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AN ANALYSIS OF THE DECLINE IN ACT COLLEGE ADMISSIONS SCORES

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ABSTRACT

Scores on college admissions examinations given in the United States have steadily declined in the last decade, prompting a number of speculations as to both the causes and consequences of this decline. In this study, I analyzed a sample of 43,647 high school students who took the American College Program Assessment in the six years from 1970 to 1975. This constituted a one percent random sample of all ACT testees for that period.

Through a variety of analytical techniques, I explored competing explanations of declining test scores. My major conclusions include: 1) the test score declines are not artifacts of the testing instruments themselves; 2) the changing sex composition of the test-taking population probably accounts for much of the score decline; 3) high school grade inflation may have contributed to the score decline; 4) the declines are not due to changes in either the performance or proportions of racial minorities taking the tests; 5) the test score declines are most marked for students planning on attaining only a Bachelor's degree; they are not due to an influx of students to two-year colleges; 6) other changes in the composition of the test-taking population, such as family size, rural/urban background, and high school type, have little to do with the score decline; 7) changing patterns of high school course enrollments may have had some effect on the general test score decline.

An Analysis of the Decline
in ACT College Admissions Scores

During the past decade, scores on standardized tests of cognitive skills given in the United States have steadily declined. This phenomenon has gripped the imagination of the public, the press, and scholars alike. A number of speculations as to the score decline have been offered, but there has been as yet no compelling, unambiguous explanation.

The purpose of this paper is to analyze a set of data from the American College Testing Program (ACT) with the intention of systematically assessing the dimensions and some possible causes of the score decline. The data will first be displayed for a number of subpopulations and analyzed to determine where the declines have been steepest and where they have been less marked. Following this, a formal model designed to estimate the parameters of some plausibly causal determinants of a distribution of test scores will be constructed. The problem is such that certain methodological difficulties, which will be discussed, mitigate strongly against the drawing of any definitive conclusions, but the approach adopted here may contribute to a clarification of the score decline.

Two preliminary points will be made. First, one may argue that focusing on declines in standardized test scores is not as important as asking questions about how to improve the schools. This is reflected in the currently popular "back to basics" movement in many American high schools. The contention in this paper is that the question "Why are test scores declining?" logically precedes the question "What can be done about declining test scores?" The question of whether the score decline dictates a reconstruction of the high school curriculum is an open one, and such policies should be preceded by a careful consideration of just what the declines represent.

Second, the recent score decline is unexplained, but just as problematic is the steady increase in test scores for the two decades preceding the inception of the current decline. Some analysts have suggested that the increase was due to society's increased emphasis on the quality of education (see Perry and Swanson 1974, and Feldt 1975, quoted in Munday 1976), but for the most part the increase was uncritically accepted as a result of an assumedly improving educational system. The current trend has been defined as a problem, while the earlier trend was defined, if at all, as desirable and expected. The causes of each trend are uncertain, and both remain largely unexplained social facts.

A comprehensive overview of the test score decline has been compiled by Harnischfeger and Wiley (1975). They note the following trends in various tests:

Scholastic Aptitude Test (SAT). Decline in verbal and mathematical scores over the past decade. Males have overtaken females in verbal scores, indicating steeper decline for females. Math declines less drastic than verbal and about equal for males and females, with females retaining lower scores than males.

American College Testing Program (ACT). Decline in both English and math. Unlike SAT, females stay considerably above males in English and have less drastic drops than in SAT. Large decrease in Social Studies (especially for females). Natural Science scores stable.

Preliminary Scholastic Aptitude Test (PSAT). No systematic declines in past decade. Males have overtaken females on verbal scores. Gap narrowed between male and female math scores, indicating a slight, though nonsystematic, rise of females' test scores.

Minnesota Scholastic Aptitude Test (MSAT). Taken by over 90% of Minnesota high school juniors. Generally reproduces SAT and ACT trends.

Iowa Test of Basic Skills (ITBS). Spans grades 1-8. No declines in grades 1-3, but declines in grades 4-8. Following earlier third graders through their schooling careers shows that they participate in declines in later grades.

Comprehensive Test of Basic Skills (CTBS). Spans grades 2-10. Similar trends as ITBS. Losses expand with each increasing grade.

National Assessment of Educational Progress (NAEP). Assesses 9-, 13-, and 17-year-olds in four-year cycles. General declines in Science. Increases in Reading-Literacy Assessment. Declines among 17- and 13-year-olds in writing skills, although 9-year-olds improved somewhat. Preschoolers of 1972 lost three points when tested three years later.

While not all tests show precisely the same pattern, the general trend is clearly downward. In instances where the declines do not occur (most notably in the NAEP), this is probably attributable to the unusual content of the particular exam compared to the other exams. Both the SAT and the ACT have experienced declines of from 2% to 3% of a standard deviation each year for the past decade. This pattern seems to be similar in many other tests.

The SAT decline cannot be attributed solely to the addition of proportionately more scores to the lower end of the distribution. While there are more low scores, there are also proportionately fewer high scores.

The proportion of SATV scores above both the 600 and 700 levels (the maximum score being 800) fell by one-third between 1971-1972 and 1974-1975. The ACT likewise has reported an increased proportion of low scores, but differs from the SAT in that its proportion of high scores has remained stable. It is not obvious why this discrepancy should exist. The most notable difference in the two tests is that the ACT is given primarily in the Midwest, South, and North Central regions of the United States, while the SAT is administered mainly in the East. It is not immediately clear why the ACT-tested areas should retain a constant proportion of high-scoring students while the East should experience a decline, but this may be useful to know.

Another characteristic of the general picture is that scores in grades 1-3 have shown no decline, perhaps even a slight increase, in the past decade. This too remains unexplained. This raises the possibility of interpreting the score decline as a cohort event, although the aforementioned pattern on the ITBS does not support this argument. Alternatively, perhaps tests designed to measure the reading skills of very young students are tapping a somewhat different dimension of reading ability than are tests designed for older students.

The decline can most accurately be viewed as a national rather than a regional phenomenon. As noted earlier, both the SAT, which is given primarily in the East, and the ACT, which is administered in the Midwest, South, and North Central United States, have experienced declines. It is interesting that the decline in the Western states is less marked[1] and that two North Central states have not shown declines.[2]

1. PROPOSED EXPLANATIONS FOR THE DECLINES

Essentially, there are four types of explanations for the declining scores. One possibility is that the score declines merely represent the random fluctuation of test scores. This can be safely disregarded. Not only the ACT data of the present study, but also data from the SAT (a larger testing service) point to systematic declines over the past several years. Similar declines have been documented for various other tests (see again Harnischfeger and Wiley 1975, pp. 2-4). Overall, these declines involve millions of people being tested over a period of several years. If the declines between any two years are small and could be attributed to chance, the larger pattern precludes this conclusion.

A second possibility is that the psychometric procedures used to equate each new form of the tests to previous forms have had the cumulative effect of making the tests more difficult. Such a drift in the test's scale could conceivably indicate that the reported declines are only artifacts of the testing instruments. Thus, if the unobserved "true score" of the test-taking population is invariant over time, these scaling and equating procedures would result in the appearance of a decline.

This does not appear to be the case. Research from SAT has shown that while a scale drift has occurred in the tests over the years, the nature of this drift has been such that it should actually be easier to obtain a good score now than earlier. Modu and Stern (1975) of SAT have reported that

> The implication of this study for the recent declines in SAT mean scores is clear, namely, that our operational equating during the 1963-73 period have had the cumulative effect of making the December 1973 candidate group appear better than they are reported to be in

> relation to the 1963 and 1966 candidate groups. Thus, if anything, the reported scores underestimate the extent of mean score decline by about 14 to 17 points [p. 20].

Thus, the score decline is even more severe than the reported drops would indicate. Harnischfeger and Wiley, using the Modu and Stern report, have demonstrated that the apparent stability of the PSAT is only an artifact of the scaling procedures. After appropriate corrections, the PSAT shows declines paralleling those of other examinations (Harnischfeger and Wiley 1975, p. 32-33).

What little technical material is available from ACT (Tech. Rep. 1, 1973; Breland 1975, p. 19) indicates similar conclusions.[3] The correct conclusion seems to be that the declines in test scores are real declines, and that the effect of the psychometric procedures is to underestimate the actual extent of the general decline.

A third possible explanation for declining scores concerns the unlimited variations on the theme "Kids are getting dumber." The basic idea here is that today's high school students are academically weaker than their counterparts of several years ago. A number of societal factors have been presented as leading to a population of students who have not learned as much as their predecessors. These include increased television viewing, increased drug usage, changes in the working patterns of the testees' parents, and changes in the motivations and attitudes of more recent examinees. (See Harnischfeger and Wiley 1975, pp. 75-113.)

