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ABSTRACT

The mathematics portion of the 1975-76 and the 1977-78 National Assessment of Educational Progress (NAEP) testing program represented a departure from the earlier mathematics assessment: in addition to surveying the cognitive domain, items were included which related to the affective component of learning mathematics. Although these questions were not specifically designed to be used in scales, many of the test packages contained five or more such attitudinal questions. Seven test booklets from 1977-78 for ages 9, 13 and 17 and all four test packages from the 1975-76 assessment were examined to derive reliable, valid and useful affective scales. The affective items were examined individually and as potential scales. The dimensionality of each item set was determined and the derived dimensions and composite item sets were analyzed for internal consistency. A canonical analysis of the 1977-78, age 17 data evaluated the predictive power of the attitudinal dimensions; at least one scale of adequate internal consistency was found in each test package. At least one reliable scale was found in three of the four age 13 packages. The NAEP mathematics data base was found to be potentially rich for research on affective constructs. Primary type of information provided by the report: Assessment Instrument (Affective Exercises); Results (Secondary Analysis). (Author/CM)

MEASUREMENT PROPERTIES OF ATTITUDE SCALES IN THE NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS DATA ON MATHEMATICS

FINAL REPORT

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ABSTRACT

The mathematics portion of the 1975-76 and the 1977-78 National Assessment of Educational Progress (NAEP) testing program represented a departure from the earlier mathematics assessment: in addition to surveying the cognitive domain, items were included which related to the affective component of learning mathematics. Although these questions were not specifically designed to be used in scales, many of the test packages contained five or more such attitudinal questions. With the recent distribution of NAEP data-tapes, the availability of attitudinal scales would offer many opportunities to the secondary analyst. This study examined eleven test packages from the last two assessment cycles to determine if reliable, valid, and usable affective scales are derivable from the mathematics assessment data.

Seven test booklets from 1977-78 were used for this analysis, including at the age seventeen level, test booklets 5, 6, 8 and 9; test booklets 8 and 9 for the thirteen-year-olds; and booklet 5 at the age nine level. All four test packages from the 1975-76 assessment were analyzed. The affective items in each test package were examined individually, and as potential scales. Factor analyses were performed to determine the dimensionality of each item set. The derived dimensions and the composite item sets were then analyzed for internal consistency. A canonical analysis was performed on the four 1977-78 age seventeen test packages to evaluate the potential predictive power of the attitudinal dimensions.

In the 1977-78 age seventeen test packages, at least one scale of adequate internal consistency was found in each test package. The results for the age thirteen students were similar, in that at least one reliable scale was found in three of the four test packages. The secondary analyst interested in such affective constructs will find the NAEP mathematics data base to be a potentially rich resource.

PREFACE

The main body of this report focuses upon the psychometric evaluation of attitude indicators in the NAEP assessments of mathematics. In addition to this analysis of the reliability and validity of attitudinal measures we performed several additional studies that pertain to the question of the quality and utility of NAEP data. These additional studies are reported in appendices to this report as follows:

A. The Home Environment and Mathematical Learning

B. Attitudes toward Mathematical Activities and the Prediction of Achievement

C. Nonresponse and "Don't Know" Response Problems in the NAEP Data

Following these is a final appendix on our experiences with the NAEP Public Use Data Tapes. The first two appendices contribute toward an assessment of the measurement properties of the attitude scales in that they explore the role of selected attitude scales in the context of a multivariate model of the learning process. In particular this approach attests to the predictive validity of the indicators of attitude toward mathematics.

This report represents the concerted effort of many people over a long period of time. Linda Harris deserves a special medal of honor for her sweat and tears in performing the bulk of the front line statistical action. She also wrote most of the main body of this final report. It is not surprising that she is known as the NAEP Wonder Woman. Marcy Rasmussen made an important contribution to early stages of the project doing statistical analysis and writing it up. Professor Wayne Welch played an invaluable role in the project as godfather and spiritual leader, and he also participated in writing and editing the numerous drafts of chapters and reports. The project would not have survived were it not for the dedication and patience of Valerie Fitzgerald who kept the budget and administrative matters in order. She also spent many, many days typing, proofing, and retyping the many drafts and redrafts. In addition, Mary Welch and Pam Radant contributed many hours to the typing of tedious tables. We also thank David Wright and Susan Oldefondt for their very generous assistance in providing data and information from NAEP. Perhaps someone will thank me for the champagne to celebrate the completion of this very, very large project.

Ronald E. Anderson

Principal Investigator

BACKGROUND

Since 1969, the National Assessment of Educational Progress has gathered information about levels of educational achievement across the country and reported its findings to the nation. Approximately ten different subjects have been assessed (e.g. science, music, reading, mathematics) with each subject being repeated every few years. For each subject-assessment, random samples of schools are drawn nationally, and within these schools, selected students aged nine, thirteen and seventeen are administered test booklets containing a variety of cognitive items. Each test booklet usually has about 2,500 students from across the country responding to the items.

Mathematics assessments were conducted in 1972-73, 1975-76, and 1977-78. These assessments included 20, 4, and 29 booklets, respectively. In these latter two assessments, items which examined student attitudes toward mathematics first appeared in the national mathematics test booklet. Although few in number and limited in scope, these items represented a departure from the heavy cognitive emphasis of most national assessments.

In the 1975-76 "Basic Mathematics" assessment, the same set of nine mathematics attitude items are included in all four test booklets given during that year: two at age thirteen, and two at age seventeen. An instrument called the "Supplementary Student Questionnaire" was administered to 17-year-olds, as well. This instrument contained many diverse items, including three sets of items relating to other attitudes or values.

In the 1977-78 mathematics assessment, there was a larger and more diverse pool of affective items, which dealt specifically with mathematics. Similar items were asked at each age level (9, 13, and 17), but the wording and response format varied somewhat across age. Fifteen of the 29 test booklets included attitude items. No items were repeated within an age level.

The attitude items were included in the test booklets primarily for traditional assessment purposes -- to assess students' attitudes on an item-by-item basis. However, one fact does emerge which is important for the purpose of this report. Whenever a test booklet contains any attitude item, it includes at least five items (often more) creating the possibility that reliable and valid attitude scales are available in the booklet. Even though these scales were not built a priori into the booklets, their empirically derived existence would be of value to secondary analysts of the NAEP data. Such scales would make it possible to examine in some depth, the role of attitudes in the learning of mathematics.

PURPOSE

The inclusion of several attitude items in certain of the mathematics test booklets gives rise to the major questions of this study: are there any reliable, valid and useable attitude scales to be found among the mathemtics test booklets used in the 1975-76 and 1977-78 assessments?

The mathematics attitude items in the booklets were of two types: (1) attitude statements followed by a Likert-type response option, and (2) a series of mathematical tasks to be rated on the three dimensions of "importance," "easiness," and "liking." Several examples from the 1977-78 assessment are presented below.

(Age 9) "Mathematics is useful in solving problems in everyday life."
agree
undecided
disagree

(Age 13) "Mathematics is more for girls than for boys."
strongly agree
agree
undecided
disagree
strongly disagree

(Age 17) "Memorizing rules and formulas."
very easy
easy
undecided
hard
very hard

The mathematics attitude items at the age nine level had three response-options, while the items at the older age levels had five options. The mathematics attitude items in the 1975-76 assessment were of the Likert type, with the same response options as the second example above.

The non-mathematical sets of attitude items from the 1975-76 Supplementary Student Questionnaire had slightly different formats. The main difference is that these item sets omit the undecided response option, as the examples below illustrate:

Life Values Items:
How important is each of the following to you in your life:

"Being successful in my line of work"
not important
somewhat important
very important

Self Attitudes Items:
"Good luck is more important than hard work for success."
strongly agree
agree
disagree

strongly disagree

School Attitudes Items:

"Most required courses here are a waste of time."

agree strongly
agree somewhat
disagree somewhat
disagree strongly

As stated previously, the main objective of this analysis is to ascertain the potential of these attitude items for creating reliable scales. Another objective is to use the scaled measures in studies predicting mathematics achievement and course participation. Due to financial constraints, a representative sample of eleven booklets was selected for analysis. Seven test booklets - four at age seventeen, two at age thirteen, and one at age nine, were selected from the 1977-78 assessment. All four of the test booklets administered in the 1975-76 mathematics assessment were analyzed. In addition, the three sets of affective items included in the Supplementary Student Questionnaire, given only to seventeen-year-olds, were analyzed. Some of these items were potentially relevant to the theoretical framework predicting mathematics achievement, and also thought to be related to mathematics affect. For example, the construct "self-esteem" has often been used in such substantive studies.

PROCEDURES

Each test booklet was administered to an independent random, national sample of students. The average sample size for the 1977-78 assessment was about 2,400 students. In 1975-76, approximately 5,000 students responded to each of the test booklets. Because the packaging of items is unique to each test booklet, and the student sample responding to each test booklet is also unique, analyses were conducted on each test booklet separately. The data analysis procedures used herein were selected in part because they are easily reproducible by most NAEP data users. The techniques outlined below are basic psychometric operations, performed with the widely used data analysis program SPSS (Statistical Package for the Social Sciences). The rationale for this approach to evaluating the measurement properties of scales is elaborated in Anderson, Welch, and Harris (1982).

The analysis procedures were carried out at both the item and scale levels. First, a frequency distribution of responses was generated for each item. Items were then examined for response distribution (i.e. extreme skewness), level of nonresponse, and possible wording-interpretation problems. Those items which appeared to be problematic were included in subsequent analyses, but flagged as potential problems. The number of such items was small in most tests. (A notable exception occurred during the 1975-76 testing, and details are discussed in the results section.)

An inter-item correlation matrix was computed for each set of attitude items. This permits an examination of the association between specific items. Item means, standard deviations, and corrected item-to-total correlations were also computed. This latter statistic measures how well a particular item "fits in" with the rest of the items in the set.

A factor analysis was performed to explore the dimensionality of the composite set. A principle-components analysis with varimax rotation was used to identify "significant" factors (eigenvalues > 1.0). Items with loadings greater than .30 were selected for inclusion in these empirically-derived factor scales.

Estimates of the internal consistency of each factor scale and the composite set of items were made using the standardized alpha coefficient. The acceptable level for reliability coefficients was set at .70, as recommended by Nunnally (1978).

In four of the tests for seventeen-year-olds, the predictive validity of the scales was examined using a procedure outlined by Piazza (1980). He points out that the traditional scaling techniques based upon inter-item covariations (such as those used here) do not necessarily produce scales which are the most meaningful in a theoretical sense. Items which may "go together" well, may not be measuring a unitary phenomenon; nor may the items relate consistently to a set of theoretically relevant predictor or criterion variables. This could be construed as evidence that more than one construct underlies the item-set; by combining the dimensions into a single scale, and correlating it with an independent variable, the various components of the scale could relate in different ways to the independent measure, and cancel each other out, yielding a low correlation between the attitude scale and independent variable. Theorized relationships are obscured, and correlated errors built into the analysis. Piazza suggests a two-stage procedure involving first the traditional methods of factor analysis to delete items which clearly do not belong. Secondly, and after one has defined the theoretically useful predictor variables, a canonical correlational analysis is performed to examine the consistency of attitude items in their relationships to a set of predictor variables. Ideally, one would use a step-by-step procedure by deleting items one by one, until a unitary set was obtained. As Piazza notes, this is a cumbersome process, and usually results in only a very few items in the final set. In our analysis, canonical correlations were used to maximize the predictive power of the affective scales. Since our item-sets analyzed generally have a large number of affective items (relative to the number Piazza dealt with), this procedure was only performed once on the composite set of items for each of the four age seventeen test packages analyzed from the 1977-78 assessment. The results were examined in terms of the patterns of relationships to the predictor variables, and whether a different, and more useful method of scaling the items is suggested. Only four tests were used for this analysis, as the criterion variables deemed theoretically interesting are included only in this assessment testing at the age seventeen level.

RESULTS

Results generated by the preceding analyses are reported separately for each of the eleven test booklets. The discussion is divided into three parts. Part One presents the findings for assessment year 1977-78 (Year 78), age nine (one test) and age thirteen (two tests). Part Two included analyses performed for the four test packages at the age seventeen level in the Year 78 assessment. Finally, Part Three reports on all of the analyses conducted on the four test packages administered in the assessment year 75-76 (Year 76), with two tests at age thirteen, and two tests at age seventeen.

Data tables are presented for each test booklet in the following order:

1. Response frequency distributions
2. Correlation matrix (including item-means, standard deviations, and item-to-scale correlations).
3. Factor matrix
4. Factor analysis (loadings over .30 on

'significant' factors)

5. Canonical analysis (when performed)
6. Scale reliabilities

The reliabilities of scales in each test-package are summarized at the end of each of these parts. In this discussion the focus is upon the reliability of affective items, and the potential predictive usefulness of the composite or derived subscales.

PART ONE

INTRODUCTION

/ Part one summarizes the results of item and scale analyses of three test packages from the 1977-78 assessment of nine and thirteen-year-olds. The items were identical for ages thirteen and seventeen, but the instructions and response-options were simplified for the nine-year-olds.

Predictive analyses using attitudinal measures from these three test booklets are unlikely given the limited number of student background variables in test booklets at the younger ages. The reliability of these affective item-sets, however, appeared worth exploring, given the rough congruence of these item sets to those at the older age level. In addition, other secondary analysts might be interested in examining the developmental role of attitude on learning mathematics, so the potential usefulness of these attitudes deserve documentation.

The conventions we used to present the results of the analyses needs some clarification. A key word or phrase from each item was selected to identify that item in the tables. This word or phrase is underscored in the frequency distribution tables. It should be noted that when the students responded to the items, these particular words were not emphasized as shown in the tables herein. Also, the figure labelled "total N possible" listed on the frequency distribution tables is the total number of students to whom the test booklet was administered. The "N" listed with each item in the frequency tables is the number of valid responses to that item. The differences in the two numbers are the nonresponses to that item. For all of the tables appearing after the frequency table, the N in parentheses under the table heading represents the students remaining in the sample after listwise deletion of missing data. With the listwise-deletion technique, any student failing to respond to any of the items in the set was deleted from the effective sample.

RESULTS FROM TEST 5, AGE 9, YEAR 78

Table I presents the frequency distributions of the seven items in this item set. These items at the nine-year-old level have three possible responses: disagree, undecided, and agree. The item stems are worded exactly the same as at the age thirteen and age seventeen levels. Two of the items deal with sex stereotyping of mathematics, while the other five focus on the usefulness of mathematics. The nine-year-olds responding to the items seem to feel that mathematics is not more appropriate for one sex or the other. They felt even more strongly that mathematics is useful to know, but are relatively undecided as to whether they wanted to "work at a job that lets them use mathematics" (JOB, and also NOT-USE).

Table II presents the inter-item correlations, means, standard deviations and item-to-total correlations for the items in Test 5. The size of the correlations indicates only a slight relationship among item reponses for age nine. The average inter-item correlation in the matrix is .10. With listwise-deletion of missing data, approximately three percent of the cases were excluded from the analysis.

In Table III the rotated factor solution is shown. Three factors were extracted, but none of the factors met the eigenvalue criterion used for this analysis. The first factor did, however, account for 64% of the covariation in the set, while the second and third factors accounted for 23% and 12%, respectively, of the remaining variance.

Since this was the only test chosen for factor analysis at age nine level, the results of the factor analysis are included despite the low level of explained variance. Table IV summarizes the results for factor one, all items loading at approximately .30, or above. All four items deal with the perceived usefulness of mathematics.

The analysis of the internal consistency of the seven items yielded few surprises (see Table V). The internal consistency estimate of reliability was only .44. When the first factor relating to usefulness was scaled, the reliability level was still substandard (.40).

RESULTS: TEST 8, AGE 13, YEAR 78

Test booklet 8 included eighteen items on mathematics attitudes. The response distributions for these items are presented in Table VI. (Again, note the underlining was added for purposes of presentation in this report and did not appear this way to the respondents.) Students were directed to respond to these statements in terms of how they felt about mathematics. Response categories were five-point Likert scales, including strongly disagree, disagree, undecided, agree, and strongly agree.

In general, the thirteen-year-olds exhibit positive attitudes towards mathematics. Sixty-eight percent enjoy mathematics, 88% are willing to work hard, and 96% want to do well in the subject. As with the nine-year-olds, mathematics is not perceived as primarily a male subject.

Most seem to understand and value the operations of mathematics; practice seeking numeric patterns, knowing the problem solving process, and understanding the relationships. Perhaps somewhat surprising is the view of 95% of these adolescents, that their parents really want them to do well in mathematics.

Table VII presents the inter-item correlations for the item set. Overall, there is a relatively low level of cohesiveness for the whole item set, as shown by an average correlation among items of .13. From scanning across the bottom row of this table - the item-to-total correlations, two items fit in most poorly, correlating less than .10 with the rest of the items. These items are "learning mathematics is mostly memorizing," and "mathematicians work with symbols rather than with ideas." Certain of the other items correlate quite highly with the total scale. These items include WORK-HARD, GIRLS, EVERYDAY, DO-WELL, and PARENTS. Except for GIRLS, these items seem to reflect a motivational dimension. The variety of the item-to-total correlations for the whole set suggest that more than one underlying construct exists in the responses.

The rotated factor matrix is shown in Table VIII. The factor solution produced four factors, two of which were at (or very near) the eigenvalue criterion. Factor one is quite strong, and accounts for 60% of the variance in the set. Factor two is much weaker, and accounts for only an additional 19% of the remaining variance.

The items loading above .30 in these first two factors are shown in Table IX. Factor one is characterized by items relating to the motivation to succeed in mathematics, i.e., "I really want to do well in mathematics." Based upon the face meaning of the items loading on factor two, two themes are incorporated on this factor; one relates to the perceived usefulness of mathematics ("most of mathematics has practical use"), and another dimension relates to the process of doing mathematics ("there is always a rule to follow in solving mathematical problems").

The internal consistency analysis of this item set (see Table X) revealed that only the composite scale reached the .70 alpha level of acceptable reliability. The four item motivation scale, however, was close to this level, with an alpha of .68. The second and more diverse factor -- usefulness and mathematical process -- had an internal consistency level of .61. This dimension is not readily interpretable on face-level, and therefore is not particularly useful in a theoretical sense.

RESULTS: TEST 9, AGE 13, YEAR 78

The fourteen items and their response distributions from Test 9 are presented in Table XI. These items are structured in the same manner as the previous test package, with five option-Likert responses. Student non-response was minimal and never exceeded one percent.

Two items are the most centrally located in the composite variable space, as evidenced by the item-to-total correlation in Table XII. HAVE-TO -- "I am taking mathematics only because I have to" (when reverse coded), and TAKE-MORE, "I would like to take more mathematics," achieve this distinction with item-to-total correlations of .42 and .46, respectively. The items which correlate the lowest with the total set are DISCOVERIES ("new discoveries are seldom made in mathematics," r = .16), and TRIAL-ERROR ("trial and error can often be used to solve a mathematics problem," r = .12). The average inter-item correlation for Test 9 is .13. This yields a standardized scale reliability of 0.67.

The factor matrix is shown in Table XIII. While the solution included four factors, only the first factor accounted for enough variance to meet the eigenvalue criterion. This factor accounted for 59% of the variance of the set. The items loading the highest on this factor are shown in Table XIV. Factor one seems to reflect some dimension of importance attached to mathematics, in that four of the five items incorporate the word "important." In content, these items deal either with why mathematics is important to learn, or what in learning mathematics is important -- as in the last two items in this table.

The internal consistency of the "importance" factor was only 0.52, which is below the level normally acceptable to educational researchers.

The total scale of fourteen items had an alpha value of .67, just below the criterion established earlier in this report. Researchers are urged to use this attitude scale with caution.

SUMMARY: RESULTS OF ANALYSES OF PART 1

The item and scale analyses performed thus far have produced a relatively low level of reliability (internal consistency) for most scales in these three tests (see Table XVI). Only one scale, the eighteen item composite scale in Test 8, achieved an alpha level above .70. Three more age thirteen scales had reliability coefficients in the .60 to .69 range. Secondary analysts using these scales are advised to expect relatively little in the way of explained variance when using these scaled items in predictive analyses.

The scales produced in the single nine-year-old test package analyzed were even weaker, with reliability coefficients in the .40 to .45 range. Analysis of these mathematics attitude items would be best accomplished on an item-by-item basis.

PART TWO

INTRODUCTION

Four test booklets were chosen for this analysis from the twelve tests administered to seventeen year-olds in 1977-78. The affective items in these booklets have mathematics as the specific attitude object. The attitude items in other booklets deal with computers, courses in school, or activities associated with mathematics (i.e., using a slide rule). In terms of predicting mathematics learning, those attitudes specifically focusing on mathematics or mathematical tasks were thought to be most salient.

The canonical correlation analysis referred to earlier is performed on the attitude items in these four tests. While Piazza recommends this technique for scale construction, its use here is intended to illustrate and contrast different properties of the scales' internal consistency, and predictive validity. Four criterion variables were chosen for the second set of variables and correlated with the attitudinal item-set (first set). The four variables were COURSEWORK, HOMEWORK, WHITE RACE, and MINORITY (percent).

The first background variable used was COURSEWORK, which is an indicator of the number of high school courses a student has taken in mathematics. The courses range from general mathematics, algebra, and trigonometry, up through calculus and computer programming. Students were asked to report both on the types of subjects they studied and the length of time each was studied (one school year, one-half school year, less than one-half of a school year). The semesters the student reported studying each course were then coded and added up to yield a score indicating the total amount of course exposure. Missing responses were treated as "no coursework," and were coded as zero.

The second background variable was HOMEWORK, which asked, "How much time did you spend on homework yesterday?" If no homework was assigned, or if the student reported doing none, or if the response was missing, a zero was assigned. Other possible responses were less than one hour (0.5), between one and two hours (1.5), or more than two hours (2.5) spent on homework the day before.

The remaining two background variables relate to race. WHITE RACE is the student's self-classification of race, dichotomized into white vs. nonwhite. If a student failed to respond to this question, the exercise administrator's observation as to the student's race was substituted. MINORITY is the principal's estimate of the percentage of nonwhite students attending the particular school.

RESULTS FROM TEST 5, AGE 17, YEAR 78

The frequency distributions of the attitude items in Test 5 are presented in Table XVII. Students were asked to rate the importance, easiness, and the student's liking of a set of six tasks performed in mathematics. The three dimensions each had five-option Likert response options. Students not responding to an item were deleted as missing cases. The extent of missing data for the items varies from about two to six percent.

The tasks being rated range from the relatively low level (working with fractions) to the more complex (doing proofs). "Doing proofs" was rated as least important, while the remainder were rated generally as important. "Working with metric measures" was rated hardest, while "working with fractions" was rated easiest. The task which was liked the most was "working with fractions," while "working with metric measures" and "doing proofs" were equally unloved by the responding students.

The inter-item correlations, item-means, standard deviations, and item-to-total correlations are shown in Table XVIII. (The four student-background variables to be used in the canonical analysis are also included in this matrix.) The item-to-total correlations are all in the mid-range, with the lowest being WORD-EASINESS ($r = .26$), and the highest MEASURING-LIKING ($r = .51$). The mean inter-item correlation is .20, further supporting a moderate level of relatedness for this item-set.

The rotated factor matrix is shown in Table XIX. Seven factors were produced to account for the total variance for the set. The first three factors meet the eigenvalue criterion, and the fourth is borderline. The items loading greater than .30 on these factors are displayed in Table XX. Factors one and two each focus on a specific task, metric measures and proofs, respectively. Factor three, however, relates more centrally to the "importance" dimension, with all six task-ratings of importance loading on this factor. The rather weak fourth factor reflects, again, a task-specific dimension relating to estimating answers.

The results of the canonical correlation analysis are presented in Table XXI. The principal linear relationship between the items and the criterion variables is defined by the items FRACTIONS-EASINESS (canonical coefficient = -.47), MEASURING-EASINESS (canonical coefficient = -.34), METRIC-IMPORTANCE (canonical coefficient = -.26) METRIC-EASINESS (canonical coefficient = -.24). This variate is most strongly related to the COURSEWORK criterion variable (canonical coefficient = .96). Students' perceptions of the easiness or difficulty of a mathematical task is related most strongly to the number of semesters a student has studied mathematics. 28% of the variance of the first canonical variate is explained by this set of background variables, with COURSEWORK as the dominant predictor.

The set of item-loadings on the second canonical variate maximally account for the residual variance from the principal linear relationship. This second relationship is principally defined by the items METRIC-LIKING (canonical coefficient = -.39), WORK-IMPORTANCE (canonical coefficient = -.30), and PROOFS-IMPORTANCE (canonical coefficient = -.30). The items loading on this variate, as opposed to the first variate, appear to relate more strongly to the liking and importance dimensions. The criterion variables which maximally define this second linear relationship are the ethnicity variables, MINORITY, the principal's estimate of the proportion of non-white students in the school, and WHITE RACE, the white-nonwhite self-identification of the students. HOMEWORK, the number of hours of homework a student reported doing the night previous to the testing, is also related to the second canonical variate. The negative sign on the coefficient indicates the more homework a student did, the more likely he or she was to rate other tasks as important or well-liked. Seven percent of the residual-variance from the first set is accounted for by the second linear set.

The results of the canonical analysis suggest that the rating-dimensions of easiness, liking, and importance are associated in different ways with certain theoretically relevant predictor variables. Based upon this, scales separating these dimensions would be most useful for predictive purposes. For this item-set, the factor analytic technique, based upon an inter-item covariation approach, suggested different scaling dimensions relating to the specific tasks. As is evidenced in the canonical analysis, however, the task-specific scales hold less potential for predictive studies -- both in terms of predictive power, and theoretical interest.

Results of the analysis of the internal consistency of the scales produced from Test 5 are shown in Table XXII. The composite scale incorporates all three rating dimensions for each of the six tasks. The alpha coefficient for this scale reveals a scale of relatively high internal consistency (alpha = .82). Each of the three dimensions when scaled produced scales of reliability in the .60 range.

This produces somewhat of a dilemma -- the scales most amenable to conceptual description (i.e., mathematical task importance) show the lowest levels of internal consistency. The composite scale, which must be interpreted generally as "positive affect toward mathematics," has the highest level of reliability.

RESULTS FROM TEST 6, AGE 17, YEAR 78

The attitude items in Test 6 were of the same format as Test 5, a three dimensional rating of six mathematical tasks (see Table XXIII). The tasks in Test 6 are different than in Test 5, and generally reflect more basic computational skills.

The task rated as the most difficult, the least important, and also the least liked was "memorizing rules or formulas." "Working with whole numbers" achieved the opposite distinction -- the most easy, the most important, and the most liked. This probably reflects the emphasis on understanding that grew out of the new math in the 60's and 70's. The current trend back to basics may produce different results in more recent assessments.

Inter-item correlations, item means, standard deviations, and item-to-total correlations are shown in Table XXIV. There is a higher average inter-item correlation for this set, (r = .23), indicating a more internally consistent scale. All of the item-to-total correlations are at least .40, with the highest coefficient (r = .54) for the liking dimension of "solving equations." The "importance" items seem to correlate slightly less well with the rest of the set.

The rotated factor solution is shown in Table XXV. Six factors were produced in order to account for the total covariation in the set. The first factor is overwhelmingly the strongest, accounting for fifty percent of the variance. The second and third factors are weaker, respectively accounting for thirteen and eleven percent of the residual variance, but still meet the eigenvalue criterion.

The items loading at or above .30 on each of these three factors are shown in Table XXVI. In factor one, all six of the importance ratings factored out on this dimension. Two other items -- the liking and easiness ratings of "working with whole numbers", also loaded on this factor. In factor two, five of the six easiness items factored out together, along with two liking items. Factor three was task-centered, with all dimensions of "memorizing rules and formulas" represented.

The factor structure of test package 6 reflects the affective rating dimension rather than the task-specific structure revealed in Test 5. The students were more consistent in their responses to the lower level, and more familiar tasks in Test 6; whereas in Test 5 students responded in terms of their past experience and knowledge of the less familiar and more difficult tasks. Consequently, in Test 6, the ratings of importance and easiness across the six tasks showed enough consistency to factor out on affect-specific dimensions.

