust regression analysis.

APPENDIX D. DESCRIPTION OF PARTITIONING ANALYSIS

In studying the decline in SAT scores, we asked ourselves these questions. What part of the decline is attributable to changes in the ability of high school seniors? What part to changes in the types of students taking the SAT? What part to the drift in the SAT scale itself?

Our general approach was to partition frequency distributions. The 1960 and 1972 high school seniors were classified into levels according to their reading test scores. The SAT takers were known nonrandom subsets of these frequency distributions. The difference between the frequency distributions of SAT takers in 1960 and 1972 was partitioned into sections from which answers to the above questions could be derived. All calculations were done in the metric of the 1960 SAT with the differences between 1972 and 1960 SAT-verbal averages (given equal reading scores) considered as drift in the SAT-verbal scale.

The (equated) reading scores have 20 items; thus there are 21 possible scores for the number of items right on the test and over 20 possible formula scores. We first grouped scores on the test into m intervals for calculations of frequency distributions. Presumably, m is small enough to be manageable but large enough to avoid serious loss of precision. Given this grouping of reading scores, we can present the following definitions:

N_1--the number of high school seniors in 1960
N_2--the number of high school seniors in 1971
N_{1A}--the number of SAT takers in 1960
N_{2A}--the number of SAT takers in 1972
F_1--an m^{th} order column vector containing the number of students at each level of reading ability in 1960. This is a frequency distribution of reading ability for the class of 1960.
$F_{1\Delta}$--an m^{th} order column vector containing the number of students at each level of reading ability in 1960 who took the SAT.
F_2--an m^{th} order column vector containing the number of students at each level of reading ability in 1972. This is a frequency distribution of reading ability for the class of 1972.
$F_{2\Delta}$--an m^{th} order column vector containing the number of students at each level of reading ability in 1972 who took the SAT.
P_1--an m^{th} order column vector containing the proportion of students at each level of reading ability who took the SAT in 1960.
P_2--an m^{th} order column vector containing the proportion of students at each level of reading ability who took the SAT in 1972.
X_1--an m^{th} order column vector containing the average SAT-verbal score for each level of reading ability in 1960.
X_2--an m^{th} order column vector containing the average SAT-verbal score for each level of reading ability in 1972.

The frequency distribution of reading scores is, therefore, represented as a column vector of length m. F_1 and F_2 represent the distributions of high school seniors in 1960 and 1972, respectively, whereas F_{1A} and F_{2A} represent the subsets of F_1 and F_2 who took the SAT. We are now prepared to manipulate these distributions.

The average SAT-verbal scores can be represented using this notation as

$$\bar{X}_{1A} = N_{1A}^{-1} F_{1A}' X_1$$

in 1960 and as

$$\bar{X}_{2A} = N_{1A}^{-1} F_{2A}' X_2$$

in 1972. Since the SAT-verbal means were computed from these same persons, these formulas are essentially the computational procedures for grouped data and are exact, not approximations. We are interested in partitioning the difference between these means into sections associated with the high school populations, SAT-takers, and the drift in the SAT scale.

According to the above definitions, the change in the distribution of reading ability for high school students is

$$\Delta F_1 = F_2 - F_1 ,$$

and the change in the proportion of students at each ability level taking the SAT is

$$\Delta P_1 = P_2 - P_1 .$$

The change in the average SAT-verbal score for persons of a given reading ability is

$$\Delta X_1 = X_2 - X_1 .$$

Before proceeding, it is important that we consider further the mean SAT score vectors, X_1 and X_2. The corresponding elements in X_1 and X_2 represent persons of nearly equal reading ability as defined by the reading tests. If the reading tests were strictly parallel to the SAT-verbal, we would expect the corresponding means to be nearly identical, i.e., $\Delta X_1 \cong 0$. The difference between these vectors is not zero because of a number of factors: sampling error, equating error, classification error, and so forth. We believe that the effect of these errors is too small to explain the observed differences between the means. We attribute most of the differences to scale drift, the slow upward growth of the SAT scores over 12 years.