Harnischfeger and Wiley have suggested several school-related variables that may in some way be contributing to the score decline by negatively affecting students' academic skills. They strongly emphasize that these are only suggestions. Among the variables they offer are pupil mobility, organizational change, changes in the length of term or school year, average daily attendance, pupil absences, pupil suspensions, teacher strikes, parent boycotts, instructional losses for various reasons, curricular changes, changes in pupil motivation, and changes in teaching staff characteristics. Any of these variables could reasonably be hypothesized to be contributing to lower test scores.

Two particularly intriguing explanations have been offered for the supposed lower level of the present population of testees. Zajonc and his associates (Zajonc 1976, Zajonc and Markus 1975) have argued that the score decline is largely attributable to changes that have been occurring in family configuration. Specifically, Zajonc contends that the closer spacing of children that occurred as a result of the baby boom of the 1950s led to a decreased "intellectual environment of the home," which in turn led the children to perform less well on the exams. His "confluence model" further predicts that when post-baby boom cohorts start writing college entrance exams, scores will again begin to rise.

It is not feasible to comment extensively here on Zajonc's model. Two points will be made. First, Zajonc is very probably wrong. His index of family intellectual environment is an oversimplified concept, most of the phenomena with which he is concerned would seem to be explainable in terms of more parsimonious models, and the data he uses do not really bear directly on the questions he is asking. Further, Zajonc seems to be misinterpreting the demographic effects of the baby boom.[4] Second, the data available for the present study do not allow his model to be adequately tested. The only question on the ACT Student Profile Section that speaks to this question at all is only available for the last three years, and reads "How many brothers and sisters under 21 years of age do you have?" Clearly this question is inadequate to test the confluence model, in that it allows no definitive answers on any facet of family configuration (i.e., spacing, birth order, family size, or sex composition) with which Zajonc is concerned.

Another approach involves curricular changes. It is certainly plausible that if today's students are taking fewer or less rigorous high school courses than their predecessors they may in fact be less academically capable than earlier testees. There has been little work done on this question, but some detailed national data are available for 1970,71 and 1972,73. (See Gertler and Barker, 1972.)

These data, collected by the National Center for Education Statistics, show decreases in enrollment in general grade-specific English courses and foreign language courses, both in absolute frequency and as a percentage of all students (see Bills 1977, Table 1, p. 10). There are declines in United States History and State History courses that have been offset by increased enrollments in electives and specialized courses. Enrollment in general mathematics has decreased, while traditional college preparatory mathematics (Algebra, Geometry, and Trigonometry) have remained constant, indicating a total decline in mathematics enrollment. Large drops have occurred in both General Science and specific sciences (Biology, Chemistry, and Physics), with the decline increasing with more stringent mathematical prerequisites.

There is solid evidence that these decreases in academic course-taking are not being compensated for by increases in more practical enrollments, such as vocational, business, or home economics courses. The decline in these courses is also substantial. The indications are that students today probably spend less time receiving academic instruction than did their predecessors. Obviously, this question (Are students less well prepared today?) is not as easily answered as the first two questions (Is the decline due to the random fluctuation of test scores? Are the tests getting harder?). There is no question but that today's students have experienced enormous changes of various nature--social, cultural, educational, economic, curricular--yet the impact of these changes upon test scores is unclear. The most accurate statement that can be made about the claim that today's students have actually learned less than their counterparts of earlier cohorts is that no one really knows.

A fourth possible explanation for declining scores emanates from the question "Who takes the tests?" This involves the idea that there is now a changed pool of testees, that is, that an increased proportion of students from the lower ability strata of their high school classes are now writing the exams. This implies that the overall level and distribution of "ability" in high schools may have remained constant (or even increased) over time, but that the changed pool of examinees has led to the decline.

This is at once an appealing theory and a statistical nightmare. The problem is one of selection, and can be most clearly stated by noting that there is absolutely no assurance that each cohort of testees is equally representative of its respective cohort of high school age individuals. More than that, there is absolutely no assurance that the _subpopulations_ of any given group of testees are as representative of their cohorts as are comparable subpopulations of other cohorts. For example, blacks writing the exams in 1970 may be a more highly selected group of students than blacks writing the exams in 1975, or vice versa. It follows from this that even if the distribution of any number of variables (i.e., race, sex, educational plans, parental income, etc.) is precisely the same from year to year, this does not establish that the test-taking populations represent their larger cohorts equally well from year to year.

The problem of selection merits a bit more attention. Kerlinger (1973) has written that "Self-selection occurs when the members of the groups being studied are in the groups, in part, because they differentially possess traits or characteristics extraneous to the research problem [p. 381]." He continues that "Self-selection into samples occurs when subjects are selected in a nonrandom fashion into a sample," and that "The crux of the matter is that when <u>assignment</u> is not random, there is always a loophole for other variables to crawl through [p. 382]."

Self-selection can profitably be thought of as a special case of nonresponse. The effect of nonresponse is to introduce bias, yet this bias cannot be properly assessed in the absence of information about the nonrespondents (in this case, students who do not write the exams). Thus, in a sense, the question "What are the characteristics of those who do not take college entrance examinations?" is analogous to the question "What are the characteristics of those who do not respond to questionnaires?", in that the bias introduced by selection cannot be measured unless one knows something of the characteristics of those not in the sample.

Self-selection in the present study occurs on the basis of both the dependent and independent variables. It is necessary to explicitly state that the analyses reported here pertain only to the population of ACT-testees for the past six years; extrapolation beyond that population is unwarranted.

Returning to this proposed explanation, the best indication that the pool is changing can be obtained by observing the patterns of standard deviations from year to year, the idea being that increasing standard deviations suggest a more heterogeneous group of testees. A number of researchers have paid some attention to this (Munday 1976, Harnischfeger and Wiley 1975), and this strategy will be employed in this study.[5]

The data available for this study (which will be described shortly) allow many, though by no means all, of these questions to be addressed. Even given the problems of measurement error (including the problem of nonresponse to specific questions on the SPS), omitted variables, and self-selection, the ACT data provide a number of variables capable of assessing many previously untested hypotheses. In addition to five kinds of test scores (English, Mathematics, Social Studies, Natural Science, and a Composite Score which is an average of the four exams), the sample also includes data on sex, high school grades, educational plans, race, and high school size for the six years from 1970-1975. In addition, the following variables exist for the most recent three years: size of the student's home town (i.e., a rural/urban measure), number of siblings (with the aforementioned deficiencies), the type of college the student plans on attending, and a variety of high school curricular variables. There are thus a number of variables by which test scores may be either broken down into subpopulations and subsequently analyzed, or which may be used as independent variables in a formal model.

Before leaving the discussion of possible explanations, it might be noted that a given explanation may be especially important in a particular year, while in another year an alternative explanation may be of greater significance. This again points to the enormous complexity of the problem.

2. SAMPLE

The sample for this study consists of a one-percent random sample of ACT-testees for each of the six years from 1970-1971 to 1975-1976. Sample sizes for each of these years are 8,033; 6,774; 7,375; 7,403; 7,144; and 6,918, for a total of 43,647. While the sample is representative of ACT-testees, it is not necessarily representative of the population of American high school students. Students from the Eastern United States are almost completely excluded, and two non-Eastern states, Wisconsin and Minnesota, have recently dropped the tests. Because of ACT's policy of insuring confidentiality, all labels identifying state of residence were removed from the sample. This removes the possibility of assessing the effect of Wisconsin and Minnesota being excluded from later cohorts of testees.

Further, the sample excludes the sizable proportion of high school students not planning on college and hence not taking the tests, and there is no way to assess the impact of the changing persistence of students to high school graduation. This again raises the issue of selection. More serious problems of selection arise from the facts that not all college-bound students are required to write college entrance examinations, and that the characteristics of college-bound students may change from year to year. It is difficult to assess just what direction the bias introduced by this selection factor will take. For example, there is some evidence that the movement toward open admissions, particularly to two-year colleges, means that more students with somewhat lower qualifications are now taking the exams.[6] At the same time, however, several large state universities seem to be deemphasizing the tests, and it is difficult to tell what emphasis private, elite institutions are currently placing on the exams. Policies regarding the exams may shift from year to year, and there exists little if any systematic data on these shifts. Hence, there is no assurance that the six cohorts in the sample are equally representative of their respective cohorts.

The most that can be said, then, is that the sample is representative of ACT-testees for the period under consideration. This should not be taken too lightly. A large proportion of American high school students do go on to college, the sample is a large one, and the area covered by the ACT is both vast and heterogeneous.