The results of the canonical analysis from Test 6 are shown in Table XXVII. The principal linear relationship between the items and the criterion variables is dominated, on the part of the items, by easiness items. Items loading most highly on this variate were "liking-solving equations", "easiness-working with percentages", "easiness-memorizing rules and formulas", "easiness-using charts and graphs", "easiness-working with whole number", and "easiness-doing long division". The criterion variable which defines the principle linear relationship is the COURSEWORK variable. HOMEWORK, or the hours of homework done the night before the testing, is also related to the first variate, task-easiness. The judgements of task-easiness are predicted by (or predictive of) the student's background in mathematics courses, and also by the amount of homework they do. This relationship accounts for twenty-one percent of the total variation, and is statistically significant.

The second linear relationship is less clear in meaning. The items loading highly on this variate are "importance-memorizing rules and formulas," "liking-memorizing rules and formulas," and "liking- doing long division." "Easiness-using charts and graphs" also loads highly (.36) on this variate, but is positively signed, and therefore does not fall along the same axis as the other negative items. The criterion variables defining this second relationship are MINORITY, the percent minority students in school, and WHITE RACE, or the ethnicity (white-nonwhite status) of the students themselves. This relationship explains only eight percent of the total variation, after the variation of the primary linear relationship is taken out.

The canonical analysis of Test 6 reveals a dominant dimension of easiness, which is closely related to the student's coursework background. These results parallel those of Test 5, where the easiness dimension also emerged strongly.

Table XXVIII shows the reliability coefficients for the composite item sets and the three affective dimensions. All four scales are of acceptable levels of internal consistency. The composite scale combines all three ratings for each of the six tasks, and attained an alpha level of .84. The three dimensions, when scaled separately, were right at the .70 reliability level. In Test 5 the subscales were of slightly lower levels of reliability -- in the .60 range -- which again attests to some interesting underlying structural differences between the two sets related to the different tasks included in the sets.

RESULTS FROM TEST 8, AGE 17, YEAR 78

The attitude set in Test 8 consists of eighteen statements about mathematics with five-option agreement Likert response scales. In general, the content of the items lies in three areas: the enjoyment of or motivation towards mathematics, the usefulness of mathematics, and general perceptions of mathematics.

The students repsonding to these items appear to be highly motivated -- 79% say they will "work hard to do well in mathematics"; 85% also say they "really want to do well in mathematics"; while 87% also say their parents "really want them to do well in mathematics." Fifty-three percent say they "enjoy mathematics," although another 30% do not share this sentiment. Ninety-one percent state that "solving mathematics problems by themselves makes them feel good."

Most students (78%) perceive mathematics to be "useful in solving everyday problems;" and 79% see mathematics as "mostly having practical value." Only 10 percent believe they can "get along in everyday life without using mathematics."

By and large, students hold relatively positive perceptions of mathematics as a discipline, or a field of study. Most students (70%) feel that exploring number patterns does play a role in mathematics. Only twelve percent see "mathematics as being made up of unrelated topics." Most students perceived the problem-solving process to be at least as important as getting a solution (HOW-TO-SOLVE, WHY-CORRECT). These students were uncertain as to whether mathematicians indeed do "work with symbols rather than with ideas" -- only 28 percent agreed, and 37% were undecided. Most students see mathematics as "rule-bound": 80 percent believe "doing mathematics requires lots of practice in following rules," and 88% agreed that "there is always a rule to follow in solving mathematics." They were fairly evenly split over the issue of whether "learning mathematics is mostly memorizing." The sex-stereotyping items elicited mostly non-stereotypic responses (see GIRLS and MEN) although the items were phrased so that only a reverse stereotype could be identified, such that males would be perceived as less able in mathematics -- only a small percentage held these views.

Inter-item correlations, means, standard deviations, and item-to-total scale correlations are shown in Table XXX. Overall, there is a wider range of item fit within this set than in the previous two tests. The average inter-item correlation for this test is .15. WORK HARD and DO-WELL correlate the highest (.50) with the set, suggesting the centrality of the motivational dimension to the composite set. Several items correlate poorly with the set, of which MEMORIZING and RULE are obvious examples. Approximately four percent of the cases were lost with the listwise deletion of missing data.

The rotated factor solution for Test 8 is presented in Table XXXI. Four factors were extracted, but only the first two met the "significance" criterion used in this analysis. Factor one accounts for fifty-seven percent of the entire variance of the set, while factor two accounts for an additional eighteen percent of the remaining variance.

The summarized factor results are shown in Table XXXII. The five items loading highly on factor one reflect a motivation to be successful in mathematics. ENJOY is either part of this motivational dimenison or related closely enough to factor out with these items. Factor two is comprised of items relating to the knowledge of mathematics as a discipline and a field of study: gender stereotyping of the study of mathematics, what mathematics covers (unrelated topics, symbols or ideas) and the relative emphasis on solutions versus the problem-solving process in mathematics. Since this is such a diverse set of ideas, the label "perceptions of mathematics" is used in Table XXXII.

The canonical analysis resulted in a different picture of the structure. As can be seen by the correlation between the criterion variables and the items in Table XXX, the items do not relate in a particularly consistent fashion to the criterion variables. For the variables COURSEWORK and HOMEWORK, all but one of the items are positively correlated, but the magnitude of the correlations ranges from .00 to .31. For the two ethnicity indicators, however, about half of the items correlate positively and half correlate negatively. Piazza argues that by traditional scaling methods these different patterns of relationships of attitude items to external variables would be obscured and a scale would be produced which had little predictive power.

The attitude items defining the principal linear relationship are ENJOY, PRACTICAL, MEN, UNRELATED, RULE and SYMBOLS. The last four of these are more closely related to the "perceptions-of-mathematics" dimension. In the factor analysis, ENJOY was part of the motivational dimension, while PRACTICAL related to the dimension "perceived usefulness of mathematics," which appeared on factor three and was quite weak. Based upon the diversity of the specific referent to mathematics, these items do not seem to measure a unitary phenomenon. By examining the canonical coefficients of the criterion variables (second set), the variable which dominates the principal linear relationship is COURSEWORK. Therefore, the principle linear relationship is between COURSEWORK on the criterion set, and a conglomeration of attitude items including "perceptions of mathematics" items, an "enjoyment" item and a "usefulness" item. This relationship accounts for one-quarter of the total covariation between the two sets.

The second linear relationship is defined, on the part of the attitude items, by WORK-HARD, DO-WELL, and MYSELF. The "enjoyment-motivational" items which dominated the principal-components factor solution emerged as the secondary, and much weaker, affective dimension in the canonical analysis. This dimension is dominated by WHITE RACE of the criterion set. HOMEWORK and PERCENT-MINORITY also account for a portion of the twelve percent of variance accounted for by this second linear relationship.

Based on the canonical analysis, somewhat different sets of items from those produced by the factor analysis would maximize the predictive validity of the attitude scales. It would seem, however, that the meaningfulness and usefulness of the canonical-derived scales are questionable, and very much dependent upon the criterion variables chosen. The items loading highly on the first canonical variate are difficult enough to label, let alone justify for use in a theory-based model. In addition, it is doubtful whether the three motivation items loading highly on the second canonical variate would have achieved an acceptable level of reliability, and therefore be of use in further analysis.

Table XXXIV presents the reliability levels of the composite scale and the two scales derived from the factor analysis. The eighteen item composite set attained a .75 estimate level. The five-item motivation, or enjoyment, scale had an internally consistent estimate of .76. The more diverse "perceptions of mathematics" dimension achieved a relatively low reliability estimate of .57. Two scales -- the composite scale and the motivation-enjoyment scale -- appear reliable enough for further use in predictive studies.

RESULTS FROM TEST 9, AGE 17, YEAR 78

The fourteen attitude items in Test 9 are of the same format as Test 8 -- statements about mathematics, followed by five-option agreement scales. The statements also pertain to similar aspects of mathemtics: usefulness, motivation, and general perceptions of mathematics.

The responses to the enjoyment, or motivation items in Test 9 reflect a mixture of positive and negative attitudes toward mathematics. Seventy-four percent agreed that a "good grade in mathematics is important to them," and 54% felt they "were good at math." Sixty-two percent, however, stated they were taking mathematics only because they "had to," and only 39% said they "would like to take more mathematics." The two usefulness items were stated in terms of job-usefulness -- 87 percent believed "it is important to know arithmetic to get a good job," but only 47% felt math such as algebra or geometry is important to know in order to get a good job, and a third believed these areas were basically unimportant.

The perception of mathematics questions covered a wider range of ideas. Seventy-seven percent agreed that "mathematics helps me to think logically," but 56% felt creative people have more trouble with mathematics. Evidently these students feel logical thought processes and creativity are mutually exclusive properties. BOYS evidenced a relatively high degree of sex-stereotyping: 90 percent believed "mathematics is more for boys than for girls." The students saw mathematics as a closed discipline: 53 percent agreed that "new discoveries are seldom made in mathematics." Seventy-three percent saw estimating as an important mathematical skill. Nearly 70 percent felt that trial and error was a useful problem-solving method, and that "justifying the mathematical statements one makes is extremely important."

Table XXXVI presents the inter-item correlation matrix, the item means, standard deviations, and item-to-total correlations. There is a wide range of item association in this set, ranging from .15 (TRIAL-ERROR), to .59 (TAKE-MORE). The mean correlation of the inter-item correlations is .18. The four items having item-to-total correlations over .50 are AM-GOOD (I am good at mathematics), LOGICALLY (Mathematics helps a person to think logically), HAVE-TO (I am taking mathmatics only because I have to--when reverse coded), and TAKE-MORE (I would like to take more mathemtics).

Three factors were produced in the factor solution for Test 9 (see Table XXXVII). Only the first factor was "significant," and accounted for nearly three-quarters of the total variation.

The summarized factor results are shown in Table XXXVIII. Factor one is the enjoyment-motivation dimension, which also emerged strongly in Test 8. Factor two is comprised of statements about why mathematics is important. Though significantly weaker than factor one, the composition of factor two is interesting, in that all the items with the word "important," and all the items implying the importance of mathematics also appeared on this factor.

The results of the canonical analysis of this set are more difficult to interpret. The attitude items defining the principal linear relationship are AM-GOOD, LOGICALLY, and HAVE-TO. The criterion variable which defines the principal linear relationship is again COURSEWORK. This suggests that the attitudes captured by these items --

confidence in mathematics (AM-GOOD), enjoyment of mathematics (HAVE-TO), and perceptions of the enhancing effects of mathematical study (LOGICALLY) are predicted by, or predictive of, participation in mathematics courses. This relationship accounts for twenty-two percent of the total covariation between the sets of variables.

The second linear relationship is defined by the attitude items ALGEBRA (It is important to know math such as algebra or geometry in order to get a good job), TAKE-MORE (I would like to take more mathematics), and GOOD-GRADE (A good grade in mathematics is important to me). These attitudes are most closely related to the ethnicity variable of the second set. Interestingly enough, the black students and the students in high-minority enrollment schools seem to be more positive on these items indicating higher levels of motivation. This relationship accounts for ten percent of the variation left over from the principal linear relationship.

The third relationship is quite weak, only accounting for an additional one percent of variation. This relationship is defined by the items AM-GOOD (I am good at mathematics), and TRIAL-ERROR (Trial and error can often be used to solve a mathematics problem). These items are associated with HOMEWORK, or the amount of homework done the night before. Evidently, one gains confidence in mathematics from doing more homework, or vice versa.

The results of the reliability analysis of the composite item set and the factor derived scales are displayed in Table XL. Two scales attained adequate levels of reliability: the composite (.76) and the motivation factor (.76). The importance dimension, as well as the 'perception of mathematics' dimension, were not internally consistent enough to meet the criterion used for this analysis.

SUMMARY: RESULTS OF ANALYSES OF PART 2

For the age seventeen level of the Year 78 assessment, four attitude item-sets were evaluated in Part Two (see Table XLI). Two of these sets, which appeared in Tests 5 and 6, dealt with the students' ratings of importance, difficulty, and liking of sets of mathematical tasks. The composite sets of items, including all three dimensions of affect, were scaled to produce general measures which had relatively high levels of internal consistency (.82 for Test 5; .84 for Test 6). The individual dimensions of affect -- liking, easiness and importance -- scaled well in Test 6 but not in Test 5. The tasks included for rating in Test 5 were of a more sophisticated variety than those in Test 6, and evoked less consistent responses.

The item-sets included in Tests 8 and 9 were statements about mathematics, to which the students were asked to agree or disagree. In Test 8, the composite set of eighteen items achieved a reliability coefficient of .75. The factor analysis of Test 8 produced one factor, enjoyment, which had an adequate level of internal consistency (.76). For Test 9, the composite set of fourteen items attained a reliability level of .76. Of the three subdimensions revealed in the factor analysis for test 9, only the first, that of enjoyment/motivation, again scaled high enough (alpha = .76) for reliable use.

The composite set in each of the four tests analyzed were acceptably reliable. For three of the four test booklets, at least one subscale was also sufficiently reliable. This provides the secondary analyst with some latitude in choosing an affective measure, either of the "general" nature of the composite, or of a more specific attitude -- motivation, liking, difficulty, etc.

The canonical analysis was useful in suggesting which attitudinal dimensions had the greatest predictive potential. The component of "motivation," or enjoyment, which was the most internally consistent, was less predictive in general than the components "difficulty" or "perceptions of mathematics." While this was an abbreviated use of Piazza's scaling technique, it did not appear to be particularly promising for application to the NAEP mathematics-attitude items. The sets of items loading on a variate together were often few in number, as well as difficult to interpret.

PART THREE

INTRODUCTION

The four tests compromising the 1975-76 mathematics assessment are analyzed in Part Three. The mathematics-attitude data for this assessment are unique among NAEP mathematics assessments in that the same set of items are included in four different tests. As noted before, all of the attitude items reviewed thus far were packaged uniquely; there were no parallel tests within ages, or even across ages. By repeating the same set of attitude items, the Year 76 assessment makes it possible to examine item responses across four independent random samples of about 5,000 students each. The results for each test follow. Frequency distributions are presented first followed by the results of the factor analysis and internal consistency analysis. After each test is discussed individually, the factor structure and reliabilities of the mathematics attitude items are compared across the four tests. For analysis of the age seventeen test packages, one-third random subsamples were drawn in order to conserve computer processing time and costs.

Seventeen-year-olds were given an additional instrument to fill out called the Supplementary Student Questionnaire. This instrument included three sets of attitude items which were also analyzed. These items dealt with the importance of particular values, the students' attitude toward themselves, and their attitudes toward their high school. These item-sets are problematic in that insufficient time was given for completion of the instrument. Consequently, high levels of missing data occur for the last few sets of items in the Supplementary Student Questionnaire. However, since they include potentially useful theoretical constructs, item and scale analyses were performed on these item-sets and the missing data problem was explored for the two age seventeen tests. The frequency tables for this part show nonresponses for each item as a percentage of the total sample. This makes it somewhat easier to gauge the magnitude of the nonresponse problem.

RESULTS FROM TEST 1, AGE 13, YEAR 76

The mathematics items and response distributions are shown in Table XLII. As a general rule, the students are pretty positive towards mathematics: 88% report "trying hard" (MATHTRY); 71% report usually "doing well" in tests and on homework (MATHWELL); and 63% say that they are "usually proud of their mathematics homework" (MATHPRD). Conversely, while 20% report having a fear of being able to do math (MATHFEAR), and only 15% assert they "have never liked mathematics," 34% say that they "wish they felt less upset in mathematics class," and another 20% are undecided about being upset. Very few responses (less than one percent) are missing for any of the items.

Based upon the item-to-total correlations shown in Table XLIII, the items all appear to be fairly highly correlated. The item which is most central to the composite variable space is MATHEASE (I feel at ease in mathematics class and like it very much.) The items which fit in least well with the rest of the items in the set are MATHSCI and MATHUPST. The coefficient for both of these items is .34 however, which still indicates a moderately high level of response consistency with the rest of the set. Cases lost through listwise deletion of missing data comprise one percent of the original sample size.

The results of the principal components factor analysis with rotation are shown in Table XLIV. Two factors were produced to account for the total covariation of the set. The first factor accounts for eighty-four percent of the variance. The second factor accounts for the remaining sixteen percent of the variance.

Table XLV displays the factor loadings for Test 1. Factor one incorporates a mix of items relating to the enjoyment of mathematics, as well as a motivation to do well in mathematics. The essence of this factor is captured by the double-barreled item MATHEASE (I feel at ease in mathematics class and like it very much), which loads .72 on this factor. In fact, seven of the nine items load strongly on this factor. Factor two focuses more upon the anxiety element: the items refer to the affective states "at ease," "fun," "never liked," "upset," and "do-well." The item which loads highest on this factor with a loading of .69 is MATHFEAR (I have a fear of not being able to do mathematics). As this item suggests, the core of this factor is associated with a performance-anxiety dimension.

Reliability analysis was performed on the composite and factor derived scales, and is summarized in Table XLVI. The nine item composite scale achieved a .79 level of internal consistency. Both the first factor, "motivation," and the second factor, "anxiety," attained acceptable levels of reliability, .79 and .74, respectively. The items which are included in both subscales are MATHWELL, MATHHATE, and MATHEASE. By doing this, the two subscales could of course not be used together, because of the built-in collinearity. It would be possible to choose one or the other of these scales, emphasizing either the liking-motivation dimension or the anxiety dimension. The relatively high degree of "overlap" suggests that this item set is basically unidimensional, and is borne out by the high estimate of internal consistency obtained for the composite scale.

RESULTS FROM TEST 2, AGE 13, YEAR 76

The response distributions to the mathematics attitude item in Test 2 are shown in Table XLVII. (These are identical items to those just discussed.) The distributions are quite similar to those in Table XLII from Test 1 of the same age level, with the largest discrepancy between comparable percentages on the two tests being equal to three percent. The students again seem to be basically positive in their orientation to mathematics (i.e., MATHTRY, MATHHATE), but as reported for Test 1, also feel somewhat anxious about performing well in mathematics class (i.e., MATHFEAR, MATHUPST). Less than one percent of the responses were missing for any of the items.

The correlation matrix for Test 2 is presented in Table XLVIII. As in Test 1, MATHEASE correlates the highest (r = .70) with the rest of the items when scaled together. MATHSCI and MATHUPST again correlate least well with the rest of the items (.34 and .29, respectively), but this is still a fairly high level of association. The relatively high level of the inter-item correlations within this set is evidenced by the mean correlation value of .29 for this test. Less than two percent of the cases were deleted due to nonresponse.

The rotated factor matrix is shown in Table XLIX. As with Test 1 at age thirteen, two factors were extracted, and again explained 84 and 16 percent of the variance, respectively.

The summarized factor results in Table L show that the same two dimensions emerge as in Test 1. Factor one represents the liking and motivational dimension. MATHEASE is again most central to this factor with a loading of .73. Factor two is characterized by the same "anxiety" dimension. The loadings in the two tests are remarkably similar; the greatest discrepancy between comparable loadings across the two tests amounts to .07 for MATHHATE on factor one.

Reliability analyses were performed on the composite and factor-derived scales, and are summarized in Table XLVII. The nine-item composite set achieved an internal consistency estimate of .78. The motivation dimension was slightly stronger than the composite in this test package, attaining an alpha coefficient of .79. The anxiety dimension again scaled adequately, achieving an alpha level of .73. As in Test 1, the items included in both subscales are MATHWELL, MATHHATE, and MATHEASE. For Test 2, as well as for Test 1, the more general "positive affect towards mathematics," and the subscales focusing on "confidence in mathematics," and "anxiety towards mathematics" can be utilized in predictive studies.

Attitudes Toward Mathematics Items

The response distributions of the mathematics-attitude items in Test 1 are presented in Table LII. These are the same nine items discussed for age thirteen. These older students appear to be somewhat less positive towards mathematics. For instance, comparing the responses form the thirteen-year-olds on Test 1 to those of the seventeen-year-olds on Test 1, only 70% of the older students agree that they try hard in mathematics, as opposed to 88% of the thirteen-year-olds. In addition, the older students seem to like mathematics less, and have more anxiety; 60 percent of the age thirteen students "feel at ease in mathematics and like it very much," while only 43 percent of the seventeen-year-olds felt the same way. Approximately six percent of the students failed to respond on each of these items.

Table LIII shows the inter-item correlation matrix, item means, standard deviations, and item-to-total correlations. Based upon the item-to-total correlations, the items MATHEASE (r = .77), MATHWELL (r = .69), and MATHPRD (r = .68) are most central to the set of items. All of the nine items fit rather well with the composite set, as demonstrated by the lowest item-to-total correlation of .44 for MATHSCI. Seven percent of the sample was excluded from analysis through listwise deletion of missing cases.

Two factors were produced in the principal components factor analysis (see Table LIV). The first factor accounted for nearly 85 percent of the variance. The second factor did not meet the eigenvalue "significance" criterion.

The items loading highly on each factor are shown in Table LV. The loadings are very similar to those for Tests 1 and 2, at the age thirteen level. Factor one reflects, again, both a motivation to do well in mathematics and a confidence in one's mathematical ability. Factor two is focused more on the anxiety element -- all of the items again stress "do-well," "pride," "ease," "fear," and "upset" as well as "disliking" mathematics. The items loading most highly on this factor are MATHFEAR ("I have a fear of not being able to do math," reverse coded), and MATHUPST ("I wish I felt less upset in math class"), both of which exemplify this anxiety component. Four items load at or above .30 on both factors, MATHWELL, MATHPRD and MATHHATE. This high degree of overlap in the subscales points to a unidimensional underlying construct -- the dimension of motivation ranges from confidence on one end of the continuum to anxiety on the opposite end. The subscales provide the analyst some latitude in choosing reliable measures which are conceptually somewhat different. Because these subscales do include overlapping items, the researcher is advised not to use them simultaneously in an analysis.

The factors and the composite scales were analyzed for internal consistency, the results of which are shown in Table LII. All three scales attained reliability coefficients of .85. As with the age thirteen test packages, the secondary analyst has the option of using the composite, more general affect scale, or either of two subscales focusing on the motivation/confidence dimension, or the anxiety dimension, all of which meet the standards for acceptable reliability.

Values in Life Items, Test 1

The response distributions to the ten items dealing with the student's assessments of the importance of certain goals or values in life are shown in Table LVII. Students were asked to rate each statement on a three-point scale of importance. Judging from the goals which were rated as "very important" by a majority of the students responding, these seventeen-year-olds desire to find "steady work," "be successful" at it, "have strong friendships," and "get married, and provide their children with better opportunities" than they had themselves. They were less adamant about "having lots of money," "living close to parents and relatives," "being community leaders," or "working to lessen inequalities." Only one goal was cited by a large proportion of students as relatively unimportant -- "getting away from their (geographical) area." There is a very high level of missing data for each item (approximately 40%). This item-set was near the end of the Supplementary Student Questionnaire, and many students did not have time to complete this section. After listwise deletion of the missing cases, only 44 percent of the original sample remains in the effective sample.

The inter-item correlation matrix, item means, standard deviations, and item-to-total correlations are presented in Table LVIII. As is evident from the widely varying magnitude of item-to-total correlations, there is no strong unitary underlying dimension for this set. The items which correlate the highest with the others when scaled together are LEADER, STEADY WORK, CHILDREN, INEQUALITIES, and SUCCESSFUL. GETTING AWAY, even when reverse-coded, still correlates poorly with the set.

Table LIX presents the rotated factor solution for the principal components analysis. Five factors were produced to account for the variation. The factors seem to represent diverse aspects of life: work (factor one), ideological pursuits (factor two), money (factor three), and family (factor four). Only the first factor met the eigenvalue criterion, and explained 44 percent of the variance.

Three items loaded at or above .30 on this first factor, and are shown in Table LX. Two of these items center on working -- STEADY WORK (being able to find steady work), and SUCCESSFUL (being successful in one's line of work). FRIENDSHIP, which loads weakly on this factor (.30), departs from the work-ethic value exemplified by these other two items.

The composite set of items and the three items loading on factor one were analyzed for internal consistency (see Table LXI). As expected, both scales showed little internal consistency. The composite scale attained an estimate of internal conssitency of .55, while the factor-derived scale labelled "work-values" only achieved an alpha coefficient of .50. Too few items dealing with specific areas of life (i.e., working, family) are included to form reliable and valid scales. The researcher who may be interested in these values ought to examine these items individually, since they are not particularly amenable to scaling procedures. The nonresponse problem with this item set, however, further depletes usefulness of this set, even when an item-by-item approach is used.

Attitudes Toward Self Items, Test 1

The frequency distribution of the eight items in the "attitudes toward self" item-set are shown in Table LXII This set of items focuses on the student's attitude toward him or herself, as well as their beliefs about fate versus the control they hold over their own lives. The response option are four-point agreement scales, with no undecided option. The students, in general, felt positive about themselves -- nearly 70 percent report "taking a positive attitude toward themselves," "being able to do things as well as most other people," and also "being persons of worth, on an equal plane with others." Most students also appeared to feel that "hard work" and "planning" are better or more reliable for achieving success than luck or fate. Two items seem to reveal an undercurrent of frustration: 28 percent believed that "those who accept their condition in life are happier than those who try to change things," and 18% reported that they are "stopped" whenever they try to get ahead. While these percentages do not represent a majority of the valid responses, they do indicate some lack of satisfaction, which is not always evident because of the "social desirability" element in such questions. Levels of missing data were quite high for these items also, ranging from 25 to 33 percent of the cases.

Based upon the item inter-correlations and item-to-scale correlations in Table LXIII, the item-set as a whole evidences a fairly low level of interrelatedness -- the mean inter-item correlation is .12. After listwise deletion of missing cases, only 51 percent of the original sample remains.

The principal components analysis reveals that there are two fairly strong dimensions underlying this set of items (see Table LXIV). Two factors were produced, respectively accounting for 64 and 36 percent of the variance. Both factors are "significant," according to the eigenvalue criterion.

The composition of the factors is shown in Table LXV. Factor one represents a "self-esteem" dimension, as the four items loading on this factor relate to a positive-negative rating of one's self (i.e., POSITIVE, SATISFIED) or a comparative evaluation of one's self in relation to others (EQUAL PLANE, ABLE). The four items loading on factor two pertain more centrally to one's view of the influences of fate in life. This is often termed "fate-control," whereby the conceptual continuum ranges from the belief that the course of one's life is totally determined by the forces of fate, up to the belief that one has virtually complete control over one's life. There is no overlap of items across these factors, as with the mathematics attitude items.

The reliability analysis demonstrates the existence of a strong dual dimensionality underlying this set of items: the two factor derived scales had much higher levels of internal consistency than did the composite scale (see Table LXII). The dimension labelled "fate control" failed to meet acceptable standards of reliability with an alpha coefficient of .62. The dimension focusing on "self-esteem" attained an alpha level of .76, which is adequately reliable by the standards used for this study. This construct has a long history of use in psychological, educational and sociological research. Unfortunately, the use of this scale in any predictive studies or causal modelling would necessitate the sacrifice of nearly half of the cases in the sample because of the time problem with the Supplementary Student

Questionnaire.

Attitudes Toward School Items, Test 1

The twelve items included in the attitudes toward school item-set, with their frequency distributions, are presented in Table LXVII. The items deal with the students' feelings about many aspects of the schooling experience -- required courses, counseling, school-technology, etc. There are four agree-disagree response options, just as for the attitudes toward self items. Based upon a visual examination of the distribution, a certain degree of dissatisfaction is revealed by these items -- of course, only three items are worded positively. The first two items, BASIC and TROUBLE show that a majority of students who responded believed the school performed inadequately in training students basic skills like mathematics and reading. This is especially apparent on TROUBLE, where 61% of the students felt more remedial assistance was needed. Another aspect of dissatisfaction is evident in items such as VOCATIONAL, EXPERIENCE, and to a lesser extent, FIND JOBS. Responses to these items suggest students felt their school should have prepared them more thoroughly for entering the work world.

Several of the other items reflect more satisfaction than dissatisfaction. Over forty percent of the students disagreed that "most required courses were a waste of time," and also reported that "school gave them new ideas about the type of work they wanted to do." They also felt that the counseling provided by the school was useful in two areas: helping continue their education (41%), and "helping them get a better idea of themselves and their relations with other people" (34%). An extremely high proportion of responses are missing from the items in this set, ranging from 30 up to 44 percent.