What is important here is the assumption that persons with similar reading test scores are expected to have the same SAT-verbal scores regardless of whether they are members of the class of 1960 or 1972. To keep the SAT scale in a common metric over these two years, we will apply the vector X_1 to the frequency distribution F_{2A} in order to develop an SAT-verbal mean adjusted for scale drift. That mean is

$$\bar{X}_{2A'} = N_{2A}^{-1} F_{2A}' X_1 .$$

The frequency distribution of SAT takers in 1960 can be written as a product of the frequency distribution of high school students and the fraction taking the SAT; that is,

$F_{1A} = F_1 \otimes P_1$

and in 1972 as

$F_{2A} = F_2 \otimes P_2$,

where $\otimes$ indicates element-by-element vector multiplication. An m^{th} order unit vector 1 is useful for calculating the number of objects in a frequency distribution: Consider

$N_{1A} = F_{1A}1$

and

$N_{2A} = F_{2A}1$.

Using $\Delta F_1 = F_2 - F_1$ and $\Delta P_1 = P_2 - P_1$, the frequency distribution F_{2A} can be partitioned

$$F_{2A} = (F_2 \otimes P_2) = (F_1 + \Delta F_1) \otimes (P_1 + \Delta P_1)$$

$$= (F_1 \otimes P_1) + (F_1 \otimes \Delta P_1) + \Delta F_1 \otimes P_1) + (\Delta F_1 \otimes \Delta P_1)$$

$$= G_{11} + G_{1\Delta} + G_{\Delta 1} + G_{\Delta\Delta} ;$$

that is, the frequency distribution of SAT takers in 1972 can be partitioned into four parts:

$G_{11} = F_1 \otimes P_1$ - which is identical to F_{1A}, the 1960 frequency distribution of SAT takers.

$G_{1\Delta} = F_1 \otimes \Delta P_1$ - which is the part of the frequency distribution associated with a change in the pattern of SAT taking.

$G_{\Delta 1} = \Delta F_1 \otimes P_1$ - which is the part of the frequency distribution associated with the change in the high school population.

$G_{\Delta\Delta} = \Delta F_1 \otimes \Delta P_1$ - which is the part of the frequency distribution associated with both change in high school population and change in the proportion taking the SAT.

G_{11} is a frequency distribution, thus must have non-negative elements. $G_{1\Delta}$, $G_{\Delta 1}$, $G_{\Delta\Delta}$ are pseudodistributions and may have negative elements. Using $N_{2A} = F_{2A}1$, we can compute

$$N_{2A} = (G_{11} + G_{1A} + G_{\Delta 1} + G_{\Delta\Delta})'1$$

$$= N_{11} + N_{1\Delta} + N_{\Delta 1} + N_{\Delta\Delta}$$

where $N_{11} = N_{1A}$, the number of SAT-takers in 1960, and $N_{1\Delta}$, $N_{\Delta\Delta}$, and $N_{\Delta\Delta}$ are pseudo N's (possibly negative) associated with the pseudodistributions. We can write the 1972 mean SAT-verbal score (adjusted for scale drift) as

$$\bar{X}_{2A'} = \frac{1}{N_{2A}} F'_{2A} X_1$$

$$= \frac{1}{N_{2A}} (G_{11} + G_{1\Delta} + G_{\Delta 1} + G_{\Delta\Delta})' X_1$$

$$= \frac{1}{N_{2A}} (N_{11}\bar{X}_{11} + N_{1\Delta}\bar{X}_{1\Delta} + N_{\Delta 1}\bar{X}_{\Delta 1} + N_{\Delta\Delta}\bar{X}_{\Delta\Delta})$$

$\bar{X}_{11} = N_{11}^{-1} G_{11} X_1 = \bar{X}_{1A}$, the mean of the 1960 SAT takers

$\bar{X}_{1\Delta} = N_{1\Delta}^{-1} G_{1\Delta} X_1$, the effect on the 1960 mean of the changing pattern of SAT taking

$\bar{X}_{\Delta 1} = N_{\Delta 1}^{-1} G_{\Delta 1} X_1$, the effect on the 1960 mean of the changing high school population

and

$\bar{X}_{\Delta\Delta} = N_{\Delta\Delta}^{-1} G_{\Delta\Delta} X_1$, the effect on the 1960 mean of the changing pattern of SAT taking in the high school population.