3. DATA

The data to be analyzed here come mainly from the Student Profile Section (SPS) of the ACT-Assessment. This is an eight-page booklet completed by all students taking the exams. The questions pertain to ten basic areas: admissions/enrollment information; educational plans, interests, and needs; special educational needs, interests, and goals; college extracurricular plans; financial aid; background information; factors influencing college choice; high school information; high school extracurricular activities; and out-of-class accomplishments.

4. VARIABLES

Sex - This is coded "1" for males and "0" for females.

High School Grades - The ACT reports high school grades in English, Mathematics, Social Studies, and Natural Science. These are taken from school records, and are coded as one-digit numbers from 0 to 4. There are two measures of overall high school grade point average. The first is taken from school records and is calculated to two decimal places. The second is self-reported and constitutes a 1 to 7 scale, with 1 corresponding to a D- to D and 7 corresponding to an A- to A. Because of its greater detail and assumed greater reliability, the former measure was used. The two measures have a zero-order correlation of .77.

Educational Plans - This information was elicited from the question "What is the highest level of education you expect to complete?" For use in regression analysis, this was transformed into a dummy variable, with "1" corresponding to respondents planning on a four-year degree or more, and "0" including all respondents aspiring toward lesser degrees.

Race - This is coded in terms of white/nonwhite, with "1" being set equal to white.

Years Certain Subjects Studied - The SPS asks students how many years (in half-year increments) they have studied the following high school subjects: English, Mathematics, Social Studies (history, civics, geography, economics), Natural Sciences (biology, chemistry, physics), Spanish, German, French, other foreign language, business or commercial subjects, and vocational or occupational subjects. Possible values for each of these measures run from 0 to 8.

High School Size - High school graduating classes with less than 199 students were coded "0"; larger classes were coded "1".

Siblings - This variable actually measures the number of siblings under the age of twenty-one, and may usefully be thought of as a product of sibship size and a variable inverse to birth order. As a measure of family size, its effects will be underestimated.

High School Type - This is coded as "1" if the student attended a public high school; other responses were coded "0".

College Type - This was coded as "1" if the student plans on attending a four-year institution, whether public or private. Other responses were coded "0".

College Size - This too was coded as a dummy variable, with "1" corresponding to colleges over 10,000 students, and "0" corresponding to smaller colleges.

Town Size - Students from home towns with less than 50,000 people received a "0"; students from larger towns were coded "1".

Cohort and Interaction Effects - A series of six dummy variables was constructed to assess cohort effects. These can be interpreted as deviations from the grand mean. To test for sex by cohort interactions, six variables were created to deal with these effects. These will be explained in more detail later.

5. OMITTED VARIABLES

Most sociological studies have been subject to the problem of omitted variables. Of particular importance in this study is the absence of measures of father's education and father's occupation, each of which is of crucial importance in research attempting to explain variations in measures of educational achievement (see, for example, Blau and Duncan 1967, Jencks et al. 1972; Sewell and Hauser 1975). One could also argue that measures of "ability," such as a ninth-grade achievement test, or a measure of motivation would provide a more adequate specification of the model. Further, no information is available on the student's state of residence. In addition, many of the most potentially interesting variables are only available for three years.

6. ACCURACY OF SELF-REPORTS

One might easily be skeptical about the accuracy of students' self-reports of various items on the SPS. This question has been dealt with by the ACT (Tech. Rep., 1, 1973) and by Maxey and Ormsby (1971). By checking self-reports against data from school records, the ACT concluded that "students typically report their out-of-class accomplishments in a reliable and honest manner [p. 318]." Maxey and Ormsby also comment on the accuracy of self-reports of high school grades and items of nonacademic achievement.

These reports are reassuring to an extent, but leave open the question of the accuracy of such problematic variables as parental income, high school curriculum, high school rank, and number of years studied certain subjects. Maxey and Ormsby cite an unpublished paper by Birnbaum (1971), who argues that "students with low achievement were much more likely to be discrepant reporters than high achievement students." If in fact more low achieving students are now writing the exams, as the depressed scores would suggest, it is possible that the accuracy of self-reports has decreased. St. John (1970), Kerckhoff, Mason, and Poss (1973), and Mason et al. (1975) have questioned the accuracy of students' self-reports of various family characteristics, but the most one can conclude here is that some inassessable amount of inaccuracy of self-reports is present in the data. Discrepant reporting is yet another case of measurement error, and operates to attenuate the relationships involving the less accurately reported variables.

7. GENERAL TRENDS

Table 1[7] shows trends in means and standard deviations of ACT scores over the past six years. The table shows that English scores have declined an average of 2% of a standard deviation per year over the period,[8] but that the 1972-73 administration of the test produced no decline over the previous year. Math scores have declined an average of 4% of a standard deviation per year, again with a break in the pattern in 1972-73. Social Studies scores have declined systematically, with some indications that the scores are showing more variation. Both the means and standard deviations of Natural Science scores have been markedly stable. Finally, the means of the Composite scores have declined regularly (again with a reversal in 1972-73), while the standard deviations have risen.[9]

Table 2 shows a percentage distribution of English scores for the period. The results show an increased proportion of low scores in more recent years, particularly if one considers scores between 13 and 18. This discrepancy exists until scores reach about the 90th percentile, indicating that there has been little change over time in English scores

Table 1

Means and Standard Deviations
of ACT Exams, 1970 to 1975

Year	English	Math	Social Studies	Natural Science	Composite	N
1970	18.06 (5.55)	19.09 (7.15)	18.76 (7.08)	20.52 (6.31)	19.23 (5.56)	8033
1971	17.76 (5.53)	18.84 (7.21)	18.61 (7.18)	20.52 (6.46)	19.06 (5.62)	6774
1972	18.18 (5.25)	19.24 (7.10)	18.45 (7.47)	20.89 (6.36)	19.31 (5.66)	7375
1973	17.85 (5.18)	18.31 (7.40)	18.05 (7.63)	20.79 (6.33)	18.86 (5.70)	7403
1974	17.72 (5.29)	17.57 (7.87)	17.35 (7.58)	21.03 (6.29)	18.55 (5.83)	7144
1975	17.45 (5.34)	17.44 (7.59)	17.00 (7.27)	20.84 (6.53)	18.30 (5.81)	6918
Total	17.85 (5.36)	18.43 (7.42)	18.05 (7.40)	20.76 (6.38)	18.90 (5.71)	43647

Table 2

Distribution of ACT English Scores by Year, 1970 to 1975

	Percentage Distribution						
Score Interval	1970	1971	1972	1973	1974	1975	Total
0-6	2.9	3.3	1.4	1.5	2.1	2.5	2.3
7-12	15.8	15.1	16.1	15.8	16.7	17.3	16.1
13-18	26.7	30.6	30.8	34.2	33.9	35.1	31.8
19-24	45.3	42.0	42.0	40.4	39.4	38.0	41.3
25-30	9.1	8.7	9.1	7.6	7.5	6.8	8.1
31-36	0.3	0.3	0.6	0.6	0.4	0.4	0.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	(8033)	(6774)	(7375)	(7403)	(7144)	(6918)	(43647)
	Cumulative Percentage Distribution						
0-6	2.9	3.3	1.4	1.5	2.1	2.5	2.3
7-12	18.7	18.5	17.5	17.2	18.7	19.8	18.4
13-18	45.4	49.1	48.3	51.4	52.7	54.9	50.2
19-24	90.6	91.1	90.3	91.8	92.1	92.8	91.4
24-30	99.7	99.7	99.4	99.4	99.6	99.6	99.6
31-36	100.0	100.0	100.0	100.0	100.0	100.0	100.0

above 25, but considerable change elsewhere in the distribution.

There is a marked increase in the proportion of low Math scores throughout the distribution (see Table 3). This is accompanied by a noticeable decrease in high Math scores.

Table 4 indicates a considerable increase in low Social Studies scores. This disparity remains until scores reach about the 98th percentile.

Table 5 shows that the distribution of Natural Science scores has been relatively stable over the period. If anything, more recent administrations of the test may be marked by fewer low scores and an increased proportion of high scores.

Finally, Composite scores show a marked tendency toward increased proportions of low scores (see Table 6). This seems to be accompanied by a slightly smaller proportion of students scoring in the highest ranges of the distribution.

8. TRENDS IN EXOGENOUS VARIABLES

Before looking at the score patterns for different subgroups, it will be useful to assess what changes have been occurring in the distribution of demographic and school-related characteristics of the population in the last six years. While this breaks up the present continuity somewhat, it will make the later presentation clearer. The most striking change in the sample from year to year is the changing sex composition (see Table 7). The proportion of female testees has gone from 50.1% in 1970-71 to 54.7% in 1975-76. A similar pattern has been documented for the SAT (see Harnischfeger and Wiley 1975, p. 24).