Table LXVIII displays the correlation matrix and item statistics for the entire set. Four items correlated highly with the total scale: CONTINUE (r = .50), NEW IDEAS (r = .54), RELATIONS (r = .55), and EMPLOYMENT (r = .51). Overall, there is a low level of item-relatedness in the set, with a mean correlational value of .11. With listwise deletion of missing data, nearly two-thirds of the cases were deleted from the effective sample.

Four factors were extracted in the principal components analysis and are presented in Table LXIX. The first two factors explain 47 and 27 percent of the variance, respectively. The last two factors are much weaker and do not attain "significance."

The composition of factors one and two are summarized in Table LXX. The four items forming a strong central core to the set (mentioned above) loaded on factor one. Three of these four items refer to the school's counseling services and the benefits students perceived as deriving from counseling. NEW IDEAS does not refer to counseling specifically, but denotes an element of satisfaction with the schooling experience that all four of these items share. It is difficult to know whether the contruct underlying this factor is a function of the "counseling" referent, or of a generally positive attitude toward school reflected in these items within the set. Factor two represents a dissatisfaction towards school. Three of the four items focus directly on the inadequacy of job training provided by school. Again, it is unclear whether the job-training aspect, or a more general dissatisfaction element is the dominant underlying dimension. It is likely that the job-training referent is stronger for this factor, as factors three and four also focus on more specific aspects of dissatisfaction with respect to school-technology, and basic-skills training.

The results of the internal consistency analysis are displayed in Table LXXI. The lack of unidimensionality is clearly evidenced by the small alpha coefficient (.59) for the composite scale. The four item scale derived from factor one, however, shows a high level of internal consistency (alpha = .83). The "dissatisfaction" dimension of factor two scaled poorly, only achieving an alpha coefficient of .56. Even though the "counseling" scale is internally consistent, several problems mitigate its usefulness. First, the meaning of this subset is not entirely clear (satisfaction with counseling versus general satisfaction with schooling). In either case, the scale measures the construct poorly. Second, employment of this scale requires the exclusion of nearly two-thirds of the sample. The biasing influence of such a sacrifice is not clear, but in any case, the gravity of the missing data problem coupled with the interpretability problem point to the lack of usefulness of scales produced from this item-set.

RESULTS FROM TEST 2, AGE 17, YEAR 76

Attitudes Towards Mathematics Items

Table LXXII presents the frequency distributions for the nine mathematics attitude items in Test 2 at the age seventeen level. The distributions are quite similar to those of Test 1 at the same age level. The largest difference in comparable response-category percentages between the two test packages is four percent. Approximately six percent of the students failed to respond to any one of the items.

The correlational data is shown in Table LXXIII. Overall, there is a fairly high degree of response consistency, as is evidenced by an average inter-item correlation of .39. Only seven percent of the sample were deleted from the effective sample due to nonresponse.

The two factors produced in the rotated factor solution are presented in Table LXXIV. As before, the first factor accounted for 86 percent of the variance, leaving only fourteen percent of the residual variance for factor two to pick up.

The factor structure of these items in Test 2 is quite similar to the structure in Test 1. (see Table LXXV). Factor one is comprised of the same seven motivation-liking items, while the six anxiety items again load on factor two. The comparable loadings of these items are very similar between Tests 1 and 2 for seventeen-year-olds. The largest discrepancy (.14) occurs for MATHHATE.

The results of the reliability analysis of the mathematics attitude items in Test 2 are shown in Table LXXXI. An alpha coefficients of .85 was generated for both the composite scale and the motivation subscale. The anxiety subscale attained an alpha level of .83. Just as for Test 1, four items are included in both of the subscales. All three scales produced from this item set are sufficiently reliable for further use.

Values in Life Items, Test 2

Table LXXLII presents the response distributions to the "values-in-life" items from Test 2. These percentages are quite similar to those for Test 1, with the largest discrepancy amounting to only 2.5 percent on MONEY. As in Test 1, the items SUCCESSFUL, MARRY, FRIENDSHIPS, STEADY WORK, and CHILDREN were rated "very important" by a majority of the students responding. The level of nonresponse for the individual items varies from 37 to 45 percent.

The correlational data and item statistics are shown in Table LXXVIII. Test 2 differs from Test 1 slightly in that the mean inter-item correlation is slightly higher (Test 2, r = .14; Test 1, r = .11). From a comparative examination of the item-to-total correlations in Tables LVIII (Test 1) and LXXVIII (Test 2), the underlying structures of the item sets are somewhat different. MARRY, FRIENDHSIPS, CHILDREN and INEQUALITIES all correlate about .10 higher with the other items when scaled in Test 2 than in Test 1. The only item which correlates even slightly less well in Test 2 is PARENTS. Forty-three percent of the total cases were lost through listwise deletion of missing data.

The results of the factor analysis of these items are presented in Table LXXIX. Factor one accounts for slightly more than half of the total variance, and is significant by our criteria. Factors two, three and four explain 23, 17 and 9 percent of the variance, respectively. Although the items loading on factor one are fairly similar for both Test 1 and Test 2 (see Table LXXX), there are some differences in item loadings for the other factors between the two tests. Recall that Test 1 had five factors, not four as in Test 2. The second and third factors in Test 1 seemed to be more clear in meaning -- ideological pursuits and family came out "cleanly." For Test 2, however, other items load with these dimensions, producing factors which are less readily interpretable. these differences in factor structure between the two tests could result from the nonresponse problem with this section of the instrument.

The results of the reliability analysis of the composite scale and first factor are displayed in Table LXXXI. As expected, the diverse composite set of items did not scale well, only achieving an alpha coefficient of .60. The three item factor-derived scale, labelled "work-values," only attained an alpha of .57, which is substandard under the criteria used herein. The secondary analyst is again advised not to attempt to scale these items related to values. Due to the high levels of nonresponse for these items, their usefulness for multivariate analysis is limited, and should be attempted only with extreme caution.

Attitudes Toward Self Items, Test 2

The response distributions to the items indicating "attitudes toward self" from Test 2 are shown in Table LXXXII. As with Test 1, the students generally feel positive about themselves (POSITIVE, ABLE, EQUAL PLANE, and SATISFIED); and again favor "hard work" and "planning" over luck or fate (GOOD LUCK, PLANNING). As with Test 1, the items ACCEPT, STOPS ME, and, to a lesser extent, PLANNING, reveal an undercurrent of frustration relating to goal attainment. The level of missing responses for these items ranges from 23 to 31 percent of the cases.

The inter-item correlation matrix is presented in Table LXXXIII. The item-to-total correlations are all in the moderate range (.20 to .30); and the mean inter-item correlation is .12. This is slightly lower than the mean correlation for Test 1. Just under fifty percent of the cases are retained after listwise deletion of missing data.

The principal components factor analysis revealed the strong dual dimensional structure which was also produced for Test 1 (see Table LXXXIV). Factor one accounts for 63 percent of the total variation, while the second factor absorbs the remaining 37 percent. The composite item loadings are quite similar between Test 1 and Test 2. Factor one represents the "self-esteem" dimension. Factor two again reflects the "fate-control" dimension, which is characterized by the item PLANNING, which loads highly (.70) on this factor.

The reliability analysis of these scales is shown in Table LXXXVI. The lack of internal consistency of the composite scale is due to the multidimensionality disclosed in the factor analysis. The four item self-esteem scale achieved a relatively high alpha coefficient (.77). The fate-control scale again scaled below the levels of acceptable internal consistency, with an alpha estimate of .65. Secondary analysts are urged to use this "fate-control" dimension with discretion, if at all. While the self-esteem scale is adequately reliable for use in predictive analyses, the high levels of missing data on this item set again diminish the usefulness of this measure.

Attitudes toward School, Test 2

The response distributions for the attitudes toward school items from Test 2 are shown in Table LXXXVII. They are quite similar to the responses for Test 1; the largest discrepancy on comparable percentages is 3.3 percent on CONTINUE. The levels of missing data are again quite high for these items, ranging from 30 up to 46 percent of the sample. As is evident from the increase in the nonresponse rate from the first to the last items in the set, the atrophy rate is particularly high for this item-set. This could reflect the placement of these items in the instrument -- time ran out just as most students got to this section.

The correlation data for this item set is presented in Table LXXXVIII. There is quite a range of item association within the composite set, with item-to-total correlations ranging from .01 to .50. The mean inter-item correlation is .14, which is slightly higher than the comparable figure, .11, for Test 1. Most notably, the four items in Test 1 which are the only items correlating above .25 with the rest of the set (CONTINUE, NEW IDEAS, RELATIONS, and FIND JOBS; see Table LXVIII), are less central to the variable space in Test 2. Seven items correlate above .25 in Test 2. The structure of the items is somewhat different between the two sets of items. This is possibly related to the high levels of missing data on these items.

The rotated factor solution is displayed in Table LXXXIX. Four factors were produced, two of which have eigenvalues above the cut-off level of 1.0. Factor one accounts for 44 percent of the variance, while factor two accounts for an additional 27%. The third and fourth factors are substantially weaker, and account for only 15% and 14% of the variance, respectively.

Table XC presents the loadings above .30 for the first two factors. As in Test 1, the first factor incorporates the four positively phrased items, three of which focus on the school's conseling services. In this test package, however, the items loading highly on factor two refer to the school's use of technological teaching aids. These two items are phrased negatively, implying dissatisfaction with the school-technology. This is quite different from factor two in Test 1, which incorporated the dimension related to job training dissatisfaction -- this dimension factored out on factor three in Test 2.

When the composite scale and the factor derived scale are tested for internal consistency, the factor relating to counseling is of high internal consistency (alpha = .82). The diverse composite scale attains a substandard reliability estimate of .64. The "school-technology" scale contains too few items to be a reliable scale. Although the first factor scales reliably, the same interpretability problem applies as in Test 1: is the scale a measure of attitudes toward school counseling, or a measure of positive affect towards school? Even if the secondary analyst can resolve this issue, the loss of nearly two-thirds of the cases because of missing data precludes the use of this scale in meaningful analyses.

SUMMARY: RESULTS OF ANALYSES OF PART THREE

The four test packages evaluated within the 1975-76 assessment are unique among NAEP mathematics assessments because of the identical attitude item sets replicated across several independent random samples. The mathematics attitude items, as we have seen, were included in both the age thirteen and age seventeen test booklets. The other three attitude item sets were included in the Supplementary Student Questionnaire and administered to two independent samples of seventeen-year-olds. This allows us to examine the stability of the response structure.

Table XCII presents the factor analytic solutions for all four test packages. As one can see from scanning the comparable item loadings across the test packages, there is a relatively high degree of stability within age levels. The largest discrepancy in loadings occurs for MATHHATE on the second factor (.14). There are some intereseting age-related differences in the factor structure. MATHPRD does not load on factor two in the age seventeen test packages as it does for the seventeen year olds. Pride in one's homework is evidently not assoicated with the performance anxiety dimension for the younger students as it is for the seventeen-year-olds. As a result of this difference, MATHPRD is not included as an "overlapping" item in the anxiety scale for the age thirteen analyses. There are also some differences in the loading of MATHEASE and MATHTRY between the two age groups but these discrepancies are not large enough to change the composition of the scales.

A summary of the results of the internal consistency analysis are given in Table XCIII. The reliability estimates of the mathematics attitude scales are quite similar across the tests, given some age differences. This item set is basically unidmensional, as evidenced by the high reliability coefficients for the composite scales. The underlying construct can be described as a motivational dimension, where the continuum extends from confidence in one's mathematical abilities on one end to a performance anxiety on the other end.

The factor-derived subscales were produced to allow the secondary researcher more conceptual specificity when using this item set. These subscales should ordinarily not be used simultaneously in an analyseis because of the built-in correlation between the two scales. For example, in a multiple regression analysis, serious multicollinearity problems would be created. All of the subscales produced from this item set are sufficiently reliable by the criteria used herein.

The other three affective item sets, although interesting in contents, pose some serious problems to the secondary analyst. Inadequate time was allowed for completion of the instrument in which these items appeared. Because of this, high levels of nonresponse characterize the items in these sets. The worst case of this occurs for the attitudes toward school item set. Nearly two-thirds of the total sample are deleted because of nonresponses to one or more items. Researchers primarily interested in these item sets could use them, but only with extreme caution.

Some differences in factor structure were observed for these items, most likely due to the missing data problem. Both the values in life item set and the attitudes toward school item set evidenced such structural differences in the factor analyses.

One subscale derived from the attitudes toward school item set attained a relatively high internal consistency estimate for both test packages. This scale, however, had interpretability problems. It was unclear whether the underlying dimension related most strongly to the school-counseling referent or the general positive tone toward school taken by these items.

The set of items indicating attitudes toward self were the most stable of those in the Supplementary Student Questionnaire. The first factor-derived scale relating to self-esteem achieved a relatively high level of reliability in both tests. However, nearly half of the cases would need to be sacrificed because of the high degree of nonresponse.

The item set focusing on the importance of certain goals or values in life did not produce any reliable scales. Too few goals relating to specific areas in life were included in the set to scale reliably. The composite scale itself was too diverse to be internally consistent.

Based upon these analyses, the affective potential of the 1975-76 mathematics assessment is the mathematics-attitude items contained in all four test booklets. This should be appealing to researchers because analyses performed on one package could be replicated on another package. Although the cognitive test items are different between Tests 1 and 2 of each age level, cross-age analyses are possible. Depending upon the comparability of properties of the cognitive tests within ages, additonal replications could be attempted with limited generalizability.

TABLES

TABLE I

FREQUENCY DISTRIBUTION:
ATTITUDES TOWARD MATHEMATICS,

Test 5, Age 9, 1977-78

Variable Name	Item	Response Categories	Percent Responding
Boys	Math is more for boys than for girls	Agree	16
		Undecided	19
		Disagree	65
		N	2419
Important	It is important to know some math in order to get a good job.	Agree	84
		Undecided	8
		Disagree	7
		N	2403
Get-Along	I can get along well in everyday life without using math.	Agree	12
		Undecided	17
		Disagree	71
		N	2410
Job	I would like to work at a job that lets me use math.	Agree	43
		Undecided	34
		Disagree	22
		N	2410
Useful	Math is useful in solving problems in everyday life.	Agree	66
		Undecided	18
		Disagree	16
		N	2409
Not-Math	Most people do not use math in their jobs.	Agree	35
		Undecided	27
		Disagree	38
		N	2420
Girls	Math is more for girls than for boys.	Agree	13
		Undecided	21
		Disagree	65
		N	2423
	TOTAL N Possible		2429

TABLE II

CORRELATION MATRIX:

TEST 5, AGE 9, YEAR 1977-78

(N = 2359)

	BOYS	IMPORTANT	GET-ALONG	JOB	USEFUL	NOT MATH	GIRLS
BOYS	1.00						
IMPORTANT	.17	1.00					
GET-ALONG	.09	.21	1.00				
JOB	.04	.07	.13	1.00			
USEFUL	.05	.11	.14	-.02	1.00		
NOT-USE-MATH	.07	.13	.17	.07	.11	1.00	
GIRLS	.21	.11	.12	.05	.04	.04	1.00
ITEM MEANS	2.50	2.78	2.60	2.22	2.51	2.03	2.53
STANDARD DEVIATION	7.56	.56	.69	.78	.75	.86	.71
ITEM-TO-TOTAL CORRELATION	.20	.27	.29	.10	.14	.19	.18

TABLE III

FACTOR MATRIX

Test 5, Age 9, Year 78

(N = 2359)

Variable	Factor 1	Factor 2	Factor 3
Boys	.07	.58	.02
Important	.32	.24	.13
Get Along	.43	.11	.32
Job	.03	.06	.35
Useful	.38	.04	-.09
Not Math	.29	.07	.12
Girls	.09	.34	.09
Eigenvalue	.85	.31	.16
% Variance	64.3	23.4	12.3

TABLE IV

FACTOR ANALYSIS:

Test 5, Age 9, Year 78

(N = 2359)

Factor	Loading	Item
Factor One: "Usefulness"	.32	It is important to know some math in order to get a good job.
	.43*	I can get along well in everyday life without using math.
	.38	Math is useful in solving problems in everyday life.
	.29	Most people do not use math in their jobs.

Eigenvalue = .85
% variance = 64.3

TABLE V

SCALE RELIABILITIES:

Test 5, Age 9, Year 78

(N = 2359)

Scale	Description	# of Items	Alpha* Reliability
Composite	Attitudes and perceptions related to math	7	.44
Factor I	Usefulness	4	.40

*Standardized item alpha for composite item sets and for factors.

TABLE VI

FREQUENCY DISTRIBUTION:
ATTITUDES TOWARD MATHEMATICS,

Test 8, Age 13, Year 78

Variable	Item	Response Categories	Percent Responding
Work-Hard	I am willing to work hard to do well in math.	Agree strongly	35
		Agree	55
		Undecided	9
		Disagree	2
		Strongly disagree	1
		N	2431
*Girls	Math is more for girls than boys.	Agree strongly	1
		Agree	5
		Undecided	10
		Disagree	33
		Strongly disagree	51
		N	2425
*Memorizing	Learning math is mostly memorizing.	Agree strongly	9
		Agree	39
		Undecided	19
		Disagree	26
		Strongly disagree	7
		N	2409
Useful	Mathematics is useful in solving everyday problems.	Agree strongly	25
		Agree	53
		Undecided	9
		Disagree	10
		Strongly disagree	3
		N	2413
*Exploring	Exploring number patterns plays almost no part in math.	Agree strongly	2
		Agree	11
		Undecided	22
		Disagree	44
		Strongly disagree	19
		N	2398
Enjoy	I enjoy math.	Agree strongly	18
		Agree	50
		Undecided	13
		Disagree	13
		Strongly disagree	5
		N	2412

TABLE VI (continued)

Variable	Item	Response Categories	Percent Responding
*Rule	There is always a rule to follow in solving math problems.	Agree strongly	27
		Agree	61
		Undecided	5
		Disagree	5
		Strongly disagree	1
		N	2412
How-to-solve	Knowing how to solve a problem is as important as getting a solution.	Agree strongly	32
		Agree	55
		Undecided	8
		Disagree	3
		Strongly disagree	1
		N	2424
*Practice	Doing math requires lots of practice in following rules.	Agree strongly	23
		Agree	55
		Undecided	11
		Disagree	10
		Strongly disagree	2
		N	2425
*Everyday	I can get along well in everyday life without using math.	Agree strongly	2
		Agree	5
		Undecided	10
		Disagree	45
		Strongly disagree	38
		N	2427
*Symbols	Mathematicians work with symbols rather than ideas.	Agree strongly	5
		Agree	19
		Undecided	43
		Disagree	27
		Strongly disagree	5
		N	2426
*Men	Fewer men than women have the logical ability to become mathematicians.	Strongly agree	3
		Agree	14
		Undecided	27
		Disagree	38
		Strongly disagree	18
		N	2419
Why-correct	Knowing why an answer is correct is as important as getting the correct answer.	Strongly agree	27
		Agree	61
		Undecided	7
		Disagree	4
		Strongly disagree	1
		N	2422

TABLE VI (continued)

Variable	Item	Response Categories	Percent Responding
Unrelated	Math is made up of unrelated topics..	Strongly agree	2
		Agree	16
		Undecided	32
		Disagree	41
		Strongly disagree	9
		N	2424
Do-well	I really want to do well in math.	Strongly agree	55
		Agree	41
		Undecided	3
		Disagree	1
		Strongly disagree	1
		N	2428
Parents	My parents really want me to do well in math.	Agree strongly	64
		Agree	31
		Undecided	3
		Disagree	-
		Strongly disagree	1
		N	2424
Myself	I feel good when I solve a math problem by myself.	Agree strongly	40
		Agree	49
		Undecided	7
		Disagree	2
		Strongly disagree	1
		N	2424

Total N possible for each data set 2434

*Starred items are reflected for subsequent analyses.

TABLE VII

CORRELATION MATRIX:

TEST 8, AGE 13, YEAR 78

(N = 2323)

	WORK HARD	GIRLS	MEMORIZING	USEFUL	EXPLORING	ENJOY	RULE	PRACTICAL	HOW-TO-SOLVE
WORK-HARD	1.00								
GIRLS	.23	1.00							
MEMORIZING	-.01	.10	1.00						
USEFUL	.11	.13	.05	1.00					
EXPLORING	.13	.23	.07	.19	1.00				
ENJOY	.49	.15	-.00	.12	.09	1.00			
RULE	.13	.12	-.15	.13	-.14	.10	1.00		
PRACTICAL	.21	.19	-.06	.27	.12	.16	-.13	1.00	
HOW-TO-SOLVE	.22	.16	.01	.20	.17	.16	-.17	.20	1.00
PRACTICE	.11	.09	-.11	.13	-.04	.05	.20	.11	.12
EVERYDAY	.22	.28	.02	.24	.19	.33	-.15	.24	.17
SYMBOLS	.01	.06	.11	.03	.08	.02	.04	-.00	.06
MEN	.11	.30	.15	.14	.23	.05	-.00	.14	.18
WHY-CORRECT	.21	.17	-.01	.15	.13	.14	-.18	.19	.31
UNRELATED	.08	.18	.14	.08	.19	.08	-.04	.12	.09
DO-WELL	.45	.19	-.04	.10	.08	.39	.16	.17	.25
PARENTS	.23	.13	-.06	.04	.08	.12	.19	.13	.14
MYSELF	.31	.19	.01	.10	.14	.31	.16	.16	.21
MEAN ITEM	4.21	4.28	2.83	3.84	3.68	3.63	4.10	3.88	4.14
STANDARD DEVIATION	.75	.91	1.12	.98	.99	1.08	.78	.78	.79
ITEM-TO-TOTAL CORRELATION	.43	.41	.05	.31	.32	.35	.23	.34	.38

(TABLE VII CONT.)

	PRACTICE	EVERYDAY	SYMBOLS	MEN	WHY CORRECT.	UNRELATED	DO-WELL	PARENTS	MYSELF
PRACTICE	1.00								
EVERYDAY	.15	1.00							
SYMBOLS	-.05	.05	1.00						
MEN	-.04	.12	.14	1.00					
WHY-CORRECT	.19	.18	-.04	.11	1.00				
UNRELATED	-.02	.12	.11	.19	.14	1.00			
DO-WELL	.14	.21	.05	.10	.21	.07	1.00		
PARENTS	.13	.10	-.01	.05	.17	.05	.35	1.00	
MYSELF	.20	.25	.00	.08	.22	.07	.46	.26	1.00
ITEM MEAN	3.87	4.14	2.91	3.56	4.10	3.38	4.48	4.58	4.26
STANDARD DEVIATION	.93	.91	.93	1.02	.75	.93	.67	.66	.76
ITEM-TO-TOTAL CORRELATION	.17	.43	.09	.29	.35	.25	.45	.26	.42

TABLE VIII

FACTOR MATRIX:*

Test 8, Age 13, Year 78

(N = 2323)

Variable	Factor 1	Factor 2	Factor 3	Factor 4
Work-hard	.43	.16	.41	.10
Girls	.17	.30	.12	.37
Memorizing	-.78	-.10	.03	.37
Useful	-.02	.43	.12	.13
Exploring	.08	.30	.03	.32
Enjoy	.23	.11	.71	.03
Rule	-.23	-.38	.02	.12
Practical	.11	.42	.16	.09
How-to-solve	.27	.35	.07	.16
Practice	-.20	-.34	.02	.18
Everyday	.08	.41	.36	.14
Symbols	.01	-.04	.02	.27
Men	.06	.17	-	.53
Why-correct	.27	.38	.03	.07
Unrelated	.05	.14	.03	.36
Do-well	.71	.07	.32	.07
Parents	.48	.14	-	-.01
Myself	.49	.20	.24	.05
Eigenvalues	2.93	.95	.63	.42
% Variances	59.5	19.2	12.8	8.5

* Varimax rotated with Kaiser Normalization.

TABLE IX

FACTOR ANALYSIS:

Test 8, Age 13, Year 78

(N = 2323)

Factor	Loading	Item
Factor One: "Motivation"	.43*	I am willing to work hard to do well in math.
	.71	I really want to do well in math.
	.48	My parents really want me to do well in math.
	.49	I feel good when I solve a math problem by myself.
Eigenvalue = 2.93 % Variance = 59.5		
Factor Two: "Usefulness"	.43	Math is useful in solving everyday problems.
	-.38	There is always a rule to follow in solving math problems.
	.42	Most of math has practical use.
	.35	Knowing how to solve a problem is as important as getting a solution.
	-.34	Doing math requires lots of practice in following rules.
	.41*	I can get along well in everyday life without math.
	.38	Knowing why an answer is correct is as important as getting the correct answer.
Eigenvalue = .95 % Variance = 19.2		

*Starred items load greater than .30 on more than one factor.

TABLE X

SCALE RELIABILITIES:

Test 8, Age 13, Year 78

(N = 2319)

Scale	Description	# of Items	Alpha* Reliability
Composite	Attitudes and perceptions related to math	18	.73
Factor 1	Motivation	4	.68
Factor 2	Usefulness	4	.61

*Standardized item alpha for composite item sets and factors.

TABLE XI

FREQUENCY DISTRIBUTION:
ATTITUDES TOWARD MATHEMATICS,

Test 9, Age 13, Year 78

Variable	Item	Response Categories	Percent Responding
Am-good	I am good at math.	Agree strongly	13
		Agree	52
		Undecided	26
		Disagree	8
		Strongly disagree	1
		N	2365
Logically	Math helps a person to think logically.	Agree strongly	18
		Agree	55
		Undecided	20
		Disagree	5
		Strongly disagree	1
		N	2353
Algebra	It is important to know math such as algebra or geometry in order to get a good job.	Agree strongly	28
		Agree	44
		Undecided	14
		Disagree	12
		Strongly disagree	2
		N	2364
Arithmetic	It is important to know arithmetic in order to get a good job.	Agree strongly	41
		Agree	47
		Undecided	7
		Disagree	4
		Strongly disagree	1
		N	2355
*Have-to	I am taking math only because I have to.	Agree strongly	6
		Agree	23
		Undecided	13
		Disagree	40
		Strongly disagree	6
		N	2357
*Discoveries	New discoveries are seldom made in math.	Strongly agree	6
		Agree	29
		Undecided	22
		Disagree	30
		Strongly disagree	12
		N	2343

TABLE XI (continued)

Variable	Item	Response Categories	Percent Responding
*Boys	Mathematics is more for boys than for girls.	Strongly agree	1
		Agree	2
		Undecided	5
		Disagree	35
		Strongly disagree	57
		N	2364
Take-more	I would like to take more math.	Strongly agree	14
		Agree	35
		Undecided	27
		Disagree	16
		Strongly disagree	9
		N	2364
*Creative	Creative people usually have trouble with math.	Strongly agree	3
		Agree	12
		Undecided	34
		Disagree	37
		Strongly disagree	14
		N	2365
Estimating	Estimating is an important mathematical skill.	Strongly agree	11
		Agree	60
		Undecided	20
		Disagree	7
		Strongly disagree	1
		N	2346
Understand	I usually understand what we are talking about in math.	Strongly agree	13
		Agree	66
		Undecided	11
		Disagree	9
		Strongly disagree	1
		N	2364
Trial-error	Trial and error can often be used to solve a math problem.	Strongly agree	10
		Agree	46
		Undecided	31
		Disagree	10
		Strongly disagree	3
		N	2360
Good-grade	A good grade in math is important to me.	Strongly agree	58
		Agree	39
		Undecided	2
		Disagree	1
		Strongly disagree	1
		N	2364

TABLE XI (continued)

Variable	Item	Response Categories	Percent Responding
Justifying	Justifying the mathematical statements a person makes is an extremely important part of math.	Strongly agree	12
		Agree	53
		Undecided	31
		Disagree	3
		Strongly disagree	1
		N	2364
	Total N Possible		2368

*Starred items are reflected for subsequent analyses.