We can now examine the three following questions:

1. What would be the number and average score of SAT takers on the SAT-verbal if the SAT-taking pattern changed as it did but the high school population stayed the same as in 1960?

The distribution would be $F_1 \circledast P_1 + F_1 \circledast P_1 = F_1 \circledast P_2$; thus the number of SAT takers would be

$$\hat{N}_{12} = (F_1 \circledast P_2)' 1 = N_{11} + N_{1\Delta} ,$$

and their mean score would be

$$\bar{X}_{12} = \frac{1}{\hat{N}_{12}} (F_1 \circledast P_2)' X_1 = \frac{N_{11}\bar{X}_{11} + N_{1\Delta}\bar{X}_{1\Delta}}{N_{11} + N_{1\Delta}} .$$

2. What would be the number of, and average score of, SAT takers if the high school population changed as it did but the proportion at each level of reading ability taking the SAT stayed the same as in 1960?

The distribution would be $F_1 \circledast P_1$, $\Delta F_1 \circledast P_1 = F_2 \circledast P_1$; thus the number of SAT takers would be

$$\hat{N}_{21} = (F_2 \circledast P_1)' 1 = N_{11} + N_{\Delta 1} ,$$

and their mean score would be

$$\bar{X}_{21} = \frac{1}{\hat{N}_{21}} (F_2 \circledast P_1)' X_1 = \frac{N_{11}\bar{X}_{11} + N_{\Delta 1}\bar{X}_{\Delta 1}}{N_{11} + N_{\Delta 1}} .$$

3. What is the average scale drift?

The average score adjusted for scale drift is

$$\bar{X}_{2A'} = \frac{1}{N_{2A}} F'_{2A} X_1 ;$$

thus, the average effect of scale drift is the difference between the adjusted and unadjusted means, which is

$$\bar{X}_{2A} - \bar{X}_{2A'} = \frac{1}{N_{2A}} F_{2A} X_2 - \frac{1}{N_{2A}} F'_{2A} X_1$$

$$= \frac{1}{N_{2A}} F'_{2A} (X_2 - X_1) = \frac{1}{N_{2A}} F'_{2A} \Delta X_1 .$$

Numerical Calculations

We divided the samples of high school students in 1960 and 1972 into six strata according to reading ability, and students for whom reading test scores were not available were placed in a seventh stratum. The strata of reading scores were so defined that the top stratum contained the top 10 percent of the 1972 students for whom scores were available, the second stratum contained the next 10 percent and the lower strata contained 20 percent each. Having set the cutoff points from the 1972 sample, we allocated the 1960 sample into strata using the same cutoff points; thus, the number in each stratum is not constrained.

The basic data, contained in columns (1) through (8) of Table D1 are taken from Tables 1 and 3 of the text. The columns are

(1) = F_1 the frequency distribution of all high school students in 1960

(2) = F_{1A} the frequency distribution of SAT takers in 1960

(3) = F_2 the frequency distribution of all high school students in 1972.

(4) = F_{2A} the frequency distribution of SAT takers in 1972

(5) = P_1 the proportion at each level of reading ability to take the SAT in 1960 (P_1 = (2) ÷ (1).)

(6) = P_2 the proportion at each level of reading ability to take the SAT in 1972 (P_2 = (4) ÷ (3).)

(7) = $\bar{X}_1$ the mean SAT-verbal score for SAT takers in 1960

(8) = $\bar{X}_2$ the mean SAT-verbal score for SAT takers in 1972.

The remaining columns are computed from (1) through (8).

(9) = (3) - (1) = ΔF_1.

(10) = (6) - (5) = ΔP_1

and

(11) = (1) ⊗ (5) = $G_{11} = F_{1A}$

(12) = (1) ⊗ (10) = $G_{1\Delta}$

(13) = (9) ⊗ (5) = $G_{\Delta 1}$

(14) = (9) ⊗ (10) = $G_{\Delta\Delta}$.

As a numerical check,

(4) = (11) + (12) + (13) + (14).

As noted above (11) = G_{11} is a frequency distribution. The other G vectors, $G_{1\Delta}$, $G_{\Delta 1}$, $G_{\Delta\Delta}$, are the gains (or losses) in particular strata of the frequency distribution in moving from F_{1A} to F_{2A}. The effect of these partitions on the number of students is calculated by adding the frequencies in the columns, the results of which are shown at the base of those columns.