Table 3

Distribution of ACT Math
Scores by Year, 1970 to 1975

Score Interval	1970	1971	1972	1973	1974	1975	Total
	Percentage Distribution						
0-6	3.7	4.9	4.1	5.6	9.4	8.1	5.9
7-12	12.9	13.4	13.5	17.3	17.6	18.7	15.5
13-18	33.1	33.9	33.1	32.0	29.3	29.0	31.7
19-24	23.1	22.3	20.7	20.8	18.8	20.7	21.1
25-30	22.3	21.1	24.5	20.7	22.2	20.7	21.9
31-36	4.6	4.4	4.1	3.7	2.8	2.8	3.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	(8033)	(6774)	(7375)	(7403)	(7144)	(6918)	(43647)
	Cumulative Percentage Distribution						
0-6	3.7	4.9	4.1	5.6	9.4	8.1	5.9
7-12	16.6	18.3	17.6	22.9	27.0	26.8	21.4
13-18	49.7	52.2	50.8	54.8	56.2	55.8	53.2
19-24	72.8	74.5	71.4	75.6	75.0	76.5	74.2
25-30	95.1	95.6	95.9	96.3	97.2	97.2	96.2
31-36	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4

Distribution of ACT Social Studies
Scores by Year, 1970 to 1975

	Percentage Distribution						
Score Interval	1970	1971	1972	1973	1974	1975	Total
0-6	5.2	5.3	5.7	7.2	7.7	6.0	6.2
7-12	18.5	19.7	22.3	21.9	24.7	28.6	22.5
13-18	20.6	18.8	17.9	17.3	19.2	21.3	19.2
19-24	31.3	31.0	28.6	29.9	27.1	24.8	28.8
25-30	22.5	23.2	23.3	21.5	18.8	17.6	21.2
31-36	2.0	1.9	2.2	2.2	2.4	1.6	2.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	(8033)	(6774)	(7375)	(7403)	(7144)	(6918)	(43647)
	Cumulative Percentage Distribution						
0-6	5.2	5.3	5.7	7.2	7.7	6.0	6.2
7-12	23.6	25.0	28.0	29.0	32.4	34.6	28.7
13-18	44.2	43.8	45.9	46.4	51.7	56.0	47.9
19-24	75.5	74.9	74.5	76.3	78.8	80.7	76.7
25-30	98.0	98.1	97.8	97.8	97.6	98.4	97.9
31-36	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 5

Distribution of ACT Natural Science Scores by Year, 1970 to 1975

	Percentage Distribution						
Score Interval	1970	1971	1972	1973	1974	1975	Total
0-6	1.2	1.6	1.0	0.7	0.5	1.0	1.0
7-12	7.5	8.0	7.2	7.4	6.2	8.5	7.5
13-18	31.8	30.3	32.9	33.3	33.0	29.1	31.8
19-24	29.3	29.8	26.9	28.9	29.0	29.1	28.8
25-30	25.7	24.8	25.7	22.5	23.7	25.3	24.6
31-36	4.5	5.6	6.3	7.3	7.6	6.9	6.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	(8033)	(6774)	(7375)	(7403)	(7144)	(6918)	(43647)
	Cumulative Percentage Distribution						
0-6	1.2	1.6	1.0	0.7	0.5	1.0	1.0
7-12	8.7	9.6	8.2	8.1	6.7	9.5	8.5
13-18	40.5	39.9	41.1	41.4	39.7	38.7	40.2
19-24	69.8	69.7	68.1	70.3	68.7	67.8	69.1
25-30	95.5	94.4	93.7	92.7	92.4	93.1	93.7
31-36	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 6

Distribution of ACT Composite Scores by Year, 1970 to 1975

	Percentage Distribution						
Score Interval	1970	1971	1972	1973	1974	1975	Total
0-6	0.7	0.8	0.4	0.6	0.8	0.8	0.7
7-12	12.0	13.1	12.9	14.3	16.4	18.1	14.4
13-18	32.0	32.0	31.3	33.2	32.4	32.2	32.2
19-24	35.2	35.0	35.0	33.5	32.7	32.0	33.9
25-30	19.1	18.3	19.3	17.3	16.8	16.3	17.9
31-36	0.8	0.8	1.1	1.1	0.9	0.6	0.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	(8033)	(6774)	(7375)	(7403)	(7144)	(6918)	(43647)
	Cumulative Percentage Distribution						
0-6	0.7	0.8	0.4	0.6	0.8	0.8	0.7
7-12	12.9	13.9	13.4	14.9	17.2	18.8	15.1
13-18	44.9	45.9	44.6	48.1	49.7	51.0	47.3
19-24	80.1	80.9	79.6	81.6	82.3	83.1	81.2
25-30	99.2	99.2	98.9	98.9	99.1	99.4	99.1
31-26	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 7

Changes in Sex Composition
of ACT Testees, 1970 to 1975

Year	Male	Female	N
1970	49.9	50.1	8033
1971	50.0	50.0	6774
1972	49.0	51.0	7375
1973	47.6	52.4	7403
1974	46.5	53.5	7144
1975	45.3	54.7	6918
Total	48.1	51.9	43647

The response to the question "What is the highest level of education you expect to complete?" has varied little over the six years (see Table 8). The only noticeable change is the declining proportion of students aspiring toward a two-year college degree, which could either reflect a real trend away from this level of education or the possiblility that fewer two-year institutions are requiring the tests.

There seems to be little systematic change in the racial composition of the sample over the six years (see Table 9). Again, though, there is no assurance that the testees of a given racial category in a given year are as representative of their cohort as are the testees of any other year. In addition, the overall response rate to this question was a distressingly low 85.3%.

The data for the three-year variables show a slight trend away from testees from small towns and rural settings, and some increase in the proportion of testees from large towns and small cities. There are no striking changes in family size (at least as it is measured here). There is a marked movement away from students planning on attending two-year public community or junior colleges, which involves the same ambiguous interpretation as the aforementioned trend in educational plans. This may also be reflected in what appears to be a trend away from small colleges and toward medium-sized colleges. The proportion of students from any particular type of high school has been relatively constant.

Table 10 shows the surprising result that the proportion of testees reporting themselves to be in the top quarter of their high school class actually increased from 1973 to 1975. There has been a small decline in the proportion reporting themselves as being in the second quartile, a

Table 8

Distribution of Educational Degree
Aspirations of ACT Testees, 1970 to 1975

Year	Educational Plans							
	Vocational/ Technical	2-Year Degree	Bachelor's Degree	Master's Degree	Professional Degree	Other	Missing	N
1970	4.3	15.5	41.4	18.1	12.5	6.4	1.9	8033
1971	4.7	16.0	39.1	18.5	14.0	6.2	1.6	6774
1972	4.2	16.4	39.5	17.1	15.0	5.7	2.2	7375
1973	4.2	16.4	38.5	15.7	18.1	6.2	0.9	7403
1974	3.6	13.6	41.2	15.0	17.4	5.3	4.0	7144
1975	3.8	12.9	41.1	15.4	18.3	5.0	3.4	6918
Total	4.1	15.2	40.1	16.6	15.8	5.8	2.3	43647

Table 9

Changes in Racial Composition
of ACT Testees, 1970 to 1975

Year	Black	American Indian	White	Spanish American	Oriental American	Other, Missing	N
1970	5.5	0.8	75.4	2.4	1.7	14.2	8033
1971	7.0	1.1	78.1	2.1	1.4	10.3	6774
1972	6.3	1.1	76.6	2.1	1.2	12.7	7375
1973	6.7	2.4	68.7	2.7	0.6	18.9	7403
1974	6.5	1.1	72.8	2.3	0.6	16.7	7144
1975	6.9	1.4	73.5	2.2	0.6	15.4	6918
Total	6.4	1.3	74.2	2.3	1.0	14.7	43647

Table 10

Distribution of High School Rank of ACT Testees, 1973 to 1975

Year	Top Quarter	2nd Quarter	3rd Quarter	4th Quarter	Missing	N
1973	37.7	40.1	19.2	2.1	0.9	7403
1974	40.5	37.8	16.1	1.8	3.8	7144
1975	42.0	38.6	14.6	1.6	3.1	6918
Total	40.0	38.9	16.7	1.9	2.5	21465

more substantial decline in the third quartile, and a steady decline in the bottom quartile.

This does not support the idea that there is an increasing proportion of students from the lower-achieving strata of the high school taking the tests. If anything, the results point to an increased proportion of more talented testees. One does not have to believe this result, and can argue instead that students do not accurately report (or even know) their class rank. Certainly there are social and psychological reasons for not placing oneself in the bottom category. While Maxey and Ormsby (1971) have demonstrated that students generally report their high school grades with a high degree of accuracy, it may be wise to remain skeptical about the apparently increasing proportion of testees from the upper strata of their high school classes.