TABLE XII

CORRELATION MATRIX:

TEST 9, AGE 13, YEAR 78

(N = 2293)

	AM GOOD	LOGIC-ALLY	ALGEBRA	ARITH-METIC	HAVE TO	DISCOV-ERIES	BOYS	TAKE MORE	CREA-TIVE	ESTI-MATING	UNDER-STAND	TRIAL-ERROR	GOOD GRADES	JUSTI-FYING
AM GOOD	1.00													
LOGICALLY	.17	1.00												
ALGEBRA	.08	.19	1.00											
ARITHMETIC	.08	.18	.25	1.00										
HAVE TO	.26	.18	.12	.18	1.00									
DISCOVERIES	.05	.09	.02	.07	.19	1.00								
BOYS	.07	.13	.06	.14	.20	.10	1.00							
TAKE MORE	.38	.20	.21	.18	.43	.05	.11	1.00						
CREATIVE	.08	.10	-.02	.08	.17	.19	.20	.07	1.00					
ESTIMATING	.10	.18	.13	.15	.01	-.01	.04	.13	.03	1.00				
UNDERSTAND	.41	.16	.05	.09	.21	.04	.10	.26	.16	.12	1.00			
TRIAL-ERROR	.02	.13	.03	.07	.03	.03	-.01	.08	.04	.12	.07	1.00		
GOOD GRADES	.18	.16	.17	.19	.22	.04	.19	.21	.11	.07	.18	.06	1.00	
JUSTIFYING	.15	.22	.19	.13	.07	.02	.11	.22	.03	.16	.10	.07	.15	1.00
ITEM MEAN	3.67	3.85	3.86	4.23	3.42	3.14	4.47	3.29	3.49	3.73	3.80	3.49	4.53	3.71
STANDARD DEVIATION	.84	.81	1.01	.82	1.20	1.14	.73	1.15	.96	.80	.82	.91	.63	.75
ITEM-TO-TOTAL CORRELATION	.37	.15	.25	.31	.41	.16	.25	.46	.21	.20	.34	.12	.34	.27

TABLE XIII

FACTOR MATRIX:*

Test 9, Age 13, Year 78

(N = 2293)

Variable	Factor 1	Factor 2	Factor 3	Factor 4
Am-good	.14	.64	.21	-.03
Logically	.42	.13	.10	-.16
Algebra	.43	-.05	.24	.03
Arithmetic	.38	-.04	.20	-.16
Have-to	-.02	-.20	-.62	.35
Discoveries	-.01	-	-.09	.32
Boys	-.15	-.03	-.11	.36
Take-more	.26	.36	.51	-.04
Creative	-.03	-.13	.05	.53
Estimating	.38	.11	-.04	.01
Understand	.15	.57	.05	-.16
Trial-error	.19	.06	-.03	-.04
Good-grade	.27	.14	.20	-.19
Justifying	.40	.11	.09	-.01
Eigenvalue	2.16	.63	.53	.38
% Variance	58.7	16.5	14.5	10.3

*Varimax rotated with Kaiser Normalization.

TABLE XIV

FACTOR ANALYSIS:

Test 9, Age 13, Year 78

(N = 2293)

Factor	Loading	Item
Factor One: "Importance"	.42	Math helps a person to think logically.
	.43	It is important to know math such as algebra or geometry in order to get a good job.
	.38	It is important to know arithmetic in order to get a good job.
	.38	Estimating is an important mathematical skill.
	.40	Justifying the mathematical statements a person makes is an extremely important part of math.
Eigenvalue = 2.16 % Variance = 58.7		

TABLE XV

SCALE RELIABILITIES:

Test 9, Age 13, Year 78

(N = 2293)

Scale	Description	# of Items	Alpha* Reliability
Composite	Attitudes and perceptions related to math	14	.67
Factor 1	Importance	5	.52

*Standardized item alpha for composite item sets and factors.

TABLE XVI
SUMMARY OF MATHEMATICS-ATTITUDE SCALE ANALYSIS
NAEP 1977-78, Ages 9 and 13

TEST	SCALE/DESCRIPTION	N OF ITEMS	N OF CASES	ALPHA RELIABILITY
5 (age nine)	COMPOSITE	7	2359	.44
	FACTOR 1: Usefulness	4	2359	.40
With Undecided's deleted:				
	COMPOSITE		645	.40
	FACTOR 1: Usefulness		645	.35
8 (age thirteen)	COMPOSITE	18	2319	.73
	FACTOR 1: Motivation	4	2319	.68
	FACTOR 2: Usefulness	4	2319	.61
9 (age thirteen)	COMPOSITE	14	2293	.67
	FACTOR 1: Importance	5	2293	.52

* Standardized item alpha for composite item sets and for factors.

TABLE XVII

FREQUENCY DISTRIBUTIONS:
STUDENT RATINGS OF MATH TASKS,

Test 5, Age 17, Year 78

(N = 2264)

TASKS	DIMENSIONS					
	Importance %		Easiness %		Liking %	
Solving word problems	Very Important	16	Very Easy	3	Like A Lot	3
	Important	55	Easy	36	Like	30
	Undecided	17	Undecided	29	Undecided	26
	Not Very Important	11	Hard	31	Dislike	33
	Not Important At All	1	Very Hard	2	Dislike A Lot	8
		N = 2215		N = 2179		N = 2192
Working with fractions	Very Important	27	Very Easy	12	Like A Lot	5
	Important	57	Easy	50	Like	43
	Undecided	10	Undecided	18	Undecided	24
	Not Very Important	6	Hard	19	Dislike	24
	Not Important At All	1	Very Hard	2	Dislike A Lot	4
		N = 2205		N = 2171		N = 2142
Estimating answers to problems	Very Important	15	Very Easy	7	Like A Lot	4
	Important	54	Easy	44	Like	35
	Undecided	20	Undecided	32	Undecided	37
	Not Very Important	10	Hard	16	Dislike	21
	Not Important At All	1	Very Hard	2	Dislike A Lot	3
		N = 2190		N = 2133		N = 2124
Measuring lengths, weights or volumes	Very Important	32	Very Easy	9	Like A Lot	4
	Important	53	Easy	44	Like	39
	Undecided	9	Undecided	21	Undecided	29
	Not Very Important	5	Hard	24	Dislike	56
	Not Important At All	1	Very Hard	2	Dislike A Lot	3
		N = 2212		N = 2165		N = 2135
Working with metric measures	Very Important	37	Very Easy	8	Like A Lot	6
	Important	39	Easy	25	Like	24
	Undecided	13	Undecided	22	Undecided	27
	Not Very Important	8	Hard	37	Dislike	33
	Not Important At All	3	Very Hard	8	Dislike A Lot	11
		N = 2189		N = 2155		N = 2141
Doing proofs	Very Important	9	Very Easy	3	Like A Lot	4
	Important	35	Easy	21	Like	16
	Undecided	30	Undecided	34	Undecided	36
	Not Very Important	19	Hard	33	Dislike	30
	Not Important At All	7	Very Hard	9	Dislike A Lot	14
		N = 2189		N = 2152		N = 2146

TABLE XVIII
CORRELATION MATRIX:
ATTITUDE ITEMS AND BACKGROUND VARIABLES
Test 5, Age 17, 1977-78
(N = 2215)

	WORD IMPORTANCE	WORD EASE	WORD LIKE	FRACTIONS IMPORTANCE	FRACTIONS EASE	FRACTIONS LIKE	ESTIMATING IMPORTANCE	ESTIMATING EASE	ESTIMATING LIKE
WORD: IMPORTANCE	1.00								
WORD: EASINESS	.12	1.00							
WORD: LIKING	.40	.44	1.00						
FRACTIONS: IMPORTANCE	.29	-.03	.10	1.00					
FRACTIONS: EASINESS	.12	.09	.08	.32	1.00				
FRACTIONS: LIKING	.12	.03	.19	.40	.57	1.00			
ESTIMATING: IMPORTANCE	.22	.11	.20	.28	.09	.14	1.00		
ESTIMATING: EASINESS	.14	.24	.16	.15	.25	.15	.16	1.00	
ESTIMATING: LIKING	.18	.13	.26	.20	.16	.29	.38	.49	1.00
MEASURING: IMPORTANCE	.26	.07	.13	.43	.19	.21	.25	.15	.15
MEASURING: EASINESS	.13	.17	.18	.19	.27	.13	.12	.29	.16
MEASURING: LIKING	.20	.11	.30	.25	.17	.26	.16	.23	.32
METRIC: IMPORTANCE	.21	.02	.11	.29	.19	.18	.16	.15	.12
METRIC: EASINESS	.15	.13	.13	.18	.27	.17	.09	.26	.17
METRIC: LIKING	.17	.05	.18	.19	.23	.22	.10	.20	.22
PROOFS: IMPORTANCE	.34	.11	.27	.22	.07	.13	.22	.12	.17
PROOFS: EASINESS	.17	.27	.24	.04	.13	.10	.13	.20	.16
PROOFS: LIKING	.19	.17	.30	.12	.09	.17	.17	.13	.22
COURSEWORK	-.13	.04	.00	-.22	-.37	-.20	-.10	-.23	-.13
HOMEWORK	-.14	-.04	-.08	-.14	-.15	-.13	-.06	-.09	-.08
WHITE RACE	.07	.07	.13	.00	-.04	.03	.04	-.04	.01
MINORITY %	-.10	-.08	-.12	-.03	.04	-.04	-.02	.02	-.03
ITEM MEANS	2.28	2.92	3.16	1.95	2.46	2.79	2.27	2.61	2.84
STANDARD DEVIATION	.90	.93	1.02	.81	.97	.99	.87	.89	.89
ITEM TO TOTAL CORRELATION	.40	.26	.43	.42	.38	.40	.34	.41	.44

TABLE XVIII (continued)

	MEASURE IMPOR.	MEASURE EASE	MEASURE LIKE	METRIC IMPOR.	METRIC EASE	METRIC LIKE	PROOF IMPOR.	PROOF EASE	PROOF LIKE	COURSE WORK	HOME WORK	WHITE RACE	MINORITY %
MEASURING: IMPORTANCE	1.00												
MEASURING: EASINESS	.31	1.00											
MEASURING: LIKING	.40	.54	1.00										
METRIC: IMPORTANCE	.33	.20	.21	1.00									
METRIC: EASINESS	.20	.38	.28	.31	1.00								
METRIC: LIKING	.22	.31	.37	.47	.66	1.00							
PROOFS: IMPORTANCE	.21	.08	.18	.15	.09	.14	1.00						
PROOFS: EASINESS	.10	.17	.12	.06	.16	.14	.38	1.00					
PROOFS: LIKING	.11	.12	.18	.07	.11	.16	.52	.62	1.00				
COURSEWORK	-.22	-.32	-.19	-.29	-.32	-.28	.01	-.02	-.01	1.00			
HOMEWORK	-.15	-.16	-.15	-.11	-.15	-.16	-.11	-.08	-.08	.30	1.00		
WHITE RACE	-.03	-.03	.03	.01	-.02	.02	.12	.09	.12	.13	-.03	1.00	
MINORITY %	.03	.09	-.01	-.00	.02	-.04	-.11	-.08	-.11	-.12	-.04	-.47	1.00
ITEM MEANS	1.88	2.64	2.83	2.01	3.10	3.18	2.81	3.24	3.33	3.68	.64	.86	15.28
STANDARD DEVIATION	.82	1.00	.95	1.06	1.12	1.09	1.10	.99	1.04	2.61	.82	.35	19.98
ITEM TOTAL CORRELATION	.43	.44	.51	.38	.45	.49	.39	.38	.41				

TABLE XIX

FACTOR MATRIX:*

Test 5, Age 17, Year 78

(N = 2215)

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Word : Importance	.11	.16	.44	.05	.02	–	.30
Word : Easiness	.01	.16	-.07	.10	.04	.16	.49
Word : Liking	.08	.16	.22	.10	.03	.03	.84
Fractions : Importance	.09	.04	.61	.08	.33	.07	-.07
Fractions : Easiness	.15	.04	.07	.05	.80	.15	.03
Fractions : Liking	.10	.07	.24	.15	.65	.–	.06
Estimating: Importance	.02	.12	.36	.29	.03	.03	.09
Estimating: Easiness	.14	.10	.03	.42	.16	.25	.14
Estimating: Liking	.08	.09	.16	.97	.10	.04	.10
Measuring : Importance	.13	.05	.57	.03	.10	.29	–
Measuring : Easiness	.21	.05	.12	.07	.10	.81	.11
Measuring : Liking	.22	.07	.32	.18	.07	.49	.15
Metric : Importance	.43	.02	.35	.03	.10	.07	–
Metric : Easiness	.63	.07	.04	.09	.15	.26	.07
Metric : Liking	.94	.08	.12	.10	.08	.10	.05
Proofs : Importance	.05	.54	.35	.05	-.01	-.02	.13
Proofs : Easiness	.07	.70	-.03	.07	.07	.12	.17
Proofs : Liking	.05	.84	.10	.10	.05	.02	.11
Eigenvalue	4.12	1.56	1.06	.94	.79	.73	.64
% Variance	41.9	15.9	10.7	9.6	8.0	7.4	6.5

* Varimas rotated with Kaiser Normalization.

TABLE XX

FACTOR ANALYSIS:

Test 5, Age 17, Year 78

(N = 2215)

Factor	Loading	Item
One	.43*	Important to work with metric measure.
	.63	Easy to work with metric measure.
	.94	Like to work with metric measure.
Eigenvalue = 4.12 % Variance = 41.9		
Two	.54*	Important to do proofs.
	.70	Easy to do proofs.
	.84	Like to do proofs.
Eigenvalue = 1.56 % Variance = 15.9		
Three	.44*	Important to solve word problems.
	.61	Important to work with fractions.
	.36	Important to estimate answers.
	.57	Important to measure lengths.
	.32	Like to measure lengths.
	.35	Important to work with metric measures.
	.35	Important to do proofs.
Eigenvalue = 1.06 % Variance = 10.7		
Four	.42*	Easy to estimate answers.
	.97	Like to estimate answers.
Eigenvalue = .94 % Variance = 9.6		

* Item loads greater than .30 on more than one factor.

TABLE XXI

CANONICAL CORRELATION ANALYSIS: Test 5, Age 17. Year 78

(N = 2215)

Coefficients for Canonical Variables of the First Set		
Variable	CANVAR 1	CANVAR 2
Word : Importance	-.12	-.31
Word : Easiness	.20	-.22
Word : Liking	.10	-.23
Fractions : Importance	-.04	-.16
Fractions : Easiness	-.47	.14
Fractions : Liking	.04	-.24
Estimating: Importance	-.05	.03
Estimating: Easiness	-.19	.12
Estimating: Liking	.01	.09
Measuring : Importance	-.11	.14
Measuring : Easiness	-.34	.21
Measuring : Liking	.07	-.14
Metric : Importance	-.26	.08
Metric : Easiness	-.24	.13
Metric : Liking	-.05	-.39
Proofs : Importance	.15	-.30
Proofs : Easiness	.07	-.14
Proofs : Liking	-.02	-.16

Coefficients for Canonical Variables of the Second Set		
	CANVAR 1	CANVAR 2
Coursework	.96	-.06
Homework	.01	-.36
White Race	.10	.57
Minority	-.06	.61
R	.53	.26
R^2	.28	.07
Significance	.00	.00

TABLE XXII

SCALE RELIABILITIES:

Test 5, Age 17, Year 78

Scale	Description	# of Items	# of Cases	Alpha* Reliability
Composite	Task-Related Affective Responses	18	1994	.82
Dimension 1	Importance	6	2109	.67
Dimension 2	Easiness	6	2037	.62
Dimension 3	Liking	6	2021	.66

* Standardized item alpha for composite item sets and dimensions.

TABLE XXIII

FREQUENCY DISTRIBUTIONS:
STUDENT RATINGS OF MATH TASKS

Test 6, Age 17, Year 78

(N. = 2231)

TASKS	DIMENSION					
	Importance %		Easiness %		Liking %	
Solving Equations	Very Important	26	Very Easy	9	Like A Lot	5
	Important	56	Easy	47	Like	43
	Undecided	13	Undecided	28	Undecided	28
	Not Very Important	5	Hard	16	Dislike	20
	Not Important At All	7	Very Hard	1	Dislike A Lot	3
	N = 2195		N = 2153		N = 2146	
Working with Percentages	Very Important	26	Very Easy	6	Like A Lot	3
	Important	56	Easy	43	Like	33
	Undecided	13	Undecided	24	Undecided	31
	Not Very Important	5	Hard	26	Dislike	29
	Not Important At All	-	Very Hard	1	Dislike A Lot	3
	N = 2166		N = 2113		N = 2074	
Memorizing rules and formulas	Very Important	19	Very Easy	4	Like A Lot	2
	Important	41	Easy	26	Like	19
	Undecided	22	Undecided	29	Undecided	30
	Not Very Important	16	Hard	36	Dislike	41
	Not Important At All	3	Very Hard	5	Dislike A Lot	9
	N = 2140		N = 2080		N = 2054	
Using Charts and Graphs	Very Important	16	Very Easy	13	Like A Lot	8
	Important	57	Easy	56	Like	49
	Undecided	16	Undecided	19	Undecided	24
	Not Very Important	10	Hard	12	Dislike	17
	Not Important At All	1	Very Hard	1	Dislike A Lot	2
	N = 2155		N = 2063		N = 2044	
Working with whole numbers	Very Important	35	Very Easy	31	Like A Lot	16
	Important	52	Easy	55	Like	56
	Undecided	9	Undecided	10	Undecided	20
	Not Very Important	4	Hard	4	Dislike	8
	Not Important At All	-	Very Hard	-	Dislike A Lot	1
	N = 2140		N = 2092		N = 2068	
Doing long division	Very Important	20	Very Easy	16	Like A Lot	8
	Important	54	Easy	51	Like	36
	Undecided	14	Undecided	19	Undecided	25
	Not Very Important	12	Hard	13	Dislike	27
	Not Important At All	1	Very Hard	1	Dislike A Lot	4
	N = 2119		N = 2098		N = 2077	

TABLE XXIV
CORRELATION MATRIX:
ATTITUDE ITEMS AND BACKGROUND VARIABLES
Test 6, Age 17, Year 78
(N = 1889)

		EQUATION IMPORTANCE	EQUATION EASE	EQUATION LIKE	PERCENTAGE IMPORTANCE	PERCENTAGE EASE	PERCENTAGE LIKE	FORMULAS IMPORTANCE	FORMULAS EASE	FORMULAS LIKE
EQUATIONS:	IMPORTANCE	1.00								
EQUATIONS:	EASINESS	.22	1.00							
EQUATIONS:	LIKING	.38	.45	1.00						
PERCENTAGES:	IMPORTANCE	.36	.12	.17	1.00*					
PERCENTAGES:	EASINESS	.18	.27	.23	.31	1.00				
PERCENTAGES:	LIKING	.18	.11	.35	.32	.58	1.00			
FORMULAS:	IMPORTANCE	.27	.10	.22	.27	.15	.20	1.00		
FORMULAS:	EASINESS	.16	.30	.25	.11	.22	.19	.27	1.00	
FORMULAS:	LIKING	.18	.16	.34	.10	.15	.30	.43	.54	1.00
CHARTS:	IMPORTANCE	.28	.10	.19	.30	.16	.19	.30	.14	.15
CHARTS:	EASINESS	.20	.34	.23	.19	.23	.16	.12	.30	.18
CHARTS:	LIKING	.19	.15	.26	.17	.16	.24	.19	.20	.26
WHOLE NUMBERS:	IMPORTANCE	.28	.15	.21	.34	.18	.13	.18	.13	.12
WHOLE NUMBERS:	EASINESS	.19	.33	.26	.28	.29	.18	.13	.21	.10
WHOLE NUMBERS:	LIKING	.20	.20	.36	.27	.20	.26	.19	.17	.25
DIVISION:	IMPORTANCE	.27	.14	.20	.33	.17	.16	.27	.11	.16
DIVISION:	EASINESS	.15	.29	.26	.21	.32	.22	.15	.21	.13
DIVISION:	LIKING	.16	.16	.33	.17	.15	.26	.19	.19	.29
	COURSEWORK	-.15	-.21	-.25	-.19	-.25	-.14	-.09	-.18	-.05
	WHITE RACE	.00	-.04	.07	-.02	.01	.09	.12	.07	.18
	HOMEWORK	-.08	-.06	-.07	-.06	-.11	-.08	-.07	-.08	-.05
	MINORITY %	-.05	.02	-.05	-.03	-.01	-.06	-.13	-.06	-.15
	ITEM MEANS	1.97	2.49	2.71	1.95	2.72	2.95	2.43	3.11	3.36
	STANDARD DEVIATION	.78	.88	.94	.77	.95	.94	1.04	.97	.95
	ITEM-TOTAL CORRELATION	.42	.40	.54	.44	.44	.46	.40	.42	.44

* IMPORTANCE DIMENSION CODED WITH "UNIMPORTANT" HIGH; EASINESS DIMENSION CODED WITH "DIFFICULT" HIGH; LIKING DIMENSION CODED WITH "DISLIKE" HIGH.

(XXIV CONT.)

	CHARTS IMPORTANCE	CHARTS EASE	CHARTS LIKE	WHOLE NUMBERS IMPORTANCE	WHOLE NUMBERS EASE	WHOLE-NUMBERS LIKE	DIVISON IMPORTANCE
EQUATIONS: IMPORTANCE							
EQUATIONS: EASINESS							
EQUATIONS: LIKING							
PERCENTAGES: IMPORTANCE							
PERCENTAGES: EASINESS							
PERCENTAGES: LIKING							
FORMULAS: IMPORTANCE							
FORMULAS: EASINESS							
FORMULAS: LIKING							
CHARTS: IMPORTANCE	1.00						
CHARTS: EASINESS	.27	1.00					
CHARTS: LIKING	.45	.58	1.00				
WHOLE NUMBERS: IMPORTANCE	.25	.17	.15	1.00			
WHOLE NUMBERS: EASINESS	.16	.31	.19	.38	1.00		
WHOLE NUMBERS: LIKING	.22	.23	.30	.42	.53	1.00	
DIVISION: IMPORTANCE	.21	.14	.15	.38	.22	.23	1.00
DIVISION: EASINESS	.14	.22	.14	.20	.38	.26	.32
DIVISION: LIKING	.12	.09	.19	.17	[illegible]	.33	.39
COURSEWORK	-.13	-.24	-.15	-.14	-.27	-.18	-.13
WHITE RACE	-.02	-.11	-.02	-.04	-.08	.00	.01
HOMEWORK	-.06	-.07	-.08	-.06	-.13	-.09	-.02
MINORITY %	-.01	.05	-.02	.02	.03	-.03	-.03
ITEM MEANS	2.19	2.32	2.55	1.80	1.84	2.20	2.20
STANDARD DEVIATION	.84	.88	.94	.75	.75	.81	.93
ITEM-TOTAL CORRELATION	.40	.44	.44	.41	.48	.51	.42

(TABLE XXIV CONT.)

		DIVISION EASE	DIVISON LIKE	COURSE WORK	WHITE RACE	HOME WORK	MIN-ORITY%
EQUATIONS:	IMPORTANCE						
EQUATIONS:	EASINESS						
EQUATIONS:	LIKING						
PERCENTAGES:	IMPORTANCE						
PERCENTAGES:	EASINESS						
PERCENTAGES:	LIKING						
FORMULAS:	IMPORTANCE						
FORMULAS:	EASINESS						
FORMULAS:	LIKING						
CHARTS:	IMPORTANCE						
CHARTS:	EASINESS						
CHARTS:	LIKING						
WHOLE NUMBERS:	IMPORTANCE						
WHOLE NUMBERS:	EASINESS						
WHOLE NUMBERS:	LIKING						
DIVISION:	IMPORTANCE						
DIVISION:	EASINESS	1.00					
DIVISION:	LIKING	.52	1.00				
	COURSEWORK	-.33	-.10	1.00			
	WHITE RACE	.00	.13	.14	1.00		
	HOMEWORK	-.09	-.09	.10	-.03	1.00	
	MINORITY %	.01	-.11	-.16	-.47	.02	1.00
	ITEM MEANS	2.30	2.84	3.56	.85	3.32	15.21
	STANDARD DEVIATION	.94	1.04	2.59	.35	2.14	20.60
	ITEM-TOTAL CORRELATION	.47	.44				

TABLE XXV

FACTOR MATRIX:*

Test 6, Age 17, Year 78

(N = 1889)

Variable		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Equations :	Importance	.44	.14	.19	.10	.08	.10
Equations :	Easiness	.05	.60	.18	.08	.06	.09
Equations :	Liking	.20	.35	.31	.12	.20	.20
Percentages:	Importance	.58	.06	.03	.08	.04	.28
Percentages:	Easiness	.16	.28	.05	.05	.05	.68
Percentages:	Liking	.15	.03	.20	.12	.15	.76
Formulas :	Importance	.38	-.04	.44	.09	.06	.08
Formulas :	Easiness	.03	.31	.55	.11	.04	.09
Formulas :	Liking	.09	.06	.83	.10	.13	.10
Charts :	Importance	.41	-	.13	.39	.01	.10
Charts :	Easiness	.11	.40	.12	.53	-.01	.08
Charts :	Liking	.13	.08	.13	.95	.10	.08
Whole Num. :	Importance	.59	.24	.01	.04	.08	-
Whole Num. :	Easiness	.35	.57	-.03	.09	.13	.10
Whole Num. :	Liking	.39	.34	.10	.16	.22	.09
Division :	Importance	.49	.08	.08	.03	.32	.04
Division :	Easiness	.18	.37	.03	.04	.46	.18
Division :	Liking	.14	.08	.19	.05	.93	.08
Eigenvalue		4.50	1.14	1.02	.85	.78	.71
% Variance		50.0	12.7	11.4	9.4	8.7	7.9

*Varimax rotated with Kaiser Normalization.

TABLE XXVI

FACTOR ANALYSIS:

Test 6, Age 17, Year 78

(N = 1889)

Factor	Loading	Item
One	.44	Important to solve equations.
	.57	Important to work with percentages.
	.38*	Important to memorize rules and formulas.
	.40	Important to use charts and graphs.
	.59	Important to work with whole numbers.
	.35*	Easy to work with whole numbers.
	.39*	Like working with whole numbers.
	.49	Important to do long division.
Eigenvalue = 4.49 % Variance = 50		
Two	.59	Easy to solve equations.
	.34*	Like to solve equations.
	.31*	Easy to memorize rules and formulas.
	.40	Easy to use charts and graphs.
	.57*	Easy to work with whole numbers.
	.34*	Like working with whole numbers.
	.37	Easy to do long division.
Eigenvalue = 1.14 % Variance = 12.7		
Three	.31*	Like to solve equations.
	.44*	Important to memorize rules and formulas.
	.55*	Easy to memorize rules and formulas.
	.83	Like to memorize rules and formulas.
Eigenvalue = 1.02 % Variance = 11.4		

* Loads greater than .30 on more than one factor.

TABLE XXVII

CANONICAL CORRELATION ANALYSIS: Test 6, Age 17, Year 78

(N = 1889)

Coefficients for Canonical Variables of the First Set		
Variable	CANVAR 1	CANVAR 2
Equations : Importance	-.03	-.03
Equations : Easiness	.07	.13
Equations : Liking	-.37	-.13
Percentages: Importance	-.14	.01
Percentages: Easiness	-.28	-.10
Percentages: Liking	.14	-.10
Formulas : Importance	-.03	-.33
Formulas : Easiness	-.19	-.08
Formulas : Liking	.18	-.47
Charts : Importance	-.02	.10
Charts : Easiness	-.20	.36
Charts : Liking	-.03	-.03
Whole Num. : Importance	.05	.09
Whole Num. : Easiness	-.20	.10
Whole Num. : Liking	-.04	.04
Division : Importance	.01	.13
Division : Easiness	-.52	.13
Division :Liking	.20	-.46

Coefficients for Canonical Variables of the Second Set		
	CANVAR 1	CANVAR 2
Coursework	.97	.08
Homework	.19	.17
Minority %	.10	.38
White Race	.05	-.75
R	.46	.28
R^2	.21	.08
Significance	.00	.00

TABLE XXVIII

SCALE RELIABILITIES:

Test 6, Age 17, Year 78

Scale	Description	# of Items	# of Cases	Alpha* Reliability
Composite	Task-Related Affective Response	18	1889	.84
Dimension 1	Importance	6	2010	.71
Dimension 2	Easiness	6	1927	.70
Dimension 3	Liking	6	1899	.71

* Standardized item alpha for composite item sets and dimensions.