The average value of the SAT score without scale drift is derived by calculating the sum of products of these frequencies and the vector (7) = X_1. The effects on the means are shown at the base of the corresponding vectors.

The calculation for deriving means of hypothetical groups is given at the bottom of the table.

Note that the vectors G_{11}, $G_{1\Delta}$, $G_{\Delta 1}$, and $G_{\Delta\Delta}$ are computed for expository and interpretive purposes. The estimated populations can be computed directly by

1. SAT-taking change only

$$N_{12} = (F_1 \otimes P_2)'1$$

and

$$\bar{X}_{12} = N_{12}^{-1} (F_1 \otimes P_2)' X_1.$$

2. High school population change only

$$N_{21} = (F_2 \otimes P_1)'1$$

$$\bar{X}_{21} = N_{21}^{-1} (F_2 \otimes P_1)' X_1.$$

3. Both changed, but no scale drift

$$\bar{X}_{2A} = N_{2A}^{-1} F_{2A}' X_1.$$

Table D1. Partition of SAT Scores (All Frequencies in 1000's)

Reading level	(1) F_1	(2) F_{1A}	(3) F_2	(4) F_{2A}	(5) P_1	(6) P_2	(7) X_1	(8) X_2	(9) ΔF_1	(10) ΔP_1	(11) G_{11}	(12) $G_{1\Delta}$	(13) $G_{\Delta 1}$	(14) $G_{\Delta\Delta}$
Top	255	108	288	177	.424	.614	547	567	33	.190	108	48	14	6
2	216	67	290	154	.310	.531	499	504	74	.221	67	48	23	16
3	358	74	575	226	.208	.393	438	453	217	.185	74	66	45	40
4	337	41	576	176	.121	.305	389	404	239	.184	41	62	29	44
5	325	18	577	121	.054	.210	341	358	252	.156	18	51	14	39
Bottom	284	7	576	54	.026	.094	337	311	292	.068	7	19	8	20
No test	89	11	133	27	.127	.207	476	454	44	.080	11	7	6	
Sum	1864	326	3015	935					1151		326	301	139	169
Average SAT-verbal		474		442							474	433	435	401

Estimated populations 1960 SAT statistics		Number	Mean
		326	474
If only SAT taking changed	$326 + 301 = 627$	$\frac{326(474)+301(433)}{627}$	= 454
If only high school seniors changed	$326 + 139 = 465$	$\frac{326(474)+139(435)}{465}$	= 462
If both changed but no scale drift		935	442
Scale drift		$\frac{1}{N_{2A}} F'_{2A}(X_2 - X_1)$	+11
1972 SAT statistics with scale drift		935	453

APPENDIX E. ESTIMATED EFFECT OF SCHOOL RETENTION ON TEST SCORES

The question of effect of school retention on test scores arises from the fact that the retention rate, from fifth grade through twelfth grade, was 66.7 percent in 1960 but rose to 79.1 percent in 1972 (Digest of Education Statistics, 1975 Edition, Table 10). If we assume that the additional students "retained" in the schools tended to be of lower ability, then a sizable share of the decline in reading scores for the high school population might be explained.

To obtain the required estimates, we needed an estimate of the correlation between dropping out and reading ability. We obtained this by reanalyzing some drop-out data obtained from one of the school systems that participated in the Growth Study from 1961 to 1969. The biserial correlation is - .525.

Using this correlation and the population proportions noted above, we then estimated, by means of the standard formula for the biserial correlation, how much the mean of the test scores would be lowered by a decrease in the number of school dropouts from 1960 to 1972. This lowering would be .095 of the standard deviation (S.D.) of the school cohort.

In the Growth Study data, the S.D. of the school cohort mentioned above is 4 percent larger than the S.D. of the population of surviving twelfth graders. If we assume that the same proportion holds in the present study, we can estimate an S.D. of 5.2. The score drop attributable to the increased retention rate would, then, be .5 points. We observed a total drop for the high school senior population of .8 points. Thus, it would appear that the increased retention alone may account for approximately 60 percent of the total decline

Further research is needed to determine whether this estimate would be confirmed by a formal study of the question.