Table 11 shows steady declines in the proportion of high school grade point averages below 2.5 from 1970 to 1975. There is some increase in the proportion of grades in the 2.51 to 3.00 range, and marked increases in grades above 3.00. It is not clear whether this represents a general grade inflation or an increase in the proportion of testees from the upper levels of their high school classes, but again the data do not support the conclusion that an increasing proportion of ACT-testees are from the lower end of the high school achievement distribution.

The proportion of students in any given high school curriculum has changed little over the last years (see Table 12). It has been observed that students are often unable to state accurately what curriculum they are in (William H. Sewell, personal communication) but there is no way to test whether this bias is operating any more in one year than another.

Table 11

Distribution of High School Grade Average
of ACT Testees, 1970 to 1975

	Grade Point Average								
Year	.0-0.5	0.51-1.00	1.01-1.50	1.51-2.00	2.01-2.50	2.51-3.00	3.01-3.50	3.51-4.00	N
1970	1.8	1.2	4.3	18.3	22.8	26.3	15.5	9.8	8033
1971	2.0	0.8	4.2	17.0	21.4	27.0	16.3	11.3	6774
1972	2.3	0.6	2.8	14.1	22.2	26.3	18.6	13.0	7375
1973	2.1	0.6	2.3	12.4	20.4	28.4	18.7	15.0	7403
1974	3.2	0.6	2.4	10.7	18.5	28.0	20.2	16.4	7144
1975	2.9	0.5	2.3	9.8	17.4	27.4	21.8	18.0	6918
Total	2.4	0.7	3.1	13.8	20.5	27.2	18.5	13.8	43647

Table 12

Distribution of High School Curriculum of ACT Testees, 1973 to 1975

Year	Curriculum: Business/ Commercial	Vocational/ Occupational	College Prep	Other/ General	Missing	N
1973	9.3	10.5	56.7	22.9	0.6	7403
1974	6.7	8.4	57.8	23.7	3.3	7144
1975	7.2	9.3	57.5	23.6	2.4	6918
Total	7.8	9.4	57.4	23.4	2.1	21465

One may also consider patterns of course-taking for the last three years. The major features (tables not shown, see Bills 1977) are: There have been some increases in the proportion of students who have taken eight semesters of Natural Science and Math. There seem to be declining enrollments in language courses. The patterns of enrollments are fairly stable elsewhere in the tables.[10]

What does this series of tables show? When course-taking increases (as in the case of Natural Science), test scores remain stable. When course-taking in a particular subject remains stable, test scores most related to that subject decline. Without trivializing the issue, this suggests that "it takes all the running you can do, to keep in the same place." That is, perhaps if the pattern of course-taking in Natural Science had paralleled that of other subjects, then Natural Science scores would have shown similar declines.

9. TRENDS IN TEST SCORES BY SEX

To return now to the trends of means and standard deviations over time, one first notices that there are marked sex differences in these trends. Table 13 shows that while women continue to score above men on the English exam, the score declines are more precipitous for women. Male scores consistently show slightly more variation than do female scores.

Math scores have declined far more for women than for men. Again, there is more variation in male scores. A similar pattern exists for the mean of Social Studies scores, although here the standard deviations are more comparable for each sex.

Table 13

Means and Standard Deviations of ACT Test Scores by Sex, 1970 to 1975

Year	English		Math		Social Studies		Natural Science		Composite		N
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	
1970	17.03 (5.52)	19.08 (5.37)	20.14 (7.17)	18.04 (6.98)	19.07 (7.12)	18.46 (7.02)	21.28 (6.45)	19.76 (6.08)	19.50 (5.66)	18.95 (5.45)	8033
1971	16.89 (5.57)	18.64 (5.35)	20.01 (7.28)	17.67 (6.94)	19.07 (7.21)	18.14 (7.12)	21.56 (6.54)	19.49 (6.21)	19.50 (5.75)	18.61 (5.45)	6774
1972	17.53 (5.23)	18.80 (5.20)	20.50 (7.16)	18.02 (6.81)	19.28 (7.42)	17.64 (7.42)	21.99 (6.50)	19.83 (6.03)	19.95 (5.73)	18.70 (5.51)	7375
1973	17.12 (5.17)	18.50 (5.09)	19.79 (7.42)	16.96 (7.11)	19.07 (7.59)	17.12 (7.55)	22.20 (6.45)	19.50 (5.94)	19.66 (5.78)	18.14 (5.52)	7403
1974	17.06 (5.28)	18.30 (5.22)	19.00 (7.95)	16.33 (7.59)	18.62 (7.66)	16.25 (7.33)	22.32 (6.41)	19.92 (5.97)	19.37 (5.94)	17.83 (5.63)	7144
1975	16.79 (5.38)	18.00 (5.25)	19.13 (7.65)	16.04 (7.25)	17.97 (7.33)	16.19 (7.12)	22.01 (6.59)	19.86 (6.31)	19.10 (5.91)	17.65 (5.64)	6918
Total	17.08 (5.37)	18.56 (5.26)	19.79 (7.45)	17.17 (7.17)	18.87 (7.40)	17.29 (7.32)	21.88 (6.50)	19.73 (6.38)	19.52 (5.80)	18.31 (5.55)	43647

There have been no obvious trends in either means or standard deviations for Natural Science scores. Male means are both higher and more variable than those of women.

Finally, the table shows that the declines on Composite scores have been far steeper over time for women than for men. This implies that the gap between male and female scores is increasing. Male standard deviations are considerably above female standard deviations, and the standard deviations are steadily increasing for each sex.

It is striking that male standard deviations are consistently higher than those of female testees, even in years when women constitute the majority of the test-taking population. The general increase in standard deviations probably does indicate an increasingly heterogeneous group of testees, but the differential between men and women may have as much to do with the actual sex-related processes of learning in the high school[11] (for example, tracking and teacher expectations) as with problems emanating from the changing pool of testees. Perhaps males are simply more heterogeneous in their academic abilities than are females.

10. TRENDS IN TEST SCORES BY RACE

Table 14 shows the breakdown of ACT scores by race. The table indicates that mean English scores for whites have declined, albeit irregularly, over the last six years. Standard deviations for whites were highest in 1970 and 1971, declined considerably in 1972 and 1973, and increased to a point between these two extremes in 1974 and 1975.

Table 14

Means and Standard Deviations of ACT
Composite Scores by Racial Groups, 1970 to 1975

Year	Black	American Indian	White	Spanish American	Oriental American	Missing/ Other	Total	N
1970	12.63 (4.16)	14.74 (5.33)	20.19 (5.17)	15.47 (5.46)	16.77 (6.02)	17.82 (5.48)	19.23 (5.56)	8033
1971	12.46 (4.51)	16.62 (6.09)	20.07 (5.19)	15.07 (5.30)	16.25 (5.59)	17.29 (5.41)	19.06 (5.62)	6774
1972	12.91 (4.43)	14.75 (4.87)	20.44 (5.20)	14.86 (5.12)	16.74 (5.46)	17.05 (5.61)	19.31 (5.66)	7375
1973	12.84 (4.52)	16.04 (5.00)	19.98 (5.28)	14.75 (5.09)	17.19 (5.09)	17.92 (5.81)	18.86 (5.70)	7403
1974	12.24 (4.70)	15.87 (5.63)	19.52 (5.47)	14.26 (5.73)	18.91 (6.34)	17.50 (5.67)	18.55 (5.83)	7144
1975	12.24 (4.64)	14.18 (4.85)	19.23 (5.45)	15.20 (6.05)	17.69 (6.20)	17.44 (5.85)	18.30 (5.81)	6918
Total	12.55 (4.50)	15.45 (5.28)	19.92 (5.31)	14.94 (5.45)	17.00 (5.80)	17.55 (5.66)	18.90 (5.71)	43647

Mean English scores for blacks increased regularly for the first four years of the study, although the scores were almost a full standard deviation below the mean for the entire sample. The scores have since decreased, but the mean for 1975 was still above the 1970 mean. The scores were most variable for the earliest and most recent groups of black testees.

The patterns for other minorities and for those not responding to the race question are mixed. In general, these groups obtain relatively low English scores, but there are no readily apparent trends in means and standard deviations.

Except for 1972, mean Math scores have steadily declined for whites. This is accompanied by increasing variation in the scores, suggesting a more heterogeneous sample of white testees. Black scores have also declined, although these are more homogeneous than white scores (i.e., the standard deviations are lower). The Math scores of other minority groups, with the exception of Oriental Americans, are generally declining.