TABLE XXIX

FREQUENCY DISTRIBUTION:
ATTITUDES TOWARD MATHEMATICS,

Test 8, Age 17, Year 78

Variable	Item	Response Categories	Percent Responding
Work-hard	I am willing to work hard to do well in math.	Agree strongly	20
		Agree	59
		Undecided	16
		Disagree	4
		Strongly disagree	1
		N	2166
*Girls	Math is more for girls than for boys.	Agree strongly	1
		Agree	2
		Undecided	8
		Disagree	37
		Strongly disagree	53
		N	2177
*Memorizing	Learning math is mostly memorizing.	Agree strongly	5
		Agree	40
		Undecided	15
		Disagree	34
		Strongly disagree	7
		N	2172
Useful	Math is useful in solving everyday problems.	Agree strongly	23
		Agree	55
		Undecided	11
		Disagree	10
		Strongly disagree	2
		N	2174
*Exploring	Exploring number patterns plays almost no part in mathematics.	Agree strongly	1
		Agree	7
		Undecided	22
		Disagree	52
		Strongly disagree	18
		N	2173
Enjoy	I enjoy math.	Agree strongly	11
		Agree	42
		Undecided	17
		Disagree	22
		Strongly disagree	8
		N	2189
*Rule	There is always a rule to follow in solving math problems.	Agree strongly	24
		Agree	64
		Undecided	4
		Disagree	7
		Strongly disagree	1
		N	2190

TABLE XXIX (continued)

Variable	Item	Response Categories	Percent Responding
Practical	Most of math has practical value.	Agree strongly	20
		Agree	59
		Undecided	16
		Disagree	4
		Strongly disagree	1
		N	2166
How-to-solve	Knowing how to solve a problem is as important as getting a solution.	Agree strongly	38
		Agree	55
		Undecided	5
		Disagree	2
		Strongly disagree	-
		N	2191
*Practice	Doing mathematics requires lots of practice in following rules.	Agree strongly	18
		Agree	62
		Undecided	11
		Disagree	7
		Strongly disagree	1
		N	2191
*Everyday	I can get along well in everyday life without using math.	Agree strongly	2
		Agree	8
		Undecided	14
		Disagree	51
		Strongly disagree	26
		N	2195
*Symbols	Mathematicians work with symbols rather than ideas.	Agree strongly	2
		Agree	26
		Undecided	37
		Disagree	30
		Strongly disagree	6
		N	2194
*Men	Fewer men than women have the logical ability to become mathematicians.	Agree strongly	1
		Agree	6
		Undecided	20
		Disagree	46
		Strongly disagree	28
		N	2192
Why-correct	Knowing why an answer is correct is as important as getting the correct answer.	Agree strongly	34
		Agree	59
		Undecided	4
		Disagree	3
		Strongly disagree	-
		N	2195
*Unrelated	Mathematics is made up of unrelated topics.	Agree strongly	1
		Agree	11
		Undecided	29
		Disagree	48
		Strongly disagree	11
		N	2192

TABLE XXIX (continued)

Variable	Item	Response Categories	Percent Responding
Do-well	I really want to do well in math.	Agree strongly	29
		Agree	56
		Undecided	11
		Disagree	3
		Strongly disagree	1
		N	2193
Parents	My parents really want me to do well in math.	Agree strongly	36
		Agree	51
		Undecided	10
		Disagree	2
		Strongly disagree	1
		N	2197
Myself	I feel good when I solve a math problem by myself.	Agree strongly	41
		Agree	50
		Undecided	7
		Disagree	2
		Strongly disagree	1
		N	2197
	Total N possible		2215

*These items were reflected for subsequent analyses.

TABLE XXX
CORRELATION MATRIX:
ATTITUDE ITEMS AND BACKGROUND VARIABLES
Test 8, Age 17, Year 78
(N = 2132)

	WORK HARD	GIRLS	MEMORIZING	USEFUL	EXPLORING	ENJOY	RULE	PRACTICAL	HOW-TO SOLVE	PRACTICE	EVERYDAY	SYMBOLS	MEN	WHY CORRECT
WORK HARD	1.00													
GIRLS	.17	1.00												
MEMORIZING	.05	.08	1.00											
USEFUL	.19	.06	.09	1.00										
EXPLORING	.10	.09	.08	.17	1.00									
ENJOY	.52	.12	.08	.25	.10	1.00								
RULE	.06	.02	-.18	.04	-.01	.07	1.00							
PRACTICAL	.23	.04	.01	.31	.12	.25	.16	1.00						
HOW-TO-SOLVE	.25	.20	-.01	.17	.13	.22	.12	.18	1.00					
PRACTICE	.11	.06	-.13	.05	.06	.06	-.31	.08	.21	1.00				
EVERYDAY	.25	.13	.08	.38	.20	.33	.05	.26	.16	-.08	1.00			
SYMBOLS	.15	.14	.15	.05	.12	.12	-.13	.07	.06	.02	.11	1.00		
MEN	.11	.35	.13	.07	.13	.06	-.04	.01	.19	-.04	.10	.21	1.00	
WHY-CORRECT	.21	.17	.01	.14	.11	.19	.09	.14	.37	-.18	.18	.16	.22	1.00
UNRELATED	.17	.17	.11	.11	.20	.16	-.06	.10	.16	-.10	.15	.23	.27	.18
DO-WELL	.54	.19	.04	.17	.09	.46	.10	.22	.26	-.16	.31	.12	.08	.25
PARENTS	.28	.05	-.02	.09	.04	.17	.08	.16	.19	-.19	.20	.06	.04	.15
MYSELF	.40	.16	.01	.14	.10	.31	.12	.18	.26	-.15	.22	.08	.20	.30
COURSEWORK	.19	.17	.16	.07	.16	.24	-.14	-.05	.17	.04	.04	.23	.27	.17
HOMEWORK	.21	.09	.09	.03	.05	.15	-.02	.00	.08	.01	.07	.10	.12	.07
WHITE RACE	-.14	.02	.10	.00	.04	-.09	-.10	-.07	.03	.09	-.03	.06	.12	.04
MINORITY %	.17	.02	-.10	.01	-.04	.09	.10	.09	.00	-.11	.06	-.06	-.11	-.02
ITEM MEAN	3.93	4.39	2.97	3.88	3.80	3.26	4.03	3.83	4.27	3.89	3.92	3.11	3.94	4.24
STANDARD DEVIATION	.78	.78	1.09	.92	.84	1.15	.81	.81	.69	.80	.92	.92	.88	.68
ITEM TO TOTAL CORRELATION	.52	.29	.09	.34	.23	.47	.09	.34	.41	.19	.42	.23	.27	.40

(TABLE XXX CONT.)

	UNRELATED	DO-WORK	PARENTS	MYSELF	COURSEWORK	HOMEWORK	WHITE-RACE	MINORITY-%
WORK HARD								
GIRLS								
MEMORIZING								
USEFUL								
EXPLORING								
ENJOY								
RULE								
PRACTICAL								
HOW-TO-SOLVE								
PRACTICE								
EVERYDAY								
SYMBOLS								
MEN								
WHY-CORRECT								
UNRELATED	1.00							
DO-WELL	.16	1.00						
PARENTS	.01	.43	1.00					
MYSELF	.16	.49	.33	1.00				
COURSEWORK	.31	.17	.10	.15	1.00			
HOMEWORK	.13	.18	.06	.15	.29	1.00		
WHITE RACE	.09	-.15	-.10	.11	.13	-.03	1.00	
MINORITY %	-.06	.19	.13	.16	-.13	.00	-.60	1.00
ITEM MEAN	3.58	4.08	4.21	4.28	3.47	.66	.80	19.76
STANDARD DEVIATION	.87	.78	.74	.74	2.68	.82	.40	25.15
ITEM TO TOTAL CORRELATION	.31	.55	.32	.46				

TABLE XXXI

FACTOR MATRIX:*

Test 8, Age 17, Year 78

(N = 2132)

Variable	Factor 1	Factor 2	Factor 3	Factor 4
Work-hard	.65	.16	.20	.02
Girls	.13	.45	.01	-.0[illegible]
Memorizing	.02	.19	.10	.32
Useful	.08	.10	.67	-
Exploring	.04	.24	.20	.01
Enjoy	.53	.10	.34	.05
Rule	-.08	.07	-.10	.53
Practical	.20	.04	.44	-.12
How-to-solve	.24	.35	.17	-.29
Practice	-.14	-.10	-.04	.51
Everyday	.27	.14	.48	.01
Symbols	.11	.35	.10	.20
Men	-	.62	-	.03
Why-correct	.23	.40	.13	-.23
Unrelated	.12	.43	.13	.11
Do-well	.79	.13	.13	-.07
Parents	.45	.06	.06	-.16
Myself	.56	.20	.10	-.16
Eigenvalue	3.23	1.02	.74	.63
% Variance	57.4	18.3	13.2	11.2

*Varimax rotated with Kaiser Normalization.

TABLE XXXII

FACTOR ANALYSIS:

Test 8, Age 17, Year 78

(N = 2132)

Factor	Loading	Item
Factor One: "Enjoyment-Motivation"	.65	I am willing to work hard.
	.53	I enjoy math.
	.79	I want to do well.
	.45	Parents want me to do well.
	.56	I feel good solving problems alone.
Eigenvalue = 3.23 % Variance = 57.4		
Factor Two: "Perceptions of Math"	.45	Math is more for girls than boys.
	.35	Knowing how to solve problems is important.
	.35	Mathematicians work with symbols, not ideas.
	.63	Fewer men than women have logical ability.
	.40	Knowing why an answer is correct is important.
	.43	Math is made up of unrelated topics.
Eigenvalue = 1.03 % Variance = 18.3		

TABLE XXXIII

CANONICAL CORRELATION ANALYSIS: Test 8, Age 17, Year 78

(N = 2132)

Coefficients for Canonical Variables of the First Set		
Variable	CANVAR 1	CANVAR 2
Work-hard	.06	-.46
Girls	.05	-.09
Memorizing	.15	.14
Useful	.04	.09
Exploring	.12	.08
Enjoy	.34	-.04
Rule	.19	.10
Practical	.27	-.05
How-to-solve	.16	.17
Practice	.12	.15
Everyday	-.18	-.02
Symbols	.19	.08
Men	.30	.19
Why-correct	.07	.20
Unrelated	.38	.10
Do-well	.04	-.39
Parents	.08	-.08
Myself	.06	-.28

Coefficients for Canonical Variables of the Second Set		
	CANVAR 1	CANVAR 2
Coursework	.92	-.02
Homework	.18	-.38
White race	.01	-.65
Minority %	.10	.37
R	.50	.34
R^2	.25	.12
Significance	.00	.00

TABLE XXXIV

SCALE RELIABILITIES:

Test 8, Age 17, Year 78

(N = 2132)

Scale	Description	# of Items	Alpha* Reliability
Composite	Attitudes and perceptions related to math	18	.75
Factor 1	Enjoyment/Motivation	5	.76
Factor 2	Perceptions of math	6	.57

*Standardized item alpha for composite item sets and factors.

TABLE XXXV

FREQUENCY DISTRIBUTIONS:
ATTITUDES TOWARD MATHEMATICS,

Test 9, Age 17, Year 78

Variable	Item	Response Categories	Percent Responding
Am-good	I am good at math.	Agree strongly	8
		Agree	46
		Undecided	24
		Disagree	19
		Strongly disagree	4
		N	2227
Logically	Mathematics helps a person to think logically.	Agree strongly	17
		Agree	60
		Undecided	16
		Disagree	7
		Strongly disagree	1
		N	2223
Algebra	It is important to know math such as algebra or geometry in order to get a good job.	Agree strongly	12
		Agree	35
		Undecided	21
		Disagree	28
		Strongly disagree	5
		N	2225
Arithmetic	It is important to know arithmetic in order to get a good job.	Agree strongly	36
		Agree	51
		Undecided	6
		Disagree	6
		Strongly disagree	1
		N	2224
*Have-to	I am taking math only because I have to.	Agree strongly	18
		Agree	44
		Undecided	11
		Disagree	23
		Strongly disagree	4
		N	2223
*Discoveries	New discoveries are seldom made in math.	Agree strongly	13
		Agree	40
		Undecided	29
		Disagree	16
		Strongly disagree	3
		N	2222
*Boys	Math is more for boys than girls.	Agree strongly	54
		Agree	36
		Undecided	7
		Disagree	2
		Strongly disagree	1
		N	2228

TABLE XXXV (continued)

Variable	Item	Response Categories	Percent Responding
Take-more	I would like to take more math.	Agree strongly	11
		Agree	28
		Undecided	29
		Disagree	20
		Strongly disagree	13
		N	2229
*Creative	Creative people usually have more trouble with math.	Agree strongly	15
		Agree	41
		Undecided	34
		Disagree	8
		Strongly disagree	2
		N	2231
Estimating	Estimating is an important math skill.	Agree strongly	8
		Agree	65
		Undecided	17
		Disagree	9
		Strongly disagree	2
		N	2223
Understand	I usually understand what we are talking about in math.	Agree strongly	8
		Agree	59
		Undecided	14
		Disagree	17
		Strongly disagree	3
		N	2229
Trial-error	Trial and error can often be used to solve a math problem.	Agree strongly	11
		Agree	59
		Undecided	20
		Disagree	9
		Strongly disagree	1
		N	2227
Good grade	A good grade in math is important to me.	Agree strongly	24
		Agree	50
		Undecided	8
		Disagree	6
		Strongly disagree	2
		N	2228
Justifying	Justifying the math statements a person makes is an extremely important part of math.	Agree strongly	15
		Agree	53
		Undecided	28
		Disagree	4
		Strongly disagree	1
		N	2227

Total N possible

*These items were reflected for the subsequent analyses.

TABLE XXXVI
CORRELATION MATRIX:
ATTITUDE ITEMS AND BACKGROUND VARIABLES
Test 9, Age 17, Year 78
(N = 2188)

	AM GOOD	LOGICALLY	ALGEBRA	ARITH-METIC	HAVE TO	DISCOVERIES	BOYS	TAKE MORE	CREATIVE	ESTIMATYING
AM GOOD	1.00									
LOGICALLY	.33	1.00								
ALGEBRA	.18	.30	1.00							
ARITHMETIC	.18	.24	.30	1.00						
HAVE TO	.41	.29	.18	.19	1.00					
DISCOVERIES	.16	.17	.04	.09	.25	1.00				
BOYS	.06	.13	.02	.09	.13	.17	1.00			
TAKE MORE	.49	.38	.29	.23	.52	.17	.13	1.00		
CREATIVE	.18	.16	-.01	.02	.20	.21	.23	.16	1.00	
ESTIMATING	.14	.14	.12	.15	.08	.06	.03	.13	.05	1.00
UNDERSTAND	.56	.29	.12	.22	.35	.12	.08	.41	.17	.09
TRAIL ERROR	.07	.15	-.01	.04	.11	.11	.06	.08	.07	.06
GOOD GRADE	.32	.33	.27	.22	.26	.12	.15	.37	.14	.14
JUSTIFYING	.21	.26	.18	.18	.17	.14	.11	.24	.13	.19
WHITE RACE	-.03	-.01	-.17	.00	.05	.13	.02	-.11	.07	-.04
MINORITY	.03	.04	.16	.03	-.02	-.10	.01	.11	-.07	.06
COURSEWORK	.37	.25	.07	.17	.30	.20	.12	.22	.15	.03
HOMEWORK	.16	.13	.10	.08	.19	.10	.07	.20	.08	.05
ITEM MEAN	3.36	3.84	3.20	4.14	3.49	3.44	4.43	3.03	3.59	3.69
STANDARD DEVIATION	.99	.82	1.12	.86	1.15	.98	.75	1.19	.91	.81
ITEM-TOTAL CORRELATION	.54	.51	.31	.34	.52	.27	.21	.59	.26	.21

(TABLE XXXVI CONT.)

	UNDERSTAND	TRIAL ERROR	GOOD GRADE	JUSTIFYING	WHITE RACE	MINORITY %	COURSWORK	HOMEWORK
AM GOOD								
LOGICALLY								
ALGEBRA								
ARITHMETIC								
HAVE TO								
DISCOVERIES								
BOYS								
TAKE MORE								
CREATIVE								
ESTIMATING								
UNDERSTAND	1.00							
TRAIL ERROR	.11	1.00						
GOOD GRADE	.29	.10	1.00					
JUSTIFYING	.17	.09	.24	1.00				
WHITE RACE	-.02	.04	-.13	-.01	1.00			
MINORITY	.04	-.02	.15	.05	-.56	1.00		
COURSEWORK	.26	.07	.14	.17	.19	-.15	1.00	
HOMEWORK	.13	-.01	.14	.08	.02	-.06	.26	1.00
ITEM MEAN	3.51	3.69	4.11	3.77	.81	18.07	3.18	.59
STANDARD DEVIATION	.96	.83	.88	.77	.39	23.46	2.60	.80
ITEM-TOTAL CORRELATION	.48	.15	.47	.36				

TABLE XXXVII

FACTOR MATRIX:*

Test 9, Age 17, Year 78

(N = 2188)

Variable	Factor 1	Factor 2	Factor 3
Am-good	.74	.20	-.12
Logically	.27	.46	-.25
Algebra	.09	.61	.07
Arithmetic	.14	.45	-.05
Have-to	-.47	-.24	.30
Discoveries	-.11	-.10	.41
Boys	-.01	-.09	.41
Take-more	.55	.40	-.20
Creative	-.15	.01	.49
Estimating	.07	.25	-.07
Understand	.65	.17	-.13
Trial-error	.08	.07	-.19
Good-grade	.28	.42	-.20
Justifying	.13	.35	-.23
Eigenvalue	3.02	.61	.50
% Variance	73.1	14.7	12.2

* Varimax rotated with Kaiser Normalization.

TABLE XXXVIII

FACTOR ANALYSIS:

Test 9, Age 17, Year 78

(N = 2188)

Factor	Loading	Item
"Enjoyment/ Motivation"	.73	I am good at mathematics.
	-.47*	I am taking math only because I have to.
	.54*	I would like to take more math.
	.56	I usually understand what we are talking about in math.
Eigenvalue =	3.01	
% Variance =	73.1	
"Importance/ Usefulness"	.45	Math helps a person to think logically.
	.61	Important to know math to get a good job.
	.44	Important to know arithmetic to get a good job.
	.40*	I would like to take more math.
	.42	A good grade in math is important to me.
	.34	Justifying the math statements you make is an important part of math.
Eigenvalue =	.60	
% Variance =	14.7	

* Loads greater than .30 on more than one factor.

TABLE XXXIX

CANONICAL CORRELATION ANALYSIS: Test 9, Age 17, Year 78

(N = 2188)

Coefficients for Canonical Variables of the First Set

Variable	CANVAR 1	CANVAR 2	CANVAR 3
Am-good	-.60	-.10	.82
Logically	-.20	-.13	.09
Algebra	.02	.50	.12
Arithmetic	-.15	-.20	.07
Have-to	-.31	-.27	-.47
Discoveries	-.17	-.36	-.38
Boys	-.10	.05	.04
Take-more	.05	.50	-.48
Creative	-.05	-.20	-.16
Estimating	.09	.14	-.21
Understanding	-.05	.05	-.02
Trial-error	.01	-.10	.35
Good-grade	.01	.48	-.14
Justifying	.13	-.02	.13

Coefficients for Canonical Variables of the Second Set

	CANVAR 1	CANVAR 2	CANVAR 3
Coursework	-.93	-.09	.50
Homework	-.23	.30	-.97
White race	-.13	.48	.02
Minority %	.03	-.60	-.35
R	.47	.32	.12
R^2	.22	.10	.01
Significance	.00	.00	.00

TABLE XL

SCALE RELIABILITIES:

Test 9, Age 17, Year 78

(N = 2188)

Scale	Description	# of Items	Alpha * Reliability
Composite	Attitudes and Perceptions related to math.	14	.76
Factor 1	Enjoyment/Motivation	4	.76
Factor 2	Importance/Usefulness	5	.65
Factor 3	Miscellaneous Perceptions	4	.50

*Standardized item alpha for composite item sets and factors.

TABLE XLI
SUMMARY OF MATHEMATICS ATTITUDE - SCALE ANALYSIS
NAEP: 1977-78, Age 17

TEST	SCALE/DESCRIPTION		N OF ITEMS	N OF CASES	ALPHA RELIABILITY
5	Composite	Task-related affective responses	18	1994	.82
	Dimension 1:	Importance	6	2109	.67
	Dimension 2:	Easiness	6	2037	.62
	Dimension 3:	Liking	6	2021	.66
6	Composite	Task-related affective response	18	1889	.84
	Dimension 1:	Importance	6	2010	.71
	Dimension 2:	Easiness	6	1927	.70
	Dimension 3:	Liking	6	1899	.71
8	Composite	Attitudes and perceptions related to mathematics	18	2132	.75
	Factor 1:	Enjoyment/motivation	5	2132	.76
	Factor 2:	Perceptions of math	7	2132	.57
	Factor 3:	Usefulness of math	3	2132	.58
	Factor 4:	Miscellaneous Perceptions	3	2132	.44
9	Composite	Attitudes and perceptions related to mathematics	14	2188	.76
	Factor 1:	Enjoyment/motivation	4	2188	.76
	Factor 2:	Importance/usefulness	5	2188	.65
	Factor 3:	Miscellaneous Perceptions	4	2188	.50

TABLE XLII
FREQUENCY DISTRIBUTION:
ATTITUDES TOWARDS MATHEMATICS
Test 1, Age 13, Year 76
(N = 4969)

Variable	Item	Response Categories	Percent Responding: Test1
MATHTRY	I try hard in mathematics.	Strongly agree	40
		Agree	48
		Undecided	9
		Disagree	2
		Strongly disagree	1
		Non Response	0
CALLMATH	I would like to be called on in math class more often.	Strongly agree	14
		Agree	32
		Undecided	28
		Disagree	19
		Strongly disagree	6
		Non Response	1
MATHWELL	I usually do well in mathematics tests and homework.	Strongly agree	25
		Agree	46
		Undecided	17
		Disagree	9
		Strongly disagree	2
		Non Response	1
MATHSCI	I would like to use mathematics in my science class.	Strongly agree	7
		Agree	18
		Undecided	23
		Disagree	33
		Strongly disagree	19
		Non Response	0
MATHEASE	I feel at ease in mathematics and like it very much.	Strongly agree	22
		Agree	38
		Undecided	21
		Disagree	13
		Strongly disagree	5
		Non Response	1
MATHPRD	I am usually proud of my mathematics homework.	Strongly agree	21
		Agree	42
		Undecided	24
		Disagree	11
		Strongly disagree	3
		Non Response	0
*MATHFEAR	I have a fear of not being able to do mathematics.	Strongly agree	6
		Agree	14
		Undecided	14
		Disagree	35
		Strongly disagree	30
		Non Response	1

(TABLE XLII CONT.)

Variable	Item	Response Categories	Percent Responding: Test 1
*MATHHATE	I have never liked mathematics.	Strongly agree	7
		Agree	8
		Undecided	12
		Disagree	34
		Strongly disagree	39
		Non Response	0
*MATHUPST	I wish I felt less upset in mathematics class.	Strongly agree	11
		Agree	23
		Undecided	20
		Disagree	28
		Strongly disagree	19
		Non Response	0

* The categories of these items are reflected for subsequent analyses.

TABLE XLIII

CORRELATION MATRIX:

FOR MATHEMATICS-ATTITUDE ITEMS

TEST 1, AGE 13, YEAR 76

(N = 4917)

	CALL-MATH	MATH-EASE	MATH-FEAR	MATH-HATE	MATH-PRD	MATH-SCI	MATH-TRY	MATH-UPST	MATH-WELL
CALLMATH	1.00								
MATHEASE	.46	1.00							
MATHFEAR	.15	.33	1.00						
MATHHATE	.32	.55	.38	1.00					
MATHPRD	.35	.50	.25	.34	1.00				
MATHSCI	.28	.34	.14	.27	.27	1.00			
MATHTRY	.26	.36	.13	.27	.34	.19	1.00		
MATHUPST	.12	.29	.39	.26	.21	.06	.09	1.00	
MATHWELL	.30	.48	.34	.34	.53	.23	.31	.27	1.00
ITEM MEANS	2.71	2.41	2.29	2.07	2.33	3.41	1.75	2.79	2.17
STANDARD DEVIATIONS	1.12	1.12	1.20	1.18	1.02	1.18	.76	1.28	.98
ITEM-TO-TOTAL CORRELATIONS	.44	.70	.43	.56	.56	.34	.38	.34	.57

TABLE XLIV

FACTOR MATRIX:*

MATHEMATICS-ATTITUDE ITEMS

Test 1, Age 13, Year 76

(N = 4917)

Variable	Factor 1	Factor 2
CALLMATH	.57	.09
MATHEASE	.72	.35
MATHFEAR	.16	.69
MATHHATE	.49	.40
MATHPRD	.62	.24
MATHSCI	.43	.07
MATHTRY	.48	.09
MATHUPST	.11	.55
MATHWELL	.52	.36
Eigenvalue	2.91	.55
% Variance	84.1	15.9

*Rotated with Kaiser Normalization

TABLE XLV

FACTOR ANALYSIS: MATHEMATICS ATTITUDE ITEMS

TEST 1, Age 13, Year 76, (N = 4917)

Factor	Variable	Loading*	Item
Factor One: "MOTIVATION"	CALLMATH	.57	I would like to be called on in math class more often.
	*MATHEASE	.72	I feel at ease in math class and like it very much.
	*MATHHATE	.49	I have never liked math.
	MTHPRD	.62	I am usually proud of my math homework.
	MATHSCI	.43	I would like to use math in my science class.
	MATHTRY	.48	I try hard in math.
	*MATHWELL	.53	I usually do well in math tests and homework.
	Eigenvalue = 2.91 % variance = 84.1		
Factor Two: "ANXIETY"	*MATHEASE	.35	I feel at ease in math class and like it very much.
	MATHFEAR	.69	I have a fear of not being able to do math.
	*MATHHATE	.40	I have never like math.
	MATHUPST	.55	I wish I felt less upset in math class.
	*MATHWELL	.36	I usually do well on math tests and homework.
	Eigenvalue = .55 % variance = 15.9		

* Loadings > .30 are presented; starred variable loads > .30 on both factors.

TABLE XLVI

SCALE RELIABILITIES:

Test 1, Age 13, Year 76

(N = 4917)

Scale	Description	# of Items	Alpha* Reliability
Composite	Mathematics Attitude Items	9	.79
Factor 1	Motivation	7	.79
Factor 2	Anxiety	5	.74

* Standarized item alpha for composite item sets and for factors.

TABLE XLVII
FREQUENCY DISTRIBUTIONS:
ATTITUDES TOWARD MATHEMATICS
Test 2, Age 13, Year 76
(N = 4958)

Variable	Item	Response Categories	Percent Responding: Test 2
MATHTRY	I try hard in mathematics.	Strongly agree	39
		Agree	49
		Undecided	8
		Disagree	3
		Strongly disagree	1
		Non Response	0
CALLMATH	I would like to be called on in math class more often.	Strongly agree	14
		Agree	29
		Undecided	30
		Disagree	19
		Strongly disagree	8
		Non Response	0
MATHWELL	I usually do well in mathematics tests and homework.	Strongly agree	22
		Agree	46
		Undecided	18
		Disagree	10
		Strongly disagree	3
		Non Response	1
MATHSCI	I would like to use mathematics in my science class.	Strongly agree	7
		Agree	17
		Undecided	24
		Disagree	30
		Strongly disagree	22
		Non Response	0
MATHEASE	I feel at ease in mathmatics and like it very much.	Strongly agree	20
		Agree	35
		Undecided	23
		Disagree	14
		Strongly disagree	7
		Non Response	1
MATHPRD	I am usually proud of my mathematics homework.	Strongly agree	18
		Agree	43
		Undecided	22
		Disagree	13
		Strongly disagree	4
		Non Response	0
*MATHFEAR	I have a fear of not being able to do mathematics.	Strongly agree	6
		Agree	17
		Undecided	15
		Disagree	34
		Strongly disagree	28
		Non Response	0

Variable	Item	Response Categories	Percent Responding: Test 2
*MATHHATE	I have never liked mathematics.	Strongly agree	7
		Agree	9
		Undecided	14
		Disagree	34
		Strongly disagree	36
		Non Response	0
*MATHUPST	I wish I felt less upset in mathematics class.	Strongly agree	9
		Agree	23
		Undecided	22
		Disagree	28
		Strongly disagree	17
		Non Response	1

* The categories of these items are reflected for subsequent analyses.

TABLE XLVIII

CORRELATION MATRIX:

FOR MATHEMATICS-ATTITUDE ITEMS

TEST 2, AGE 13, YEAR 76

(N = 4890)

	CALL-MATH	MATH-EASE	MATH-FEAR	MATH-HATE	MATH-PRD	MATH-SCI	MATH-TRY	MATH-UPST	MATH-WELL
CALLMATH	1.00								
MATHEASE	.43	1.00							
MATHFEAR	.11	.30	1.00						
MATHHATE	.34	.59	.31	1.00					
MATHPRD	.33	.50	.25	.36	1.00				
MATHSCI	.28	.37	.10	.28	.24	1.00			
MATHTRY	.26	.37	.09	.20	.36	.17	1.00		
MATHUPST	.08	.27	.35	.23	.18	.04	.05	1.00	
MATHWELL	.29	.46	.33	.37	.56	.22	.30	.24	1.00
ITEM MEANS	2.77	2.52	2.37	2.16	2.40	3.44	1.78	2.80	2.26
STANDARD DEVIATIONS	1.15	1.17	1.22	1.21	1.04	1.19	.80	1.24	1.01
ITEM-TO-ITEM CORRELATION	.42	.70	.38	.58	.57	.34	.38	.29	.57

TABLE XLIX

FACTOR MATRIX:*

MATHEMATICS-ATTITUDE ITEMS

Test 2, Age 13, Year 76

(N = 4890)

Variable	Factor 1	Factor 2
CALLMATH	.56	.05
MATHEASE	.73	.34
MATHFEAR	.13	.64
MATHHATE	.56	.34
MATHPRD	.61	.27
MATHSCI	.43	.04
MATHTRY	.50	.06
MATHUPST	.08	.53
MATHWELL	.52	.40
Eigenvalue	2.86	.56
% Variance	83.6	16.4

*Varimax Rotated with Kaiser Normalization

TABLE L

FACTOR ANALYSIS: MATHEMATICS ATTITUDE ITEMS

Test 2, Age 13, Year 76, (N = 4890)

FACTOR	Variable	Loading*	Item
Factor One: "MOTIVATION"	CALLMATH	.56	I would like to be called on in math class more often.
	*MATHEASE	.73	I feel at ease in math class and like it very much.
	*MATHHATE	.56	I have never liked math.
	MATHPRD	.61	I am usually proud of my math homework.
	MATHSCI	.43	I would like to use math in my science class.
	MATHTRY	.50	I try hard in math.
	MATHWELL	.52	I usually do well in math tests and homework.
	Eigenvalue = 2.86 % variance = 83.6		
Factor Two: "ANXIETY"	*MATHEASE	.34	I feel at ease in math class and like it very much.
	MATHFEAR	.64	I have a fear of not being able to do math.
	*MATHHATE	.34	I have never liked math.
	MATHUPST	.53	I wish I felt less upset in math class.
	*MATHWELL	.40	I usually do well in math tests and homework.
	Eigenvalue = .56 % variance = 16.4		

* Loadings > .30 are presented, starred variables load > .30 on both factors.

TABLE LI

SCALE RELIABILITIES:

Test 2, Age 13, Year 76

(N = 4890)

Scale	Description	# of Items	Alpha* Reliability
Composite	Mathematics Attitude Items	9	.78
Factor 1	Motivation	7	.79
Factor 2	Anxiety	5	.73

* Standardized item alpha for composite item sets and for factors.

TABLE LII
FREQUENCY DISTRIBUTIONS:
ATTITUDES TOWARD MATHEMATICS
Test 1, Age 17, Year 76
(N = 1709)

Variable	Item	Response Categories	Percent Responding: Test 1
MATHTRY	I try hard in mathematics.	Strongly agree	23
		Agree	47
		Undecided	13
		Disagree	10
		Strongly disagree	1
		Non Response	6
CALLMATH	I would like to be called on in math class more often.	Strongly agree	6
		Agree	21
		Undecided	29
		Disagree	28
		Strongly disagree	10
		Non Response	6
MATHWELL	I usually do well in mathematics tests and homework.	Strongly agree	16
		Agree	43
		Undecided	17
		Disagree	14
		Strongly disagree	4
		Non Response	6
MATHSCI	I would like to use mathematics in my science class.	Strongly agree	7
		Agree	20
		Undecided	26
		Disagree	29
		Strongly disagree	12
		Non Response	6
MATHEASE	I feel at ease in mathematics and like it very much.	Strongly agree	14
		Agree	29
		Undecided	21
		Disagree	21
		Strongly disagree	9
		Non Response	6
MATHPRD	I am usually proud of my mathematics homework.	Strongly agree	11
		Agree	36
		Undecided	25
		Disagree	17
		Strongly disagree	5
		Non Response	6
*MATHFEAR	I have a fear of not being able to do mathematics.	Strongly agree	6
		Agree	19
		Undecided	13
		Disagree	35
		Strongly disagree	21
		Non Response	6

Variable	Item	Response Categories	Percent Responding: Test I
*MATHHATE	I have <u>never liked</u> mathematics.	Strongly agree	10
		Agree	12
		Undecided	10
		Disagree	35
		Strongly disagree	28
		Non Response	6
*MATHUPST	I wish I felt less <u>upset</u> in mathematics class.	Strongly agree	8
		Agree	24
		Undecided	20
		Disagree	27
		Strongly disagree	14
		Non Response	6

* The categories of these items are reflected for subsequent analyses.

TABLE LIII

CORRELATION MATRIX:

FOR MATHEMATICS-ATTITUDE ITEMS

TEST 1, AGE 17, YEAR 76

(N = 1591)

	MATH-TRY	CALL-MATH	MATH-WELL	MATH-SCI	MATH-EASE	MATH-PRD	MATH-FEAR	MATH-HATE	MATH-UPST
MATHTRY	1.00								
CALLMATH	.41	1.00							
MATHWELL	.45	.40	1.00						
MATHSCI	.29	.43	.34	1.00					
MATHEASE	.46	.49	.60	.39	1.00				
MATHPRD	.49	.44	.66	.33	.63	1.00			
MATHFEAR	.17	.19	.43	.20	.45	.37	1.00		
MATHHATE	.39	.40	.48	.34	.64	.46	.46	1.00	
MATHUPST	.12	.14	.36	.17	.44	.34	.49	.39	1.00
ITEM MEAN	2.14	3.18	2.44	3.20	2.82	2.68	2.52	2.37	2.85
STANDARD DEVIATION	.95	1.08	1.06	1.14	1.31	1.22	1.22	1.30	1.22
ITEM-TO-TOTAL CORRELATION	.50	.51	.69	.44	.77	.68	.51	.66	.45

TABLE LIV

FACTOR MATRIX:*

MATHEMATICS-ATTITUDE ITEMS

Test 1, Age 17, Year 76

(N = 1591)

Variable	Factor 1	Factor 2
MATHTRY	.64	.10
CALLMATH	.67	.09
MATHWELL	.60	.45
MATHSCI	.49	.15
MATHEASE	.65	.53
MATHPRD	.47	.38
MATHFEAR	.17	.69
MATHHATE	.51	.50
MATHUPST	.17	.68
Eigenvalue	3.77	.68
% Variance	84.8	15.2

*Varimax rotated with Kaiser Normalization.

TABLE LV

FACTOR ANALYSIS: MATHEMATICS ATTITUDE ITEMS

Test 1, Age 17, Year 76, (N = 1591)

Factor	Variable	Loading*	Item
Factor One: "MOTIVATION"	MATHTRY	.64	I try hard in mathematics.
	CALLMATH	.67	I would like to be called on in math class more often.
	*MATHWELL	.60	I usually do well in math tests and homework.
	MATHSCI	.49	I would like to use math in my science class.
	*MATHEASE	.65	I feel at ease in math class and like it very much.
	*MATHPRD	.65	I am usually proud of my math homework.
	*MATHHATE	.51	I have never liked math.
	Eigenvalue = 3.77 % variance = 84.8		
Factor Two: "ANXIETY"	*MATHWELL	.45	I usually do well in math tests and homework.
	*MATHEASE	.53	I feel at ease in math class and like it very much.
	*MATHPRD	.38	I am usually proud of my math homework.
	MATHFEAR	.69	I have a fear of not being able to do math.
	*MATHHATE	.50	I have never liked math.
	MATHUPST	.68	I wish I felt less upset in math class.
	Eigenvalue = .68 % variance = 15.2		

* Loadings over .30 were included. Starred variables indicate item loads > .30 on more than one factor.

TABLE LVI

SCALE RELIABILITIES:

Test 1, Age 17, Year 76

(N = '591)

Scale	Description	# of Items	Alpha * Reliability
Composite	Mathematics Attitude Items	9	.85
Factor 1	Motivation	7	.85
Factor 2	Anxiety	6	.85

* Standardized item alpha for composite item sets and for factors.

TABLE LVII
FREQUENCY DISTRIBUTIONS:
IMPORTANCE OF VALUES-IN-LIFE* ITEMS
Test 1, Age 17, Year 76
(N = 1709)

Variable	Item	Response Categories	Percent Responding: Test 1
SUCCESS-FUL	Being successful in my line of work.	Not important	1
		Somewhat important	11
		Very important	50
		Non Response	38
MARRY	Finding the right person to marry and having a happy life.	Not important	3
		Somewhat important	9
		Very important	49
		Non Response	39
MONEY	Having lots of money.	Not important	13
		Somewhat important	38
		Very important	10
		Non Response	39
FRIENDSHIPS	Having strong friendships.	Not important	1
		Somewhat important	10
		Very important	50
		Non Response	39
STEADY WORK	Being able to find steady work	Not important	2
		Somewhat important	10
		Very Important	48
		Non Response	40
LEADER	Being a leader in my community	Not important	26
		Somewhat important	27
		Very Important	6
		Non Response	41
CHILDREN	Being able to give my children better opportunites than I have had	Not important	3
		Somewhat important	16
		Very important	40
		Non Response	41
PARENTS	Living close to parents and relatives	Not important	20
		Somewhat important	29
		Very important	10
		Non Response	41
GETTING AWAY	Getting away from this area of the country	Not important	35
		Somewhat important	17
		Very important	6
		Non Response	42
INEQUALITIES	Working to correct social and economic inequalities.	Not important	16
		Somewhat importnat	31
		Very important	11
		Non Response	42

*Responses to the stem-question "How important is each of the following to you in your life".

TABLE LVIII

CORRELATION MATRIX:

VALUES-IN-LIFE ITEMS,

TEST 1, AGE 17, YEAR 76

(N = 957)

	SUCCESSFUL	MARRY	MONEY	FRIENDSHIP	STEADY WORK	LEADER	CHILDREN	PARENTS	GETTING AWAY	INEQUALITIES
SUCCESSFUL	1.00									
MARRY	.11	1.00								
MONEY	.17	-.03	1.00							
FRIENDSHIPS	.14	.08	.03	1.00						
STEADY WORK	.38	.13	.22	.21	1.00					
LEADER	.18	.03	.24	.17	.13	1.00				
CHILDREN	.13	.24	.09	.09	.23	.15	1.00			
PARENTS	.08	.06	.11	.01	.09	.16	.13	1.00		
GETTING AWAY	.06	.08	-.09	.08	.06	.01	-.03	.11	1.00	
INEQUALITIES	.13	.01	.02	.15	.10	.27	.18	.19	.11	1.00
ITEM MEAN	2.79	2.77	1.95	2.80	2.77	1.65	2.64	1.82	2.50	1.92
STANDARD DEVIATION	.43	.51	.61	.44	.49	.65	.57	.69	.68	.68
ITEM-TO-TOTAL CORRELATION	.33	.16	.17	.23	.36	.34	.29	.24	.03	.23

TABLE LIX

FACTOR MATRIX:*

VALUES-IN-LIFE ITEMS

Test 1, Age 17, Year 76

(N = 957)

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
SUCCESSFUL	.49	.21	.13	.09	-.04
MARRY	.11	-	-.05	.39	-.10
MONEY	.16	.08	.69	-.01	.06
FRIENDSHIPS	.30	.18	-.03	.05	-.07
STEADY WORK	.78	.01	.16	.21	-.01
LEADER	.16	.43	.26	.04	-.04
CHILDREN	.13	.18	.08	.61	.08
PARENTS	.02	.29	.13	.14	-.16
GETTING AWAY	-.09	.02	.07	-.03	.65
INEQUALITIES	.15	.68	-.10	.05	.17
Eigenvalue	1.50	.64	.57	.41	.32
% Variance	43.6	19.5	16.5	12.0	9.3

Varimax rotated with Kaiser Normalization.

TABLE LX

FACTOR ANALYSIS: IMPORTANCE OF VALUES IN LIFE ITEMS

Test 1, Age 17, Year 76, (N = 957)

Factor	Loading*	Item
Factor One: "WORK VALUES"	.48	Importance: Being successful in my line of work.
	.30	Importance: Having strong friendships.
	.68	Importance: Being able to find steady work.
Eigenvalue = 1.50 % variance = 43.6		

* Only loadings > .30 were included on a factor.

TABLE LXI

SCALE RELIABILITIES:

Test 1, Age 17, Year 76

(N = 957)

Scale	Description	# of Items	Alpha * Relability
Composite	Important Life-Values	10	.55
Factor One	Work-Values	3	.50

* Standardized item alpha for composite item sets and for factors.

TABLE LXII

FREQUENCY DISTRIBUTIONS: ATTITUDES TOWARD SELF

Test 1, Age 17, Year 76

(N = 1709)

Variable	Item	Response Categories	Percent Responding: Test 1
POSITIVE	I take a positive attitude toward myself.	Strongly agree	28
		Agree	41
		Disagree	5
		Strongly disagree	1
		Non Response	25
GOOD LUCK	Good luck is more important than hard work for success.	Strongly agree	3
		Agree	8
		Disagree	38
		Strongly disagree	26
		Non Response	25
EQUAL PLANE	I feel I am a person of worth, on an equal plane with others.	Strongly agree	27
		Agree	42
		Disagree	4
		Strongly disagree	1
		Non Response	26
ABLE	I am able to do things as well as most other people.	Strongly agree	25
		Agree	45
		Disagree	5
		Strongly disagree	
		Non Response	25
STOPS ME	Every time I try to get ahead, something or somebody stops me.	Strongly agree	5
		Agree	13
		Disagree	42
		Strongly disagree	12
		Non Response	28
PLANNING	Planning only makes a person unhappy since plans hardly ever work out anyway.	Strongly agree	5
		Agree	12
		Disagree	34
		Strongly disagree	21
		Non Response	28
ACCEPT	People who accept their condition in life are happier than those who try to change things.	Strongly agree	10
		Agree	18
		Disagree	26
		Strongly disagree	13
		Non Response	33
SATISFIED	On the whole, I am satisfied with myself.	Strongly agree	21
		Agree	39
		Disagree	10
		Strongly disagree	2
		Non Response	25

TABLE LXIII

CORRELATION MATRIX:

ATTITUDES-TOWARD-SELF ITEMS

TEST 1, AGE 17, YEAR 76

(N = 878)

	POSITIVE	GOOD LUCK	EQUAL PLANE	ABLE	STOPS ME	PLANNING	ACCEPT	SATISIFIED
POSITIVE	1.00							
GOOD LUCK	-.07	1.00						
EQUAL PLANE	.58	-.13	1.00					
ABLE	.40	-.01	.54	1.00				
STOPS ME	-.23	.33	-.23	-.08	1.00			
PLANNING	-.13	.37	-.16	-.03	.39	1.00		
ACCEPT	.03	.23	.01	.04	.19	.29	1.00	
SATISFIED	.43	-.02	.39	.33	-.19	-.04	.18	1.00
ITEM MEAN	1.68	3.19	1.68	1.71	2.80	3.06	2.63	1.87
STANDARD DEVIATION	.62	.77	.60	.60	.76	.84	.98	.71
ITEM-TO-TOTAL CORRELATION	.22	.26	.21	.29	.12	.25	.31	.26

TABLE LXIV

FACTOR MATRIX:*

ATTITUDES-TOWARDS-SELF ITEMS

Test 1, Age 17, Year 76

(N = 878)

Variable	Factor 1	Factor 2
POSITIVE	.71	-.11
GOOD LUCK	-.04	.56
EQUAL PLANE	.79	-.15
ABLE	.62	.03
STOPS ME	-.22	.55
PLANNING	-.08	.67
ACCEPT	.12	.43
SATISFIED	.56	.02
Eigenvalue	2.03	1.15
% Variance	63.8	36.2

*Varimax rotated with Kaiser Normalization.

TABLE LXV

FACTOR ANALYSIS: ATTITUDES TOWARD SELF ITEMS

Test 1, Age 17, Year 76; (N = 878)

Factor	Loading*	Item
Factor One: "SELF ESTEEM"	.71	I take a positive attitude towards myself.
	.79	I feel I am a person of worth, on an equal plane with others.
	.62	I am able to do things as well as most other people.
	.56	On the whole, I'm satisfied with myself.
	Eigenvalue = 2.03 % variance = 63.8	
Factor Two: "FATE CONTROL"	.56	Good luck is more important than hard work for success.
	.55	Everytime I try to get ahead something or somebody stops me.
	.67	Planning only makes a person unhappy since plans hardly ever work out anyway.
	.43	People who accept their condition in life are happier than those who try to change things.
	Eigenvalue = 1.15 % variance = 36.2	

* Loadings over .30 were included on factors.

TABLE LXII

SCALE RELIABILITIES:

Test 1, Age 17, Year 76

(N = 878)

Scale	Description	# of Items	Alpha* Reliability
Composite	Attitudes toward Self items	8	.53
Factor One	Self-Esteem	4	.76
Factor Two	Fate-Control	4	.62

* Standardized item alpha for composite item sets and for factors.

TABLE LXVII
FREQUENCY DISTRIBUTIONS:
ATTITUDES TOWARDS SCHOOL ITEMS
Test 1, Age 17, Year 76
(N = 1709)

Variable	Item	Response Categories	Percent Responding: Test 1
BASIC	School should have placed more emphasis on basic academic subjects (math, sci, english, etc.)	Agree Strongly	11
		Agree somewhat	31
		Disagree somewhat	21
		Disagree strongly	6
		Non Response	31
TROUBLE	School should have provided more help for students who were having trouble with subjects like math and reading.	Agree strongly	29
		Agree somewhat	32
		Disagree somewhat	6
		Disagree strongly	1
		Non Response	32
WASTE	Most required courses here are a waste of time.	Agree strongly	11
		Agree somewhat	17
		Disagree somewhat	27
		Disagree strongly	15
		Non Response	30
VOCATIONAL	School should have placed more emphasis on vocational and technical programs.	Agree strongly	16
		Agree somewhat	29
		Disagree somewhat	15
		Disagree strongly	4
		Non Response	36
EXPERIENCE	School did not offer enough practical work experience.	Agree strongly	16
		Agree somewhat	26
		Disagree somewhat	17
		Disagree strongly	4
		Non Response	37
CONTINUE	School provided me with counseling that will help me continue my education.	Agree strongly	12
		Agree somewhat	29
		Disagree somewhat	14
		Disagree strongly	10
		Non Response	35
NEW IDEAS	School gave me new ideas about the type of work I want to do.	Agree strongly	14
		Agree somewhat	27
		Disagree somewhat	14
		Disagree strongly	9
		Non Response	36
RELATIONS	School provided me with counseling that helped me get a better idea of myself and my relations with other people.	Agree strongly	9
		Agree somewhat	25
		Disagree somewhat	17
		Disagree strongly	11
		Non Response	38

(TABLE LXVII CONT.)

Variable	Item	Response Categories	Percent Responsing: Test 1
EMPLOYMENT	School provided me with counseling that will help me find employment.	Agree strongly	7
		Agree somewhat	20
		Disagree somewhat	19
		Disagree strongly	13
		Non Response	41
FIND JOBS	School should help students find jobs when they leave school.	Agree strongly	18
		Agree somewhat	27
		Disagree somewhat	13
		Disagree strongly	5
		Non Response	37
TELEVISION	School should have used more television lectures.	Agree strongly	5
		Agree somewhat	19
		Disagree somewhat	21
		Disagree strongly	11
		Non Response	44
MACHINES	School should have used teaching machines or computer-assisted instruction more extensively.	Agree strongly	8
		Agree somewhat	22
		Disagree somewhat	18
		Disagree strongly	10
		Non Response	42

TABLE LXVIII

CORRELATION MATRIX:

ATTITUDES-TOWARDS-SCHOOL ITEMS

TEST 1, AGE 17, YEAR 76

(N = 662)

	BASIC	TROUBLE	WASTE	VOCA-TIONAL	EXPERIENCE	CONTINUE	NEW IDEAS	RELATIONS	EMPLOY-MENT	FIND JOBS	TELE-VISION	MACHINES
BASIC	1.00											
TROUBLE	.35	1.00										
WASTE	.09	-.13	1.00									
VOCATIONAL	.02	.19	-.28	1.00								
EXPERIENCE	.03	-.12	.30	-.35	1.00							
CONTINUE	.05	.00	.26	-.01	.17	1.00						
NEW IDEAS	.08	-.05	.26	.04	.13	.54	1.00					
RELATIONS	.09	-.01	.24	-.00	.12	.58	.57	1.00				
EMPLOYMENT	.10	-.03	.21	-.10	.16	.51	.53	.61	1.00			
FIND JOBS	.10	.17	-.15	.22	-.17	-.01	.10	.06	.12	1.00		
TELEVISION	.03	.08	-.11	.15	-.09	.03	.05	.06	-.12	.14	1.00	
MACHINES	.05	.07	-.03	.15	-.06	.06	.09	.07	.04	.11	.47	1.00
ITEM MEANS	2.30	1.69	2.36	2.07	2.91	2.34	2.26	2.50	2.61	2.06	2.63	2.50
STANDARD DEVIATION	.82	.72	.96	.83	.83	.94	.96	.92	.92	.90	.88	.93
ITEM-TO-TOTAL CORRELATION	.20	.09	.15	.02	.05	.50	.54	.55	.51	.13	.16	.21

TABLE LXIX

FACTOR MATRIX:*

ATTITUDES-TOWARDS-SCHOOL ITEMS

Test 1, Age 17, Year 76

(N = 622)

Variable	Factor 1	Factor 2	Factor 3	Factor 4
BASIC	.08	-.05	.03	.68
TROUBLE	-.03	.23	.03	.53
WASTE	-.29	.49	.04	-.03
VOCATIONAL	.04	.62	.11	.08
EXPERIENCE	-.16	.54	.03	-.01
CONTINUE	.71	-.10	.04	.01
NEW IDEAS	.73	-.03	.07	.01
RELATIONS	.79	-.04	.05	.03
EMPLOYMENT	.74	-.04	-.01	.05
FIND JOBS	.10	.33	.11	.15
TELEVISION	.02	.14	.67	.03
MACHINES	.06	.08	.67	.04
Eigenvalue	2.44	1.39	.72	.62
% Variance	47.2	26.8	13.9	12.0

*Varimax rotated with Kaiser Normalization.

TABLE LXX

FACTOR ANALYSIS: ATTITUDES TOWARD SCHOOL ITEMS

Test 1, Age 17, Year 76, (N = 662)

Factor	Loading*	Item
Factor One: "COUNSELING"	.71	School provided me with counseling that will help me continue my ed··cation.
	.73	School gave me new ideas about the type of work I want to do.
	.79	School provided me with counseling that helped me get a better idea of myself and my relations with other people.
	.74	School provided me with counseling that will help me find employment.
	Eigenvalue = 2.44 % variance = 47.2	
Factor Two: "DISSATISFACTION"	.49	Most required courses here are are a waste of time.
	.61	Schools should have placed more emphasis on vocational and technical programs.
	.54	School did not offer enough practical work experience.
	.33	School should help students find jobs when they leave school.
	Eigenvalue = 1.39 % variance = 26.8	

* Loading > .30 were included on factors.

TABLE LXXI

SCALE RELIABILITIES:

Test 1, Age 17, Year 76

(N = 662)

Scale	Description	# of Items	Alpha * Reliability
Composite	Attitudes towards school items	12	.59
Factor One	Counseling	4	.83
Factor Two	Dissatisfaction	4	.56

* Standardized item alpha for composite item sets and for factors.

TABLE LXXII
FREQUENCY DISTRIBUTION:
ATTITUDES TOWARD MATHEMATICS
Test 2, Age 17, Year 76
(N = 1704)

Variable	Item	Response Categories	Percent Responding: Test 2
MATHTRY	I try hard in mathematics.	Strongly agree	24
		Agree	45
		Undecided	13
		Disagree	10
		Strongly disagree	2
		Non Response	6
CALLMATH	I would like to be called on in math class more often.	Strongly agree	4
		Agree	19
		Undecided	30
		Disagree	28
		Strongly disagree	13
		Non Response	6
MATHWELL	I usually do well in mathematics tests and homework.	Strongly agree	15
		Agree	40
		Undecided	18
		Disagree	16
		Strongly disagree	5
		Non Response	6
MATHSCI	I would like to use mathematics in my science class.	Strongly agree	7
		Agree	19
		Undecided	28
		Disagree	26
		Strongly disagree	15
		Non Response	5
MATHEASE	I feel at ease in mathematics and like it very much.	Strongly agree	12
		Agree	30
		Undecided	22
		Disagree	19
		Strongly disagree	11
		Non Response	6
MATHPRD	I am usually proud of my mathematics homework.	Strongly agree	10
		Agree	35
		Undecided	25
		Disagree	19
		Strongly disagree	5
		Non Response	6
*MATHFEAR	I have a fear of not being able to do mathematics.	Strongly agree	6
		Agree	17
		Undecided	14
		Disagree	33
		Strongly disagree	24
		Non Response	6

(TABLE LXXII CONT.)

Variable	Item	Response Categories	Percent Responding: Test 2
*MATHHATE	I have never liked mathematics.	Strongly agree	11
		Agree	12
		Undecided	11
		Disagree	31
		Strongly disagree	29
		Non Response	6
*MATHUPST	I wish I felt less upset in mathematics class.	Strongly agree	9
		Agree	20
		Undecided	23
		Disagree	27
		Strongly disagree	14
		Non Response	7

* The categories of these items are reflected for subsequent analyses.

TABLE LXXIII

CORRELATION MATRIX

FOR MATHEMATICS-ATTITUDES ITEMS

TEST 2, AGE 17, YEAR 76

(N = 1587)

	MATH-TRY	MATH-CALL	MATH-WELL	MATH-SCI	MATH-EASE	MATH-PRD	MATH-FEAR	MATH-HATE	MATH-UPST
MATHTRY	1.00								
CALLMATH	.39	1.00							
MATHWELL	.45	.36	1.00						
MATHSCI	.28	.33	.29	1.00					
MATHEASE	.49	.47	.58	.39	1.00				
MATHPRD	.50	.40	.65	.30	.60	1.00			
MATHFEAR	.20	.17	.41	.23	.42	.36	1.00		
MATHHATE	.44	.38	.47	.40	.64	.44	.43	1.00	
MATHUPST	.13	.14	.41	.17	.41	.38	.47	.29	1.00
ITEM MEAN	2.14	3.27	2.53	3.24	2.86	2.73	2.44	2.40	2.81
STANDARD DEVIATION	.98	1.07	1.12	1.16	1.22	1.08	1.22	1.34	1.21
ITEM-TO-TOTAL CORRELATION	.52	.47	.68	.43	.76	.68	.50	.65	.44

TABLE LXXIV

FACTOR MATRIX:*

Test 2, Age 17, Year 76

(N = 1587)

Variable	Factor 1	Factor 2
MATHTRY	.66	.11
CALLMATH	.60	.08
MATHWELL	.56	.48
MATHSCI	.45	.17
MATHEASE	.71	.44
MATHPRD	.62	.42
MATHFEAR	.23	.62
MATHHATE	.61	.36
MATHUPST	.11	.72
Eigenvalue	3.69	.61
% Variance	85.9	14.1

*Varimax rotated with Kaiser Normalization.