While the pattern is less clear for some groups than for others, mean Social Studies scores seem to be dropping across the board. The trend in standard deviations is not really clear, but there appears to be a general rise.

The salient feature of the breakdown of Natural Science scores is stability. Some racial groups display fairly erratic patterns, but these are groups with more limited sample sizes (e.g., American Indians and Oriental Americans).

Composite scores for whites have declined steadily from year to year (again with the exception of 1972), while the standard deviations have concurrently risen. Scores for blacks have been less consistent, but the two most recent cohorts have shown the lowest means and lowest standard deviations. Except for Oriental Americans, where the two most recent cohorts have been the highest achieving, the remaining minority groups have performed most poorly in the last two years.

These results do not suggest that changes in the performance of minorities substantially accounts for the general decline in test scores. Indeed, the greatest declines for any particular racial group on the English, Social Studies, and Composite scores have been for whites, and the declines for whites on the Math exam have been nearly as large as for any other group.[12] In sum, given the stability in the year-to-year racial composition of the test-taking population, there is no justification for attributing the score decline to the changing performance of minority students.

11. TRENDS IN TEST SCORES BY HIGH SCHOOL GRADE AVERAGE

Table 15 shows that declines have occurred at all levels of high school grade average. A brief glance at the table might suggest that the declines have been comparable throughout the distribution, but it is misleading to merely consider the absolute number of points that the scores have dropped. A more reasonable approach is to assess the decline in terms of the proportion of the baseline (1970) standard deviation that the decline represents. This technique reveals that the steepest declines consistently occur in the highest levels of high school average. Students with high GPAs in 1975 differ more in their test score performance from students with similar GPAs in 1970 than do analogous groups with lower GPAs. If nothing else, this indicates a general grade inflation in high schools.

Table 15

Means and Standard Deviations of ACT Composite Scores
by Grade Point Average of ACT Testees, 1970 to 1975

	Grade Point Average									
Year	0.0- 0.5	0.51- 1.00	1.01- 1.50	1.51- 2.00	2.01- 2.50	2.51- 3.00	3.01- 3.50	3.51 4.00	Other	N
1970	14.75 (5.83)	14.05 (4.53)	15.30 (4.71)	15.98 (4.61)	17.66 (4.92)	19.93 (4.72)	22.69 (4.55)	24.73 (4.39)	19.23 (5.56)	8033
1971	15.06 (5.29)	13.76 (4.44)	14.90 (4.39)	15.61 (4.78)	17.30 (4.83)	19.58 (4.85)	22.21 (4.75)	24.38 (4.53)	19.06 (5.62)	6774
1972	15.85 (5.47)	15.09 (5.46)	14.60 (4.16)	15.60 (4.72)	17.56 (4.88)	19.35 (5.01)	21.70 (4.97)	24.66 (4.48)	19.31 (5.66)	7375
1973	15.61 (5.95)	13.11 (4.11)	13.94 (4.47)	14.73 (4.56)	16.71 (4.66)	18.67 (4.97)	21.24 (4.88)	24.06 (4.83)	18.86 (5.70)	7403
1974	16.37 (5.51)	12.93 (4.91)	13.60 (4.98)	14.33 (4.78)	16.09 (4.90)	18.11 (5.12)	20.76 (5.00)	23.47 (4.95)	18.55 (5.83)	7144
1975	16.01 (5.48)	12.50 (3.75)	13.13 (4.72)	14.22 (4.63)	15.61 (5.01)	17.53 (5.01)	20.23 (5.11)	23.16 (4.88)	18.30 (5.81)	6918
Total	15.70 (5.60)	13.69 (4.61)	14.46 (4.62)	15.25 (4.72)	16.91 (4.92)	18.87 (5.02)	21.40 (4.96)	23.98 (4.75)	18.90 (5.71)	43647

12. DISTRIBUTION OF TEST SCORES BY SEX

One may also look at the percentage distributions of test scores. Table 16 shows that the increased proportion of low Composite scores is more prominent for women than for men. Male scores are persistently above those of women on the ACT-Composite. Consider for example the "Total" column of each panel in the table. Whereas 13.4% of male scores are below 12, 16.7% of female scores are below this figure. A similar pattern holds at each other upper boundary of a particular interval. This is not an artifact of the higher proportion of female testees; the proportion of low scoring women exceeds the proportion of low scoring men. The distributions for each of the four exams parallel these results.

In sum, there is a great deal of evidence suggesting that the changing composition of the test-taking population has been accompanied by a greatly increased proportion of low scoring women. This is quite probably the case, and if one accepts that this is a major contributor to the general score decline, is not necessarily disturbing. Perhaps it even allows the decline to be interpreted as a good thing, in that it represents more equal opportunity between the sexes. Consider the following speculation. Arbitrarily divide potential college students into four groups: bright males, less bright males, bright females, and less bright females. Traditionally the first three groups have been most likely to attend college,[13] while more recently, whether because of the feminist movement or other social processes leading to increased educational opportunity, and as evidenced by the proportion of females taking college entrance tests, the group of less bright females is beginning to be more highly represented among college aspirants. Thus, discrimination based on sex is reduced and equality of opportunity is increased, and one result of this trend is a decline in test scores.

Table 16

Percentage Distribution of ACT
Composite Scores by Sex, 1970 to 1975

	Men							Women						
Year	1970	1971	1972	1973	1974	1975	Total	1970	1971	1972	1973	1974	1975	Total
Score Interval														
0-6	0.7	0.8	0.4	0.5	1.1	0.8	0.7	0.7	0.9	0.4	0.8	0.6	0.8	0.7
7-12	11.7	12.6	11.0	12.3	13.3	16.1	12.7	12.6	13.6	14.8	16.0	19.1	19.7	16.0
13-18	30.9	29.7	28.2	29.7	29.3	27.1	29.2	33.1	34.2	34.2	36.3	35.1	36.4	34.9
19-24	34.4	35.0	36.2	34.3	34.1	34.9	34.8	36.0	35.1	33.8	32.8	31.4	29.7	33.1
25-30	21.3	20.8	22.6	21.7	20.9	20.2	21.3	16.9	15.9	16.1	13.3	13.2	13.1	14.7
31-36	1.0	1.2	1.5	1.4	1.3	0.9	1.2	0.6	0.4	0.7	0.7	0.5	0.4	0.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
(N)	(4007)	(3389)	(3616)	(3522)	(3321)	(3133)	(20988)	(4026)	(3385)	(3759)	(3881)	(3823)	(3785)	(22659)

While declines have been more precipitous for women than for men and while this probably has some utility in explaining depressed scores, it is not necessarily true that this aspect of the changed pool is exerting that much impact. It does nothing to explain the decline in male scores, and it is not certain how much of the increased proportion of women taking the tests is due to a possible drift of men away from college or to a drift of women toward college. A potentially important question (which cannot be assessed here) is "Why has the sex composition of the sample changed?" Men might be taking college admissions tests in lesser proportions as a reaction to the end of the draft or to a changing job market, while the increased proportion of female testees may be a result of the general trend toward equal opportunity for women. To adequately address the full impact of the increased proportion of female testees on test scores, more should be known about the characteristics of the women taking tests now who would not have been taking them a few years ago, and about the characteristics of the men who are not now taking the tests who would have earlier (assuming this group does in fact exist).

13. A MODEL OF THE SCORE DECLINE

The analyses reported thus far have demonstrated the dimensions of the score decline for various subpopulations of testees. They have indicated where the declines are steepest, where they are less marked, and have often suggested tentative explanations for the general score decline. For the most part, however, these analyses have involved only bivariate techniques. The next section of this study will utilize multivariate techniques to address the score decline.

The final stage of the statistical analyses involved the use of multiple regression, in which a number of models were specified regressing the five kinds of test scores on various independent variables. In the present study, cohort effects are coded as a series of dummies. The coding is such that the cohort effects can be interpreted as deviations from the grand mean. This differs for the parameterization used in Bills (1977), in which the cohort effects were interpreted as deviation from the 1970 mean.

The only interaction terms considered here are those between cohort and sex. These new variables were created simply by multiplying together the sex and cohort variables.

These parameters allow one to estimate whether or not the effect of being of a given sex and of being in a given cohort contributes significantly to the predictive power of the model. In view of the changing composition of the test-taking population, these interactions are potentially important.

14. RESULTS OF THE REGRESSION ANALYSIS

The following discussion will be set in terms of models in which the dependent variable is the ACT-Composite score.[14] The effects of predetermined variables operate similarly though not identically in each of the four exams. While there are several discrepancies between tests, focusing on the Composite regressions should serve to keep the presentation reasonably direct. We will first specify and estimate the more restricted six-year model, and then proceed to the more fully specified three-year model.

15. RESULTS OF SIX-YEAR MODEL

Table 17 indicates the effects of cohort on the Composite score. Basically, this is simply a way to map out the yearly means. Again, these can be read as deviations from the grand mean.

While entering sex into the equation leaves the cohort effects essentially unchanged, including the sex by cohort interaction terms indicates that the cohort effects were being suppressed somewhat in the first equation. In addition, the interaction effects are themselves significant. These results thus provide some support for the thesis that the declines are partly attributable to the changing sex composition of the sample.

The regression of ACT-Composite on high school average, educational plans, race, and high school size yields no great surprises (see Table 18). Race and high school grade average both exert large effects, educational plans a bit less, and high school size, as expected, has a relatively minor effect. Adding sex to the equation adds significantly to the adjusted R^2, and also leads to an increase in the effect of high school average. This effect is underlined even more with the addition of cohort effects to the model.

Two things seem to be occurring here. First, the effects of being in a particular cohort are greatly suppressed when these five background measures are not controlled. Controlling for these variables, the effects of being in a particular cohort are more substantial. Second, these equations provide fairly compelling evidence for the presence of a general high school grade inflation. While high school grades are rising, this has not been accompanied by a corresponding increase in test scores. The adjusted trend clearly differs from the observed trend.

Table 17

Regression of ACT Composite Scores on Cohort and Sex by Cohort Interactions, 1970 to 1975

Independent Variables	(1) B	(2) B	(3) B
YR70	.199	.187	.506
YR71	.032	.025	.106
YR72	.459	.463	.342
YR73	-.085	-.100	.274
YR74	-.312	-.302	-.397
YR75	-.565	-.536	-.661
SEX		1.206	.566
SEX70			-.636
SEX71			-.162
SEX72			.248
SEX73			.345
SEX74			.195
SEX75			.268
R^2	.003	.015	.015
Error of Estimate	5.614	5.582	5.580

Table 18

Regression of ACT Composite Scores on Background, Cohort, and Sex by Cohort Interactions, 1970 to 1975

Independent Variables	(1) B	(2) B	(3) B	(4) B	(5) B
HSA	3.771	4.019	4.187	4.187	4.183
EDPLANS	2.423	2.092	2.083	2.083	2.084
RACE	4.836	4.678	4.522	4.522	4.521
HSSIZE	.442	.452	.808	.808	.808
SEX		1.701	1.713	1.713	1.382
YR70				.786	.950
YR71			-.336	.450	.465
YR72			-.313	.473	.404
YR73			-.944	-.158	-.214
YR74			-1.676	-.890	-.976
YR75			-2.116	-1.330	-1.348
SEX70					-.328
SEX71					-.030
SEX72					.142
SEX73					.110
SEX74					.172
SEX75					-.038
R^2	.394	.415	.432	.432	.432
Error of Estimate	4.378	4.300	4.240	4.240	4.239

Finally, the sex by cohort interactions were entered into the equation. Net of the variables already in the equation, the influence of these variables is not great. They serve to attenuate the sex main effect by about 20%, and slightly increase the cohort effects.

What have the regression equations shown us thus far? A few points stand out. First, test scores can be predicted reasonably well given the five background variables available for all six years, even given the relative unimportance of high school size. Second, the dimensions of the observed declines in test scores are obscured somewhat by changes taking place in the population. Specifically, high school average is increasing and the sex composition is changing. Controlling for these measures indicates that the reduced form cohort effects are considerably underestimated.

These results also suggest that while race is a major determinant of test scores, it is probably not implicated to any appreciable extent in the general score decline in test scores. On the basis of the preceding equations, it is more plausible to assert that the increased proportion of women is contributing significantly to the decline, and that the general grade inflation also has had an impact. As suggested earlier, this can possibly be explained as a social-psychological process. If relatively "untalented" students are achieving better high school grades, they are more likely to perceive themselves as good students, to aspire to college, to take the college entrance exams, and to do poorly. This might well be one of the major causal factors in the decline.

16. RESULTS OF THREE-YEAR MODEL

A second series of equations was estimated for the most recent three years of the sample for which more complete data were available.

Table 19 shows the results of similar equations to those discussed previously. These map the means over time, and show the means adjusted for cohort effects and sex by cohort interactions.

In the next equation, ACT-Composite was regressed on sex, high school average, educational plans, race, and high school size (see Table 20). Except for a somewhat smaller effect of race for the 1973-1975 population than the 1970-1975 population, these variables operate similarly in the six-year and three-year models.

In the next step, additional demographic and school-related variables were introduced into the equation. These include size of the student's home town, number of siblings, the type of college the student plans on attending, the size of the college the student plans on attending, and the type of high school the student attended (see section on "Variables" for the coding of these measures). While this vector of variables does not add greatly to the adjusted R^2, many of the variables are worth talking about. College type, for example, is seen to exert a large positive effect (B = .825) on Composite scores. At the same time, this variable is probably tapping much the same thing as the measure of educational plans--the two have a zero-order correlation of .467--and the inclusion of this variable is probably the major reason that the B associated with educational plans is reduced by 23% in this equation.

Secondly, high school type appears to be an important variable. This can be interpreted to mean that students from private high schools do better on the exams than do students from public schools.

Table 19

Regression of ACT-Composite Scores on
Cohort and Sex by Cohort Interactions, 1973 to 1975

Independent Variables	(1) B	(2) B	(3) B
YR73	.228	.207	.179
YR74	-.019	-.028	-.067
YR75	-.262	-.249	-.257
SEX		1.500	1.543
SEX73			.043
SEX74			-.093
SEX75			-.048
R^2	.001	.018	.018
Error of Estimate	5.780	5.732	5.732

Table 20

Regression of ACT Composite Scores on Background Curricular, Cohort, and Sex by Cohort Interactions, 1973 to 1975

Independent Variables	(1) B	(2) B	(3) B	(4) B	(5) B	(6) B	(7) B
SEX	1.976	1.912	1.183	1.354	1.344	1.314	1.262
HSA	4.413	4.383	3.623	3.474	3.485	3.522	3.522
EDPLANS	2.129	1.642	1.154	1.007	.993	1.008	1.007
RACE	3.480	3.466	3.305	3.246	3.261	3.304	3.306
HSSIZE	.789	.693	.651	.628	.620	.600	.599
TOWN		.373	.360	.064	.055	.088	.089
SIBS		-.052	-.065	-.064	-.063	-.067	-.067
COLTYPE		.825	.578	.585	.571	.611	.611
COLSIZE		.156	.098	.038	.039	.012	.011
HSTYPE		-.904	-.612	-.502	-.482	-.500	-.500
ENG			.022	.007	.013	.007	.007
MATH			.472	.422	.415	.417	.417
SS			-.005	-.037	-.038	-.039	-.039
NS			.366	.348	.338	.346	.346
SPAN				.209	.199	.193	.144
GER				.445	.434	.421	.421
FR				.338	.325	.317	.317
OTH				.430	.419	.406	.406
BUS					-.038	-.031	-.031
VOC					-.047	-.045	-.045
YR73						.552	.578
YR74						-.035	-.083
YR75						-.551	-.532
SEX73							-.052
SEX74							.098
SEX75							-.042
R^2	.420	.427	.476	.500	.501	.506	.506
Error of Estimate	4.406	4.377	4.185	4.090	4.088	4.064	4.064

Size of town seems to be moderately important, and college size, not surprisingly, is unimpressive. The apparently trivial effect of family size should be interpreted cautiously. This variable, it will be recalled, was measured in such a way that its effect is almost certainly underestimated by a substantial amount.

The next several steps speak to questions of the impact of the high school curriculum on test scores (see Table 21). These are added in three steps. First, traditional academic subjects are entered. These include the number of terms the student has studied English, Math, Social Studies, and Natural Science. Second, four foreign language courses were introduced. These are Spanish, German, French, and Other. Finally, business and vocational courses are added.

The results of adding the traditional academic courses are striking. The adjusted R^2 is increased by 11%, the coefficient of sex is decreased by 38%, high school average by 17%, and educational plans by 30%. The measures of Math and Natural Science courses both appear to be exerting relatively large impacts, while English and Social Studies contribute relatively little.