TABLE LXXV

FACTOR ANALYSIS: MATHEMATICS ATTITUDE ITEMS

Test 2, Age 17, Year 76, (N = 1587)

Factor	Variable	Loading*	Item
Factor One: "MOTIVATION"	MATHTRY	.66	I try hard in math.
	CALLMATH	.60	I would like to be called on in math class more often.
	*MATHWELL	.56	I usually do well in math tests and homework.
	MATHSCI	.45	I would like to use math in my science class.
	*MATHEASE	.71	I feel at ease in math class and like it very much.
	*MATHPRD	.62	I am usually proud of my math homework.
	*MATHHATE	.61	I have never liked math.
	Eigenvalue = 3.69 % variance = 85.9		
Factor Two: "ANXIETY"	*MATHWELL	.48	I usually do well in math tests and homework.
	*MATHEASE	.44	I feel at ease in math class and like it very much.
	*MATHPRD	.42	I am usually proud of my math homework.
	MATHFEAR	.62	I have a fear of not being able to do math.
	*MATHHATE	.36	I have never liked math.
	MATHUPST	.72	I wish I felt less upset in math class
	Eigenvalue = .61 % variance = 14.1		

* Loadings > .30 are included in a factor.

TABLE LXXXI

SCALE RELIABILITIES:

Test 2, Age 17, Year 76

(N = 1587)

Scale	Description	# of Items	Alpha* Reliability
Composite	Mathematics Attitude Items	9	.85
Factor 1	Motivation	7	.85
Factor 2	Anxiety	6	.83

* Standardized item alpha for composite item sets and for factors

TABLE LXXVII
FREQUENCY DISTRIBUTIONS:
IMPORTANCE OF VALUES-IN-LIFE* ITEMS
Test 2, Age 17, Year 76
(N = 1709)

Variable	Item	Response Categories	Percent Responding: Test 2
SUCCESSFUL	Being successful in my line of work.	Not important	1
		Somewhat important	12
		Very important	50
		Non Response	37
MARRY	Finding the right person to marry and having a happy life.	Not important	2
		Somewhat important	10
		Very important	50
		Non Response	38
MONEY	Having lots of money.	Not important	11
		Somewhat important	38
		Very important	13
		Non Response	38
FRIENDSHIPS	Having strong friendships.	Not important	2
		Somewhat important	11
		Very important	49
		Non Response	38
STEADY WORK	Being able to find steady work	Not important	1
		Somewhat important	11
		Very Important	49
		Non Response	39
LEADER	Being a leader in my community	Not important	27
		Somewhat important	27
		Very Important	6
		Non Response	40
CHILDREN	Being able to give my children better opportunites than I have had	Not important	3
		Somewhat important	16
		Very important	41
		Non Response	45
PARENTS	Living close to parents and relatives	Not important	21
		Somewhat important	29
		Very important	9
		Non Response	41
GETTING AWAY	Getting away from this area of the country	Not important	35
		Somewhat important	16
		Very important	8
		Non Response	41
INEQUALITIES	Working to correct social and economic inequalities.	Not important	14
		Somewhat importnat	31
		Very important	13
		Non Response	42

*Responses to the stem-question "How important is each of the following to you in your life".

TABLE LXXVIII

CORRELATION MATRIX:

VALUES-IN-LIFE ITEMS

TEST 2, AGE 17, YEAR 76

(N = 971)

	SUCCESSFUL	MARRY	MONEY	FRIENDSHIPS	STEADY WORK	LEADER	CHILDREN	PARENTS	GETTING AWAY	IN-EQUALITIES
SUCCESSFUL	1.00									
MARRY	.16	1.00								
MONEY	.11	.05	1.00							
FRIENDSHIPS	.25	.22	.17	1.00						
STEADY WORK	.36	.25	.22	.30	1.00					
LEADER	.16	.09	.18	.17	.09	1.00				
CHILDREN	.15	.31	.14	.18	.30	.20	1.00			
PARENTS	.06	.11	.06	.14	.10	.23	.19	1.00		
GETTING AWAY	-.10	-.02	.11	.04	.08	.05	.08	-.14	1.00	
INEQUALITIES	.18	.12	.03	.15	.11	.31	.20	.15	.17	1.00
ITEM MEAN	2.77	2.77	2.03	2.77	2.79	1.67	2.63	1.81	1.53	1.98
STANDARD DEVIATION	.46	.49	.62	.47	.44	.66	.58	.69	.72	.68
ITEM-TO-TOTAL CORRELATION	.27	.27	.24	.36	.39	.36	.40	.20	.07	.34

TABLE LXXIX

FACTOR MATRIX:*

VALUES-IN-LIFE ITEMS

Test 2, Age 17, Year 76

(N = 971)

Variable	Factor 1	Factor 2	Factor 3	Factor 4
SUCCESSFUL	.52	.13	-.13	.08
MARRY	.19	.06	-.04	.47
MONEY	.28	.13	.12	.05
FRIENDSHIPS	.40	.16	.01	.20
STEADY WORK	.65	-.02	.07	.30
LEADER	.15	.69	.02	.04
CHILDREN	.18	.22	.08	.55
PARENTS	.05	.32	-.17	.21
GETTING AWAY	.02	.05	.82	.01
INEQUALITIES	.13	.41	.15	.14
Eigenvalue	1.76	.77	.57	.31
% Variance	51.6	22.6	16.7	9.0

*Varimax rotated with Kaiser Normalization.

TABLE LXXX

FACTOR ANALYSIS: IMPORTANCE OF VALUES IN LIFE ITEMS

Test 2, Age 17, Year 76, (N = 971)

Factor	Loading	Item
Factor One: "WORK VALUES"	.52	Importance: Being successful in my line of work.
	.40	Importance: Having strong friendships.
	.65	Importance: Being able to find steady work.
Eigenvalue = 1.76 % variance = 51.6		

* Only loadings over .30 were included on a factor.

TABLE LXXXI

SCALE RELIABILITIES:

Test 2, Age 17, Year 76

(N = 971)

Scale	Description	# of Items	Alpha* Reliability
Composite	Important Life-Values	10	.60
Factor One	Work-Values	3	.57

* Standardized item alpha for composite item sets and for factors.

TABLE LXXXII
FREQUENCY DISTRIBUTIONS: ATTITUDES TOWARD SELF
Test 2, Age 17, Year 76
(N = 1704)

Variable	Item	Response Categories	Percent Responding: Test 2
POSITIVE	I take a positive attitude toward myself.	Strongly agree	25
		Agree	44
		Disagree	6
		Strongly disagree	1
		Non Response	24
GOOD LUCK	Good luck is more important than hard work for success.	Strongly agree	2
		Agree	8
		Disagree	40
		Strongly disagree	25
		Non Response	25
EQUAL PLANE	I feel I am a person of worth, on an equal plane with others.	Strongly agree	26
		Agree	43
		Disagree	5
		Strongly disagree	1
		Non Response	25
ABLE	I am able to do things as well as most other people.	Strongly agree	26
		Agree	45
		Disagree	5
		Strongly disagree	1
		Non Response	23
STOPS ME	Every time I try to get ahead, something or somebody stops me.	Strongly agree	5
		Agree	13
		Disagree	41
		Strongly disagree	11
		Non Response	30
PLANNING	Planning only makes a person unhappy since plans hardly ever work out anyway.	Strongly agree	5
		Agree	11
		Disagree	36
		Strongly disagree	20
		Non Response	28
ACCEPT	People who accept their condition in life are happier than those who try to change things.	Strongly agree	11
		Agree	19
		Disagree	26
		Strongly disagree	13
		Non Response	31
SATISFIED	On the whole, I am satisfied with myself.	Strongly agree	20
		Agree	41
		Disagree	7
		Strongly disagree	2
		Non Response	30

TABLE LXXXIII

CORRELATION MATRIX:

ATTITUDES-TOWARDS-SELF ITEMS

TEST 2, AGE 17, YEAR 76

(N = 848)

	POSITIVE	GOOD LUCK	EQUAL PLANE	ABLE	STOPS ME	PLANNING	ACCEPT	SATISFIED
POSITIVE	1.00							
GOOD LUCK	.01	1.00						
EQUAL PLANE	.48	.00	1.00					
ABLE	.43	-.07	.53	1.00				
STOPS ME	-.27	.30	-.16	-.20	1.00			
PLANNING	-.14	.39	-.10	-.12	.50	1.00		
ACCEPT	-.02	.31	-.04	-.04	.23	.26	1.00	
SATISFIED	.51	.05	.46	.38	-.21	-.13	.12	1.00
ITEM MEAN	1.74	3.13	1.70	1.75	2.84	3.02	2.63	1.86
STANDARD DEVIATION	.60	.72	.62	.62	.77	.84	.97	.69
ITEM-TO-TOTAL CORRELATION	.22	.34	.27	.19	.13	.24	.27	.28

TABLE LXXXIV

FACTOR MATRIX:*

ATTITUDES-TOWARDS-SELF ITEMS

Test 2, Age 17, Year 76

(N = 848)

Variable	Factor 1	Factor 2
POSITIVE	.70	-.09
GOOD LUCK	.04	.58
EQUAL PLANE	.71	-.03
ABLE	.63	-.09
STOPS ME	-.27	.60
PLANNING	-.14	.70
ACCEPT	.05	.44
SATISFIED	.68	.01
Eigenvalue	2.11	1.22
% Variance	63.4	36.6

*Varimax rotated with Kaiser Normalization.

TABLE LXXXV

FACTOR ANALYSIS: ATTITUDES TOWARD SELF ITEMS

Test 2, Age 17, Year 76, (N = 848)

Factor	Loading*	Item
Factor One: "SELF ESTEEM"	.70	I take a positive attitude toward myself.
	.71	I feel I am a person of worth, on an equal plane with others.
	.63	I am able to do things as well as most other people.
	.56	On the whole, I'm satisfied with myself.
	Eigenvalue = 2.11 % variance = 63.4	
Factor Two: "FATE CONTROL"	.58	Good luck is more important that hard work for success.
	.60	Every time I try to get ahead something or somebody stops me.
	.70	Planning only makes a person unhappy since plans hardly ever work out anyway.
	.44	People who accept their condition in life are happier than those who try to change things.
	Eigenvalue = 1.22 % variance = 36.6	

* Loadings over .30 were included.

TABLE LXXXVI

SCALE RELIABILITIES:

Test 2, Age 17, Year 76

(N = 848)

Scale	Description	# of Items	Alpha Reliability *
Composite	Attitudes toward Self items	8	.53
Factor One	Self-Esteem	4	.77
Factor Two	Fate-Control	4	.65

* Standardized item alpha for composite item sets and for factors.

TABLE LXXXVII
FREQUENCY DISTRIBUTIONS:
ATTITUDES TOWARDS SCHOOL ITEMS
Test 2, Age 17, Year 76
(N = 1704)

Variable	Item	Response Categories	Percent Responding: Test 2
BASIC	School should have placed more emphasis on basic academic subjects (math, sci., english, etc.)	Agree Strongly	11
		Agree somewhat	31
		Disagree somewhat	23
		Disagree strongly	5
		Non Response	30
TROUBLE	School should have provided more help for students who were having trouble with subjects like math and reading.	Agree strongly	29
		Agree somewhat	32
		Disagree somewhat	7
		Disagree strongly	2
		Non Response	30
WASTE	Most required courses here are a waste of time.	Agree strongly	11
		Agree somewhat	19
		Disagree somewhat	25
		Disagree strongly	14
		Non Response	31
VOCATIONAL	School should have placed more emphasis on vocational and technical programs.	Agree strongly	15
		Agree somewhat	26
		Disagree somewhat	18
		Disagree strongly	5
		Non Response	36
EXPERIENCE	School did not offer enough practical work experience.	Agree strongly	13
		Agree somewhat	26
		Disagree somewhat	17
		Disagree strongly	5
		Non Response	39
CONTINUE	School provided me with counseling that will help me continue my education.	Agree strongly	14
		Agree somewhat	26
		Disagree somewhat	15
		Disagree strongly	10
		Non Response	35
NEW IDEAS	School gave me new ideas about the type of work I want to do.	Agree strongly	16
		Agree somewhat	27
		Disagree somewhat	14
		Disagree strongly	8
		Non Response	35
RELATIONS	School provided me with counseling that helped me get a better idea of myself and my relations with other people.	Agree strongly	10
		Agree somewhat	23
		Disagree somewhat	17
		Disagree strongly	11
		Non Response	39

(TABLE LXXXVII CONT.)

Variable	Item	Response Categories	Percent Responding: Test 2
EMPLOYMENT	School provided me with counseling that will help me find employment.	Agree strongly	9
		Agree somewhat	18
		Disagree somewhat	20
		Disagree strongly	13
		Non Response	40
FIND JOBS	School should help students find jobs when they leave school.	Agree strongly	17
		Agree somewhat	26
		Disagree somewhat	15
		Disagree strongly	5
		Non Response	37
TELEVISION	School should have used more television lectures.	Agree strongly	6
		Agree somewhat	18
		Disagree somewhat	20
		Disagree strongly	10
		Non Response	46
MACHINES	School should have used teaching machines or computer-assisted instruction more extensively.	Agree strongly	8
		Agree somewhat	20
		Disagree somewhat	17
		Disagree strongly	10
		Non Response	45

TABLE LXXXVIII

CORRELATION MATRIX:

ATTITUDES-TOWARDS-SCHOOL ITEMS

TEST 2, AGE 17, YEAR 76

(N = 633)

	BASIC	TROUBLE	WASTE	VOCATIONAL	EXPERIENCE	CONTINUE	NEW IDEAS	RELATIONS	EMPLOYMENT	FIND JOBS	TELEVISION	MACHINES
BASIC	1.00											
TROUBLE	.40	1.00										
WASTE	-.02	.03	1.00									
VOCATIONAL	.01	.10	.24	1.00								
EXPERIENCE	.07	.07	.19	.40	1.00							
CONTINUE	.13	.05	-.11	.04	-.02	1.00						
NEW IDEAS	.06	.07	-.15	.05	-.06	.48	1.00					
RELATIONS	.11	.05	-.08	.07	-.02	.59	.57	1.00				
EMPLOYMENT	.09	.02	-.04	.13	-.04	.48	.50	.59	1.00			
FIND JOBS	.02	.13	.06	.21	.16	.07	.13	.19	.15	1.00		
TELEVISION	.11	.04	.04	.18	.15	.05	.01	.15	.12	.18	1.00	
MACHINES	.13	.08	-.05	.11	.14	.07	-.02	.10	-.01	.17	.51	1.00
ITEM MEANS	2.36	1.73	2.57	2.22	2.21	2.34	2.22	2.44	2.59	2.06	2.63	2.53
STANDARD DEVIATION	.81	.72	.98	.88	.83	.96	.94	.96	.95	.87	.89	.93
ITEM-TO-TOTAL CORRELATIONS	.20	.19	.01	.30	.20	.39	.35	.50	.43	.29	.31	.23

TABLE LXXXIX

FACTOR MATRIX:*

ATTITUDES-TOWARDS-SCHOOL ITEMS

Test 2, Age 17, Year 76

(N = 633)

Variable	Factor 1	Factor 2	Factor 3	Factor 4
BASIC	.08	.10	-.01	.60
TROUBLE	.03	.01	.10	.66
WASTE	-.12	-.15	.36	-.01
VOCATIONAL	.11	.10	.72	.02
EXPERIENCE	-.05	.14	.52	.07
CONTINUING	.68	.05	-.06	.08
NEW IDEAS	.70	-.03	-.05	.05
RELATIONS	.83	.13	-.01	.04
EMPLOYMENT	.72	.02	.96	.01
FIND JOBS	.17	.19	.26	.07
TELEVISION	.08	.63	.15	.04
MACHINES	-.01	.80	.03	.10
Eigenvalue	2.32	1.39	.79	.73
% Variance	44.4	26.6	15.1	13.9

*Varimax rotated with Kaiser Normalization.

TABLE XC

FACTOR ANALYSIS: ATTITUDES TOWARD SCHOOL ITEMS

Test 2, Age 17, Year 76, (N = 633)

Factor	Variable	Item
Factor One: "COUNSELING"	.68	School provided me with counseling that will help me continue my education.
	.70	School gave me new ideas about the type of work I want to do.
	.83	School provided me with counseling that helped me get a better idea of myself and my relations with other people.
	.72	School provided me with counseling that will help me find employment.
	Eigenvalue = 2.32 % variance = 44.4	
Factor Two: "SCHOOL-TECHNOLOGY"	.63	School should have used more television lectures.
	.80	School should have used teaching machines or computer assisted instruction more extensively.
	Eigenvalue = 1.39 % variance = 26.6	

* Loadings > .30 were included.

TABLE XCI

SCALE RELIABILITIES:

Test 2, Age 17, Year 76

(N = 633)

Scale	Description	# of Items	Alpha * Reliability
Composite	Attitudes toward school items	12	.64
Factor One	Counseling	14	.82
Factor Two	School-Technology	2	**

* Standardized item alpha for composite item sets and for factors.

** Too few items to scale.

TABLE XCII

COMPARISON OF FACTOR LOADINGS, SCALE RELIABILITIES,**
OF MATHEMATICS ATTITUDE ITEMS ACROSS AGES 13 and 17, TESTS 1 and 2

Variable	Age 17 Test 1 Factor 1	Age 17 Test 1 Factor 2	Age 17 Test 2 Factor 1	Age 17 Test 2 Factor 2	Age 13 Test 1 Factor 1	Age 13 Test 1 Factor 2	Age 13 Test 2 Factor 1	Age 13 Test 2 Factor 2
CALLMATH	.67*	.09	.60*	.08	.57*	.09	.56*	.05
MATHEASE	.65*	.53*	.71*	.44*	.72*	.35*	.73*	.34*
MATHFEAR	.17	.69*	.23	.62*	.16	.69*	.13	.64*
MATHHATE	.51*	.50*	.61*	.36*	.49*	.40*	.56*	.34*
MATHPRD	.65*	.38*	.62*	.42*	.62*	.24	.61*	.27
MATHSCI	.49*	.15	.45*	.17	.43*	.07	.43*	.04
MATHTRY	.64*	.10	.66*	.10	.48*	.09	.50*	.06
MATHUPST	.11	.68*	.11	.72*	.11	.55*	.08	.53*
MATHWELL	.60*	.45*	.56*	.48*	.53*	.36*	.52*	.40*
	α = .85	α = .85	α = .85	α = .84	α = .79	α = .74	α = .79	α = .73
	N = 1591		N = 1587		N = 4917		N = 4890	

** Cronbach's alpha coefficient reliability estimate of starred item sets

TABLE XCIII
SUMMARY OF MATHEMATICS-ATTITUDE SCALE ANALYSIS
NAEP 1975-76, Ages 13 and 17

Scale/Description	N of Items	Alpha Reliabilities: Age 17, Test Number: 1	Age 17, Test Number: 2	Age 13, Test Number: 1	Age 13, Test Number: 2
		(1709)*	(1704)	(4969)	(4958)
"Mathematics-Attitude" Items					
Composite	9	.85	.85	.79	.78
Factor 1: confidence	7	.85	.85	.79	.79
Factor 2, anxiety	**	.85	.84	.74	.73
		(1591)	(1587)	(4917)	(4890)
"Important Values-In-Life" Items					
Composite	10	.55	.60		
Factor 1: Work-Values	3	.50	.57		
		(957)	(971)		
"Attitudes-Toward-Self" Items					
Composite	8	.53	.53		
Factor 1: self-esteem	4	.76	.77		
Factor 2: fate control	4	.62	.65		
		(878)	(848)		
"Attitudes-Toward-School" Items					
Composite	12	.59	.64		
Factor 1: counseling	4	.83	.82		
Factor 2: miscellaneous **	**	.56			
		(662)	(633)		

* Numbers in parentheses are N of cases adjusted for nonresponses.

** Composition and number of items on factor varies across the tests.

THE HOME ENVIRONMENT AND MATHEMATICAL LEARNING -- NEW FINDINGS FROM THE NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS

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ABSTRACT

Building upon recent findings that mathematics participation, i.e., amount of course work, is the major determinant of achievement in mathematics, a status-participation theory of achievement is proposed to delineate the effects of both social status and home environment on achievement. With 1977-78 mathematics assessment data from the National Assessment of Educational Progress, path analysis was used to explore the effects of participation, attitude toward mathematics, race, sex, TV watching time, home reading material, and parents' education. With few exceptions, the status achievement model is supported by these data. Home environment factors tend to have greater effects on participation than they do on achievement. Parents' education has an indirect effect on achievement but sex and race have direct effects on achievement. Thus, selected status characteristics have associated boundaries constraining the equalization of achievement but the home and family impact learning primarily by influencing the process of course recruitment.

THE HOME ENVIRONMENT AND MATHEMATICAL LEARNING--
NEW FINDINGS FROM
THE NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS

In the past two decades, educational researchers have produced a large body of literature concerning the relative influences of family and school on student achievement (cf. Bridges, Judd, and Moock, 1979; Averch, et. al., 1974). The conclusions of this broad spectrum of empirical investigations have not been very obvious nor consistent, on the question of whether or not characteristics of schools and the schooling process have a major impact upon student learning. However, some data from the National Assessment of Educational Progress (NAEP) have shed new light on the question of the relative contribution of family and schools to mathematics achievement. Specifically, in a nationwide testing of U.S. 17-year-olds we found that mathematics participation (number of semesters they had taken of mathematics coursework) accounted for more variation in mathematics achievement than did a large set of family background characteristics (Welch, Anderson, and Harris, 1982). We do not know to what extent course participation contributes to learning in subject areas other than mathematics, but the NAEP data have dramatically shown that mathematics is an area in which learning depends upon exposure to coursework.

Given that schooling has such a strong effect upon mathematics achievement, we may ask whether or not family and social structural characteristics play a role in the learning of mathematics and related problem solving. If the family does indeed make a difference, does it have its impact only through the transmission of values and aspirations, or, can it directly affect students' knowledge levels? For example, knowledge of literature and politics can be transmitted directly through the normal course of family interaction, but in more technical areas such as mathematics and science, the knowledge itself may not be as commonly diffused. Assuming that the home environment does facilitate the process of learning mathematics in some indirect (and possibly direct) ways, it is important to know how specific features of the home environment operate to produce variations in achievement. It is also important to know if these processes function identically across different subgroups, for example, women and minorities. These are the basic questions which guided the analysis presented in this report.

CONCEPTUAL FRAMEWORK

An extensive body of research on status-attainment processes (cf. Kerckhoff, 1974; Gordon, 1977) has established that parents' socio-economic status (SES) has a direct effect on students' educational attainment. (Educational attainment generally is defined as post high school accomplishments.) Numerous studies (cf. Hauser, 1973; Bridge, Judd, and Moock, 1979) also have shown a relationship between social class and educational achievement. However, those studies employing non-recursive models (e.g., two-stage least squares) have found that the effects of parental education and occupation levels may be indirect rather than direct. Bridges, Judd, and Moock (1979) reviewed this literature and concluded that "the effect of parents' education upon achievement may be indirect when other family characteristics are controlled; "parents' education affects students' attitudes and expectations, which in turn determine achievement."

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Recent findings on the role of participation in mathematics achievement (Welch, Anderson, Harris, 1982), suggest that such conceptual models of the achievement process must be expanded. We therefore propose a status-participation theory of achievement, which is graphically depicted in Figure 1. Rather than anticipating direct effects of SES on achievement, we posit that the effects are indirect. Furthermore, our hypothesis is that the causal structure is as follows: parents' education shapes and affects motivations and learning opportunities, which, in turn affect the level of participation which in turn largely determines the student's level of achievement. The process outlined involves a chain of three endogenous or dependent variables each determined by a variable which was predetermined in a prior step in the process.

Sociological research on the status-value relationship confirms that a major role of social class is to transmit different values and attitudes at different levels of the status structure (see Kohn, 1969). For instance, highly educated parents are more likely than lesser educated parents to be aware that mathematical knowledge is important in obtaining professional jobs. They are also likely to communicate this to their children, especially by encouraging them to take mathematics courses. In addition, highly educated parents are probably more likely to acquire reading material and to provide other such learning opportunities in the home. Finally, highly educated parents probably tend to discourage such detrimental pastimes as obsessive television viewing.

The educational and occupational status of parents also can be expected to affect school learning opportunities through a variety of other mechanisms. Because their parents may select certain neighborhoods and schools, children from high SES families may be likely to attend schools with relatively high per capita expenditures and a student body with high need achievement characteristics.

THE NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS (NAEP) DATA

The recent availability of a wealth of data from the NAEP mathematics assessment provides an opportunity to test the foregoing model of the learning process. Approximately 26,000 17-year-old students were tested in the 1977-78 mathematics assessment. Asking them about their participation in math courses gave us the only nationwide data with high-quality measures of both achievement and participation.

The status-participation model described in the previous section was tested using path analysis procedures on selected variables in one data set, Test Booklet 8. While there are ten such test booklets available for 17-year-olds in 1978, this particular test booklet was chosen because it contains a scale of general attitude toward mathematics. NAEP uses a matrix sampling of items into test booklets such that each test has a unique subset of both cognitive and affective items.

The National Assessment is funded by the National Institute of Education and conducted by the Education Commission of the States. NAEP employs a deeply stratified, multi-stage probability sampling design in all of its assessments (NAEP, 1980). In the first stage of sampling the U.S. is divided into approximately seventy-five geographical units, which are stratified as to size and type of community? The second stage of sampling consists of selecting schools (including both public and private) within each geographical unit. Schools are sampled with probabilities proportional to the number of students eligible to be tested. The third sampling stage takes place when a test administrator randomly selects a designated number of age-eligibles from within a school.

Each test booklet in the 1978 mathematics assessment was administered to an independent sample of over 2,000 students. The data package (Test 8) used in this secondary analysis contains 2,219 age seventeen student records. Because of the complex sampling design, a design factor of 2.0 was used to underweight each case whenever tests of statistical inference were applied. Thus the effective sample size and the degrees of freedom were reduced to half the actual sample size.

NAEP assessments tend to emphasize achievement items and contain very few background questions; consequently many of the desired variables such as parental encouragement are not available for multivariate analysis. In addition to indicators of achievement, participation, and attitude, several home and status variables were available for analysis. Multiple regressions of achievement and participation on these variables were performed on three separate test booklets: Tests 5, 6, and 8. Those that did not maintain significant ($p > .01$) contributions across all three tests were dropped from further analysis. The surviving predictor variables, i.e., race, sex, parents' education, TV time, and amount of home print material, are described in the next section.

INDICATORS

(1) ACHIEVEMENT. Mathematics achievement was operationally defined as the proportion of cognitive exercises a student answered correctly. Students not responding and those who responded "don't know" to an item were scored as incorrectly answering that exercise. The data set used in this study contains 53 cognitive items; these items assess the student's knowledge and understanding of mathematics topics, their ability to perform computational tasks, and their capacity to apply mathematical skills and concepts. The Cronbach's alpha coefficient of reliability (internal consistency) was 0.90 for the full set of items. Procedures for evaluating such tests, as delineated by Anderson, Welch and Harris (1982), were applied to this measure of achievement.

(2) PARTICIPATION Participation was operationalized as the number of semesters a student had studied each of the following five mathematics courses: first year algebra, second year algebra, geometry, trigonometry, and calculus. Two semesters, or a year, was scored as "2" semesters, one-half year of study was scored as "1" semester, and less than one-half year of study was scored as "0.5" semesters. Students indicating that they had not studied a particular course and those not responding to an item were scored as studying "0" semesters. The semesters of study of each of the five courses were added together to produce a measure ranging from 0 to 10 semesters of mathematics coursework. This variable measured the amount of formal study of mathematics which a student reported being exposed to. The five courses included were those which students traditionally take for college preparation.

(3) ATTITUDE. A scale was constructed that reflected the students' enjoyment of and motivation for learning mathematics. The students were asked to indicate the degree to which they agreed or disagreed with each of five statements. The statements that composed this scale were as follows:

(1) I am willing to work hard to do well in mathematics.
(2) I enjoy mathematics.
(3) I really want to do well in mathematics.
(4) My parents really want me to do well in mathematics.
(5) I feel good when I solve a mathematics problem by myself.

The response alternatives for each statement were (a) strongly disagree, (b) disagree, (c) undecided, (d) agree, and (e) strongly agree.

In a factor analysis of a larger set of mathematics attitude items, these five statements loaded together as the first factor and accounted for 57% of the variance. This subscale had a reliability coefficient (Cronbach's alpha) of .76. Missing responses for each individual item were assigned the mean value for that item. For each student, the values on the five items were added together to produce a score reflecting his motivation to learn mathematics.