There are a number of explanations for these results. It does not seem reasonable that the number of semesters that a student has studied English should have so little effect upon his Composite test score, especially since three of the four tests are meant to measure some kind of reading ability. Probably the major reason for this observed result is that there is so little variation in English enrollments in the test-taking population. Given a ceiling of 8.0 for these curricular variables, the mean for English is 7.52. The corresponding standard deviation (1.07)

Table 21

Regression of ACT Composite Scores on Curricular, Cohort, and Sex by Cohort Interactions, 1973 to 1975

Independent Variables	(1) B	(2) B	(3) B	(4) B	(5) B	(6) B
ENG	.115	.072	.073	.073	.092	.092
MATH	.927	.836	.833	.836	.806	.806
SS	-.017	-.061	-.061	-.063	-.067	-.067
NS	.655	.621	.618	.624	.615	.615
SPAN		.278	.274	.272	.286	.286
GER		.642	.638	.633	.635	.635
FR		.458	.453	.451	.477	.477
OTH		.574	.570	.564	.563	.563
BUS			-.009	-.004	.026	.026
VOC			-.022	-.021	-.035	-.035
YR73				.284	.272	.267
YR74				-.587	-.061	-.066
YR75				-.360	-.349	-.349
SEX					.561	.571
SEX73						.010
SEX74						-.011
SEX75						-.000
R^2	.234	.281	.281	.283	.285	.285
Error of Estimate	5.061	4.903	4.903	4.896	4.889	4.890

is only about half that of Math or Natural Science. Thus, the estimate that an extra semester of high school English will only raise a student's Composite score 0.02 points may be largely a result of the low variations in enrollments in English. A competing explanation is that this relationship is nonlinear and that additional English courses above a given level have little effect.

Alternatively, perhaps these estimates are accurate, and English courses really do have very little effect on scores. The previous explanation seems more compelling, but the data do not allow this interpretation to be dismissed altogether.

Still another interpretation is that increased enrollments in Math and Natural Science courses do not cause higher test scores, but rather that better students seem to take more courses in Math and Natural Science. This takes us back to the previously noted lack of an earlier measure of ability analogous to the ACT exam. The importance of this omitted variable now becomes boldly underlined.

Since we have no measure of ability, there is no way to tell if some kinds of courses lead to higher test scores, or if students who would have scored well anyway select themselves into these courses. The results of adding the four language courses into the equation suggest that the second interpretation is closer to the truth. The results show that the curriculum variable having the largest effect on Composite scores is the number of semesters a student has studied German. Unless one can spin a compelling story about the efficacy of studying the German language to improve one's cognitive skills, these results indicate not that studying foreign languages necessarily affects test scores, but that students more likely to score highly tend to take more foreign language courses. That is, the results suggest that curricular variables are a proxy for ability rather than a measure of instructional impact.

This leads to an interesting issue. While knowledge of a student's curricular profile can do much to aid in predicting his test score, the same knowledge does not necessarily do much to explain trends in test scores (at least in the absence of an earlier ability measure). It is possible that actually giving all students another semester of English may do more to raise scores than giving all students another semester of German, or for that matter, Natural Science or Math.

Before proceeding to the next step, it might be noted that the inclusion of these curricular variables in the equation led to the effects of town size and college size being reduced to negligible amounts.

Net of everything already in the equation, business and vocational courses do not have a large impact on test scores. Not surprisingly, what little effect they do have is negative.

The next step is to add the three cohort dummies into the equation. Comparing the resultant equation to the equation containing only these three dummies reveals that by not controlling for this wide range of variables, the actual cohort effects are nontrivially suppressed. When all of these variables have been considered, the adjusted declines are considerably more severe than the observed declines.

Finally, adding the sex interactions does little to change the extant relationships. By this time, though, the model contains 24 independent variables, and interpretations are becoming increasingly problematic.

The next equation shows the gross effects of English, Math, Social Studies, and Natural Science enrollments on the Composite score. The parameters are all appreciably larger than when the background variables are being controlled, but their sizes relative to each other are the same. Math and Natural Science courses bear a stronger relationship to Composite test scores than do English or Social Studies courses. Again, the posited tendency for good students to select themselves into these courses cannot be overemphasized.

Adding the language and nonacademic courses produces the same results as reported earlier. The following three steps, in which cohort, sex, and sex by cohort are added, suggest that the main suppressing effects of the reduced form cohort effects come not from the curricular variables, but from the other background variables. Again, the major candidate is high school grade average.

17. CONCLUSIONS

The preceding pages have presented a great deal of numerical information, the interpretation of which is not always straightforward. Even with the previously discussed methodological difficulties in mind, we may suggest the following generalizations:

1) Prior research has established that the observed declines in test scores are not artifacts of the tests themselves.

2) My analyses offer some evidence that the general score decline is partly a function of the changed sex composition of the test-taking population. The increased proportion of female testees, many of whom

probably come from lower academic ability levels, is likely an important factor in explaining the score declines.

3) There is some good reason to believe that high school grade inflation is involved in the decline in test scores. This was presented as a social-psychological process as follows: If high school grades are generally rising, and if much of a student's perceptions of his academic ability derives from the grades he receives, then an increasing proportion of less able students may now be perceiving themselves as "college material." They would then aspire to college, take the ACT exam, and probably perform poorly. This would thus contribute to the score decline.

4) The declines in test scores do not seem to be attributable to any great extent to changes in the performance of racial minorities. Indeed, white declines have in general been steeper than those of blacks and other minorities. Further, minority composition has not changed dramatically.

5) The declines in test scores seem to be most marked for students planning on attaining only a Bachelor's degree. This suggests two possibilities: a) The best students plan on going well beyond a Bachelor's degree and these students will probably do very well on the tests regardless of what cohort they are in, and b) the test performance of students entering two-year colleges is probably not implicated to any great extent in the decline over the past six years. This may be due to the fact that many students planning on entering two-year colleges do not take the tests.

6) A variety of other background variables, such as high school type, rural/urban background, and number of siblings, exert generally modest effects on test scores, but probably do not have much to do with changes in test scores.

7) There is a strong statistical relationship between high school course enrollments and test scores. This is probably principally a consequence of self-selection into courses. That is, curricular variables in this study are more a proxy for academic ability than a measure of instructional impact. Still, the effects are robust enough to suggest that declines in the taking of academic courses, to the extent that such declines have occurred, could plausibly lead to lower test scores.

If these conclusions and interpretations are correct, they suggest that much of the current dismay over declining test scores is misplaced. If scores are declining largely because a broader spectrum of students now aspire to college and therefore take the tests, this decline in test scores is an acceptable trade-off for expanded educational opportunity. Certainly it is worthwhile to strengthen the high school curriculum and to place increased emphasis on course content and on the development of academic skills, but the current "back to basics" movement, however otherwise justified, does not seem to be dictated by the declines in scores on college admissions tests.

NOTES

[1]The median of the ACT Composite for eight Western states went from 19.6 in 1970-1971 to 19.1 in 1974-1975. In eight Southern states the figures are 18.4 and 17.4 and in ten North Central states 20.2 and 19.3 (Munday 1976, p. 6).

[2]One state has gone from a 1970-1971 median of 19.1 to a 1974-1975 median of 19.2. A second state has remained at 20.5. Neither state is identified in the ACT reports.

[3]Maxey (personal communications) reports that preliminary analyses of scale drift in the ACT indiate that a slight, nonsignificant drift has occurred.

[4]For a more extended discussion, see Wright (1976).

[5]This approach is not foolproof, and its usefulness is conditional on the assumptions one is willing to make about the form of the test score distribution. Increased standard deviations do not <u>necessarily</u> imply increased heterogeneity of the test-taking population; perhaps one is merely sampling from a different part of the distribution. Thus, while this is an intuitively appealing approach, it will be supplemented by a number of cross-tabulations and breakdowns of the data.

[6]For information on the movement toward two-year colleges, see Johnson 1973; Peterson 1972; Carnegie Commission 1970, 1973; and Wade 1973.

[7]The data for this table and all subsequent tables are drawn from the present sample.

[8]Since the distribution of scores on the four exams are somewhat different, a one-point decline on one exam is not necessarily the same as an equal decline on another. This makes it reasonable to discuss declines as percentages of standard deviations.

[9]An interesting question is why the four exams have experienced different trends. Since everyone in the sample took all four tests, theories involving a changed pool of testees cannot speak to the issue of differential declines. The results may suggest that high schools are maintaining a strict natural science curriculum, even as qualifications are apparently declining in other areas. Alternatively, perhaps the sample is being increasingly selected on natural science ability.

[10]These findings are somewhat at variance with those of Gertler and Barker reported earlier, which were, of course, for a more general population of students than the present sample.

[11]There is a growing literature on this topic. See Rosenbaum (1976); Alexander and Eckland (1974); and Stacey, Bereaud, and Daniels (1974).

[12]The result is the same whether the declines are measured in absolute amounts or as proportions of standard deviations for both the white and black distributions.

[13]The research of Sewell and Shah (1967, 1968) provides ample support for this assertion.

[14]The reader interested in equations pertaining to English, Math, Social Studies, and Natural Science scores may consult Bills (1977). In many cases the estimates are considerably divergent.

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