(4) HOME PRINT. This variable reflected the amount of reading material that existed in the student's home. Students are asked to report whether they did or did not have each of the following five forms of printed matter in their homes: regular newspaper service, a regular magazine subscription, more than 25 books, an encyclopedia, and a dictionary. Students not responding to an item were assigned "0" for that item. The forms of printed matter which the students reported having in their homes were scored and summed to yield a scaled measure ranging from 0 (none) to 5 (all of the

five types of printed material were in the home).

(5) TV TIME. The variable "television viewing time" was operationally defined as the number of hours a student reported watching television the night before the test administration. Responses were coded as follows: "0" for no television watched, "0.5" for "less than one hour, "1" for one hour, "2" for two hours, and so on, up to "6" for six or more hours. Students not responding to this item were assigned the mean score of all those responding.

(6) SEX. The gender of each student was reported by the exercise administrator. Males were assigned a value of "1" and females a "0," which was an arbitrary coding assignment.

(7) PARENTS' EDUCATION was operationally defined as the average educational level attained by the parents. Students reported the level of schooling completed by each of their parents on a six-point scale: (1) did not complete 8th grade; (2) completed 8th grade, but did not go to high school; (3) went to high school, but did not graduate from high school; (4) graduated from high school; (5) graduated from high school and had some college; and (6) graduated from college. The scores for each of the parents were then added and divided by two. If missing data were encountered for one of the two parents, the single figure was used as the "average" for that student. If responses to this question were missing for both parents, the student was randomly assigned an average educational level.

(8) RACE. Each student was asked to give his or her racial

background. For purposes of this analysis, the item was dichotomized into white ("1") or nonwhite ("0"). For those cases in which the student did not respond to the item, the test administrator's observation of the student's race was used.

RESULTS

All of the home environment, as well as the other social background variables, are significantly ($p < .05$) correlated at the zero-order level with mathematics achievement. With the exception of sex, they are similarly correlated with mathematics course participation (see Table 1). While the seven predictor variables together account for 56% of the variance in achievement (see Table 2), most of the variables contribute relatively little to the prediction of achievement. As expected, participation in mathematics courses has a very large effect on achievement.

The regression results for the prediction of participation are also given in Table 2. The six predictor variables accounted for 20% of the variation in participation. Except for sex all of the variables have statistically significant effects on participation. When the r (zero-order correlation) is compared with the beta (standardized regression weight) for each variable, it becomes evident that the effects on achievement of most of the variables are indirect rather than direct. Of special note is the finding that the home environment variables, as indicated by the size of the regression coefficients, tend to have greater effects on participation than they do on achievement.

In accord with the conceptual model (Figure 1), attitude was regressed on only its antecedent variables: sex, parents' education, and race. Almost none of the variance (3%) in attitude is captured by these three variables, and only race has a statistically significant effect.

As with attitude, "home print" and "TV time" were regressed on sex, parents education, and race. Only parents education has a significant effect on both of these "home" factors. Race, however, has a significant effect on the amount of home print.

These results are graphically depicted in Figure 2 where all nonsignificant paths are deleted. The path coefficients (standardized regression weights) are given for each predicted and significant path. The empirical adequacy of this model is assessed by the computation of reproduced correlations as shown in Table 3. The sum of the direct effect, the indirect effect, and the noncausal correlation component gives the reproduced correlation, which should approximate the observed correlation. The mean of the absolute differences across all pairs of reproduced and observed correlations is .031, which indicates that the model is adequate with respect to this data.

DISCUSSION

The path model departs form our initial status-participation model in several minor ways. First, some status characteristics, namely sex and race, have direct as well as indirect effects on achievement. As hypothesized, parents education affects achievement only indirectly by influencing the home environment and the process of recruitment to mathematics coursework. Of particular note is the finding that sex and participation are not correlated. Prior to 1978, 17-year-old women were found to take less coursework in mathematics than men, but this disparity has diminished (cf. Armstrong, 1981). In contrast, race differences continued to persist and this is evident by the strong effects of race on both participation and achievement. Second, the role of attitude is less than was anticipated in that parents' education does not explain any variance in attitude. The fact that sex and race do not account for much variance in attitude suggests that there may be weaknesses in the attitude scale itself. It may be that the broad, general statements about mathematics included in our attitude scale may not be closely linked to feelings that motivate performance in concrete situations.

While the path model has a satisfactory fit with the data, there are two problem areas indicated by a few large discrepancies between the observed and the reproduced correlations. One problem occurs in the relationship between race and parents' education. The correlation between these two variables is rather high (.17), which may contribute to the large discrepancies involving the correlations of race with attitude and TV time. One possible solution would be to specify a causal connection between parents' education and race. Another problem area concerns the relationship between parents' educational and achievement, where a discrepancy of 0.1 exists between the observed and the reproduced correlations. It would appear that the best solution to this problem would be the inclusion of better affective measures and home environment factors, e.g., "parental encouragement."

CONCLUSION

The home environment definitely has a facilitating effect on students' high school mathematics achievement, and as demonstrated in this study its effect is mediated through the process of recruitment to participation in coursework. Bridges, Judd, and Moock (1979) suggest that the major role of parental education consists of producing attitudinal motivations. This was not confirmed by this investigation of NAEP data; instead we found that participation intervened between parental education and student achievement. More investigation on the attitude-achievement relationship is warranted but we cannot dismiss the possible facilitating role of attitudes until we have utilized other and perhaps better affective indicators.

To put these findings into perspective we calculated some implications of our causal model using a simulation program called ALTER. The hypothetical computation estimated what the effect would be of somehow encouraging all 17-year-olds to watch, on the average, one less hour per day of television. The estimated increase in the level of achievement nationwide would be only one and one-half percentage points. Yet between 1972 and 1978 the national performance of age 17 students declined four percent. Although the factors leading to this decline are still a matter of speculation, the most important factor is probably declining student participation in mathematics coursework. Changes in participation can easily eclipse the effects of the home environment.

Although these conclusions are tentative they should be used to suggest further investigations. It is obvious from these findings that achievement, at least in the domain of mathematics, can not be studied apart from participation without losing sight of a major aspect of the learning process.

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FIGURE 1

A STATUS-PARTICIPATION MODEL

OF THE ACHIEVEMENT PROCESS

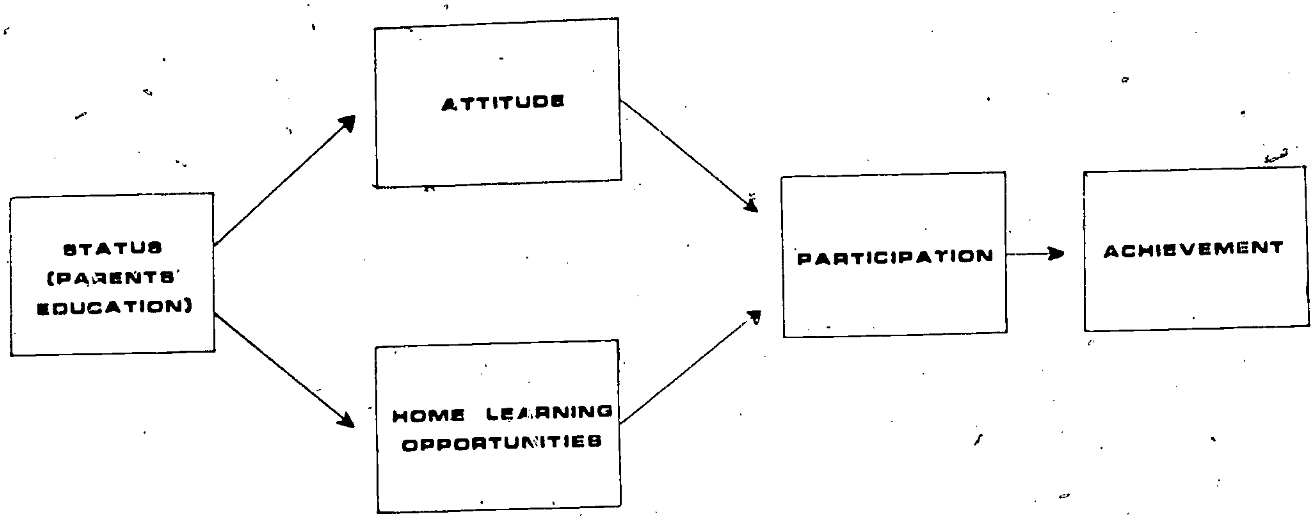

FIGURE 2

PATH DIGARAM WITH PATH COEFFICIENTS

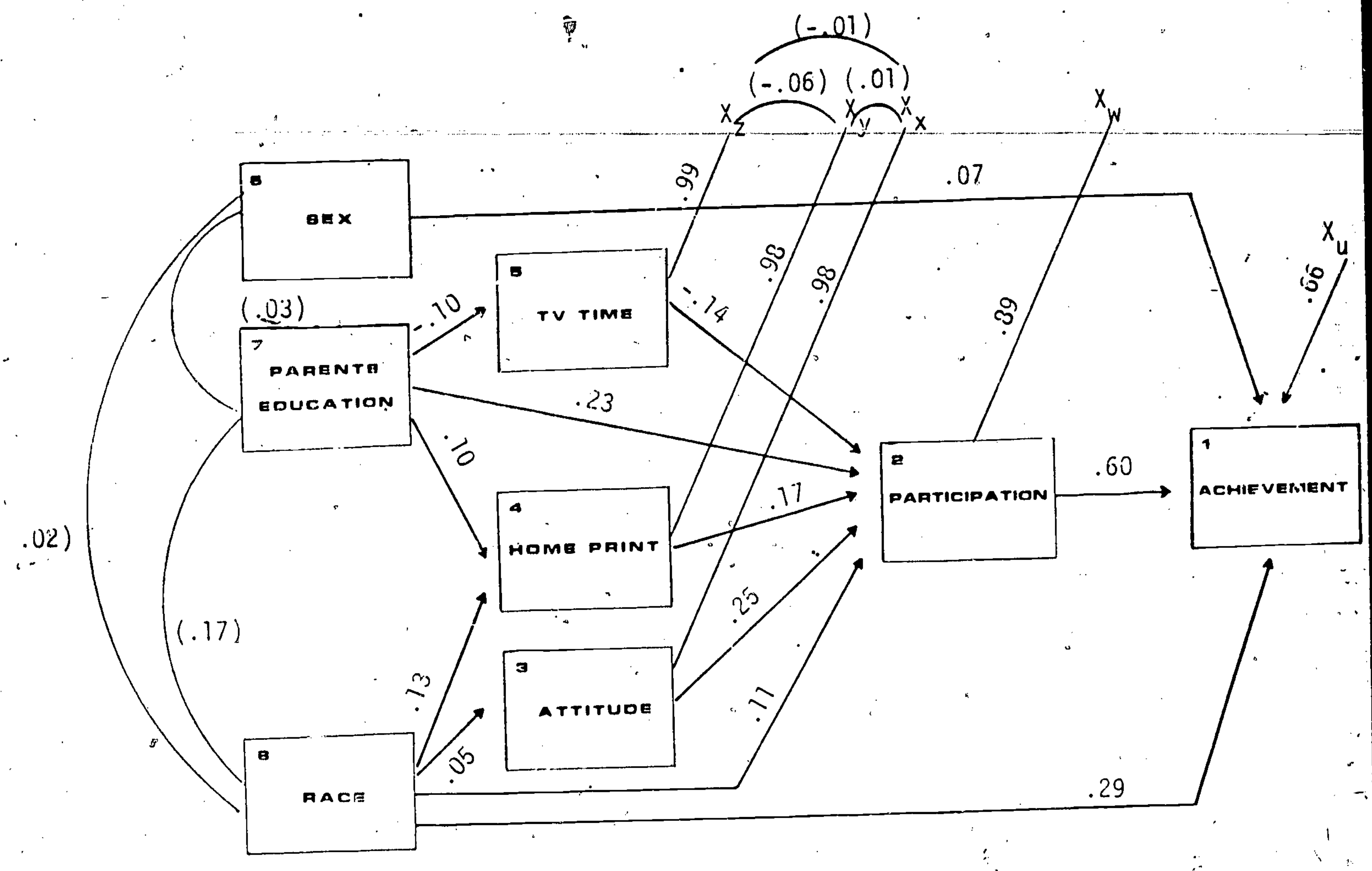

TABLE 1

CORRELATION COEFFICIENTS

Test 8, Age 17, Year 78

(N = 2219)

VARIABLE	MEAN	STANDARD DEVIATION	CORRELATION COEFFICIENTS						
ACHIEVEMENT	.56	.18							
PARTICIPATION	3.44	2.67	.68						
ATTITUDE	19.76	2.98	.12	.24					
TV TIME	3.98	1.57	.25	.22	.01				
HOME PRINT	1.79	1.69	-.17	-.18	-.01	-.06			
SEX	.50	.50	.07	-.01	.01	.04	-.01		
PARENTS ED	4.39	1.21	.31	.30	.02	-.11	.13	.03	
RACE	.79	.40	.39	.13	-.16	-.09	.14	.17	.02
			ACH	PAR	ATT	TV	HOME	ED	SEX

TABLE 2

PATH REGRESSION COEFFICIENTS

Test 8, Age 17, Year 78

DEPENDENT VARIABLE	PREDICTOR VARIABLE	PATH COEFFICIENT (BETA)	PATH REGRESSION COEFFICIENT (B)	STANDARD ERROR OF B
ACHIEV.	PARTICIPATION	.599*	.0394	.0015
(R^2 = .56)	ATTITUDE	.028	.0016	.0012
	HOME PRINT	.070	.0079	.0023
	TV TIME	-.031	-.0029	.0019
	SEX	.074*	.0260	.0070
	PARENTS ED	.050	.0074	.0031
	RACE	.289*	.1256	.0090
PARTICIPATION	ATTITUDE	.251*	.2255	.0245
(R^2 = .20)	HOME PRINT	.167*	.2829	.0465
	TV TIME	-.138*	-.1973	.0387
	SEX	.004	.0245	.1444
	PARENTS ED	.229*	.5105	.0612
	RACE	.108*	.7129	.1837
ATTITUDE	SEX	-.053	-.3161	.1768
(R^2 = .03)	PARENTS ED	.034	.0859	.0744
	RACE	-.053*	-1.1720	.2202
HOME PRINT	SEX	-.011	-.0347	.0933
(R^2 = .03)	PARENTS ED	.102*	.1348	.0392
	RACE	.129*	.5045	.1162
TV TIME	SEX	.047	.1752	.1119
(R^2 = .02)	PARENTS ED	-.103*	-.1616	.0471
	RACE	-.075	-.3475	.1393

* Significant at the 0.001 level.

TABLE 3

COMPONENTS OF REPRODUCED CORRELATIONS OF

PREDICTOR VARIABLES ON EACH DEPENDENT VARIABLE

DEPENDENT VARIABLE	PREDICTOR VARIABLE	DIRECT EFFECT	INDIRECT EFFECT	NONCAUSAL CORRELATION COMPONENT	REPRODUCED* ZERO-ORDER CORRELATION	OBSERVED ZERO-ORDER CORRELATION
ACHIEVEMENT	PARTICIPATION	.60	-	-	.60	.68
	ATTITUDE	-	.15	.00	.15	.12
	HOME PRINT	-	.10	.02	.12	.25
	TV	-	-.08	-.01	-.09	-.17
	SEX	.07	-	.00	.07	.07
	PARENTS ED	-	.17	.04	.21	.31
	RACE	.29	.10	.03	.41	.39
PARTICIPATION	ATTITUDE	.25	-	.00	.25	.24
	HOME PRINT	.17	-	.03	.20	.22
	TV	-.14	-	-.01	-.15	-.18
	SEX	-	-	.01	.01	-.01
	PARENTS ED	.23	.03	.02	.28	.30
	RACE	.10	.03	.04	.18	.13
ATTITUDE	HOME PRINT	-	-	-.00	.00	.01
	TV	-	-	.00	.00	-.01
	SEX	-	0	.00	.00	.01
	PARENTS ED	-	-	.01	.01	.02
	RACE	-.05	-	.01	-.04	-.16
HOME PRINT	TV	-	-	-.06	-.06	-.06
	SEX	-	-	-.01	.01	-.01
	PARENTS ED	.10	-	.02	.12	.13
	RACE	.13	-	.02	.15	.14
TV TIME	SEX	-	-	-.00	.00	.04
	PARENTS ED	-.10	-	.00	-.10	-.11
	RACE	-	-	-.02	-.02	-.09
SEX	PARENTS ED	-	-	.03	.03	.03
	RACE	-	-	.02	.02	.02
PARENTS ED	RACE	-	-	.17	.17	.17

*The average discrepancy of reproduced and observed correlations is .031.

ATTITUDES TOWARD MATHEMATICAL ACTIVITIES AND THE PREDICTION OF ACHIEVEMENT

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ATTITUDES TOWARD MATHEMATICAL ACTIVITIES AND THE PREDICTION OF ACHIEVEMENT

Students' attitudes toward mathematics have been a major concern to mathematics educators and researchers for more than twenty-five years. Many of the earlier studies focused upon the description of mathematics attitudes and the factors which influence these attitudes (e.g., Dutton, 1956; Poffenburger and Norton, 1956, 1959; Aiken, 1963) and investigations of such concerns continue (Callahan, 1971; Aiken, 1972; Beck, 1977). While some early research focused upon the role that attitudes toward mathematics play in relation to mathematics achievement, this topic has become one of increasing concern and attention (Fedon, 1958; Aiken, 1961; Fennema and Sherman, 1977; Armstrong, 1980; Brassell, Petry, and Brooks, 1980). Attention to the nature and role of attitudes toward mathematics has become central in the literature of mathematics education, and periodic reviews have suggested new theoretical and methodological directions for research (Aiken, 1970a, 1970b, 1976; Knaupp, 1973; Fennema, 1974).

Begle (1969) identified ninety-three mathematics attitude studies which had been completed between 1960 and 1976. Well over a hundred other studies were found dealing with anxiety, test anxiety, motivation, personality, school attitudes or self-concept. The literature on the nature and role of attitudes toward mathematics is so extensive and characterized by problems, which will be discussed below, that it is difficult to summarize the findings in this area.

Unfortunately, the literature on mathematics attitudes is fraught with inconsistencies. There are several reasons for this state of affairs. Perhaps the primary culprit is the multiplicity of meaning assigned to the concept of "attitude." The problems ensuing from such imprecision, problems in comparability and interpretation of data, plague the research. Part of this problem, as Aiken (1970a) notes, is the prevalence of studies which measure a "generalized attitude" toward mathematics rather than measuring attitudes toward specific mathematical activities. Additional problems often stem from the failure to differentiate between different types of attitudes. For example, attitudes about the place of math in society (which is largely a cognitive component of attitude) obviously differ from attitudes about liking math (which is mostly an affective component of attitude). Even when researchers do differentiate among attitudes toward math, readers may fail to recognize these differences and confusion results.

A second problem is the frequent inadequacy of attitude measurement instruments. While some researchers have devised refined attitude scales (Fennema and Sherman, 1976; Sandman, 1974), the use of one-item scales and unstandardized "home-grown" scales (Aiken, 1976) proliferates. Additionally, Knaupp (1973) points out that many of the instruments used to measure mathematics attitudes are inappropriate for young children. The sheer number of different ways in which attitudes are measured (as well as conceptualized) makes the literature in this area quite unwieldy and sometimes undecipherable (cf. Kulm, 1981).

A third limitation in this literature, applying only to those studies regarding the relationship between mathematics attitudes and mathematics achievement, revolves around the measurement of achievement. Some studies use one or two tests of mathematic achievement which usually provide only a measure of general mathematics achievement (e.g., Beck, 1977). The use of achievement measures which allow for separate analyses of achievement for specific mathematical domains is increasing, however. In light of the research demonstrating that groups of students may differentially excel in particular types of mathematical tasks (e.g., Macoby and Jacklin, 1974; Fennema, 1974), and that students' attitudes toward mathematics may vary according to the math activity in question, this development is to be lauded.

Begle (1979:99) points out that assessments of student achievement in mathematics have typically suffered from one of two opposite problems. Either the studies have excellent samples, but less than thorough testing of mathematics skills, or they have excellent coverage of mathematics but less than desirable samples. The same problem seems to plague assessments of the nature and role of attitudes toward mathematics. The studies with superior samples often do not incorporate the range of attitudinal variables of interest (e.g., Hanushek, 1972: Chapters 4 and 5). Likewise, studies with a thorough exploration of attitudes toward mathematics frequently do not have superior samples (e.g., Elmore and Vasu, 1980).

A final problematic aspect of much of the work done in the area of math attitudes and achievement, especially in the past, is the relative lack of multivariate studies (Aiken, 1976). Recent work in the field, however, more often employs a multivariate analysis and attempts to examine mediating variables and interaction effects (Fennema and Sherman, 1977; Armstrong, 1980).

In an attempt to overcome some of these difficulties in the mathematics attitude/achievement research the authors developed a multivariate model called the status-participation model and applied it to the National Assessment data for seventeen year old students. The results are presented in a companion paper entitled "The Home Environment and Mathematical Learning," and provide a foundation for additional analysis on the attitude-achievement relationship. The status-participation theory of achievement posits that the effects of social status and home environment are indirect rather than direct upon achievement. Specifically, parents' education tends to shape the home environment and the attitudes of the adolescent, which in turn are the chief determinants of participation in mathematics. Furthermore, the model specifies that participation is the chief predictor of achievement in mathematics. A model such as this in a useful analytical tool in exploring the role of attitude because it dictates that attitude be examined in the context of its major interrelationships.

The attitude measure that we utilized in the previous report was a standard Likert-type scale of mathematics interest and enjoyment. Using this measure in a path analysis of the status-participation model we found that mathematics attitude does not significantly impact mathematics achievement directly. The role of attitude, like home environmental factors, seems to be one of influencing participation or recruitment to mathematics coursework.

To explore whether or not this finding is a function of the particular indicator of attitude utilized, we chose in this investigation to replicate the earlier analysis but substituting a different measure of attitude toward mathematics. Kulm (1981) and others have argued that more conrete, experiental attitude measures be used in such studies. It is possible to explore this possibility with secondary analysis of the data from the National Assessment of Educational Progress (NAEP) since in at least two test packages for age

17 students, questions about specific mathematical activities (or topics) were included. Carpenter, et. al. (1980) interpreted these affective items and claimed that the students seemed to be making useful discriminations on these items.

THE NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS (NAEP) DATA

The recent availability of a wealth of data from the NAEP mathematics assessment provides an opportunity to test models of the learning process. Approximately 26,000 17-year-old students were tested in the 1977-78 mathematics assessment. Asking all of them about their participation in mathematics courses gave us the only nationwide data with high-quality measures of both achievement and participation.

The hypotheses described in the previous section were tested using path analysis procedures on selected variables in one data set, Test Package 6. While there are ten such test packages available for 17-year-olds in 1978, this particular test package was chosen because it contains a scale of general attitude toward mathematics. NAEP uses a matrix sampling of items into test booklets such that each test has a unique subset of both cognitive and affective items.

The National Assessment is funded by the National Institute of Education and conducted by the Education Commission of the States. NAEP employs a deeply stratified, multistage probability sampling design in all of its assessments (NAEP, 1980). In the first stage of sampling the U.S. is divided into approximately seventy-five geographical units, which are stratified as to size and type of community. The second stage of sampling consists of selecting schools (including both public and private) within each geographical unit. Schools are sampled with probabilities proportional to the number of students eligible to be tested. The third sampling stage takes place when a test administrator randomly selects a designated number of age-eligibles from within a school.

Each test package in the 1978 mathematics assessment was administered to an independent sample of over 2,000 students. The data package (Test 6) used in this secondary analysis contains 2,232 age seventeen student records. Because of the complex sampling design, a design factor of 2.0 was used to underweight each case whenever tests of statistical inference were applied. Thus the effective sample size and the degrees of freedom were reduced to half the actual sample size, i.e., 1,116 students.

NAEP assessments are notorious for their measurement of achievement but generally quite limited in their testing of background questions; consequently many of the desired variables such as parental encouragement are not available for multivariate analysis. In addition to indicators of achievement, participation, and attitude, several home and status variables were available for analysis. Multiple regressions of achievement and participation on these variables were performed on three separate test packages: Tests 5, 6, and 8. Those that did not maintain significant ($p > .01$) contributions across all three tests were dropped from further analysis. The remaining predictor variables, i.e., race, sex, parents' education, TV time, and amount of home print material, are described in the next section.

INDICATORS

(1) ACHIEVEMENT. Mathematics achievement was operationally defined as the proportion of cognitive exercises a student answered correctly.

Students not responding and those who responded "don't know" to an item were scored as incorrectly answering that exercise. The data set used in this study contains 53 cognitive items; these items assess the student's knowledge and understanding of mathematics topics, their ability to perform computational tasks, and their capacity to apply mathematical skills and concepts. The Cronbach's alpha coefficient of reliability (internal consistency) was 0.90 for the full set of items. Procedures for evaluating such tests, as delineated by Anderson, Welch and Harris (1982), were applied to this measure of achievement.

(2) PARTICIPATION Participation was operationalized as the number of semesters a student had studied each of the following five mathematics courses: first year algebra, second year algebra, geometry, trigonometry, and calculus. Two semesters, or a year, was scored as "2" semesters, one-half year of study was scored as "1" semester, and less than one-half year of study was scored as "0.5" semesters. Students indicating that they had not studied a particular course and those not responding to an item were scored as studying "0" semesters. The semesters of study of each of the five courses were added together to produce a measure ranging from 0 to 10 semesters of mathematics coursework. This variable measured the amount of formal study of mathematics which a student reported being exposed to. The five courses included were those which students traditionally take for college preparation.

(3) ATTITUDE. A scale was constructed that assessed student attitude towards specific mathematical activities. Six mathematical activities

were listed and the student was asked to rate each activity on point scales: first, a scale from "very important" to "not important at all"; next, a scale from "very easy to "very hard"; and finally, a scale from "like it a lot" to "dislike it a lot". This third affective rating scale was the only one incorporated into the attitude scale used in this analysis. (The other three rating categories on the "like--dislike" scale were "like it", "undecided," and "dislike it.") The six mathematical activities combined for our attitude measure appeared in the test booklet as follows:

A. Solving equations

B. Working with percentages

C. Memorizing rules and formulas

D. Using charts and graphs

E. Working with whole numbers

F. Doing long division

When the liking scale ratings for these six activities were combined for purposes of reliability estimation, a Cronbach's alpha of .70 resulted. While this is not a high level of internal consistency, it was deemed sufficient to proceed in exploring the validity and usefulness of this scale. The attitude score that was used in the analysis which follows was constructed by adding together the six "like--dislike" rating scales. An "importance of mathematical activities" indicator and an "easiness of mathematical activities" indicator were also created so as to examine the association of these attitude dimensions to the "liking" dimension to which we devoted our major attention.

(4) HOME PRINT. This variable reflected the amount of reading material

that existed in the student's home. Students are asked to report whether they did or did not have each of the following five forms of printed matter in their homes: regular newspaper service, a regular magazine subscription, more than 25 books, an encyclopedia, and a dictionary. Students not responding to an item were assigned "0" for that item. The forms of printed matter which the students reported having in their homes were scored and summed to yield a scaled measure ranging from 0 (none) to 5 (all of the five types of printed material were in the home).

(5) TV TIME. The variable "television viewing time" was operationally defined as the number of hours a student reported watching television the night before the test administration. Responses were coded as follows: "0" for no television watched, "0.5" for "less than one hour, "1" for one hour, "2" for two hours, and so on, up to "6" for six or more hours. Students not responding to this item were assigned the mean score of all those responding.

(6) SEX. The gender of each student was reported by the exercise administrator. Males were assigned a value of "1" and females were assigned a "0".

(7) PARENTS' EDUCATION was operationally defined as the average educational level attained by the parents. Students reported the level of schooling completed by each of their parents on a six-point scale: (1) did not complete 8th grade; (2) completed 8th grade, but did not go to high school; (3) went to high school, but did not graduate from high school; (4) graduated from high school; (5) graduated from high school and had some college; and (6) graduated from college. The scores for

each of the parents were then added and divided by two. If missing data were encountered for one of the two parents, the single figure was used as the "average" for that student. If responses to this question were missing for both parents, the student was randomly assigned an average educational level.

(8) RACE. Each student was asked to give his or her racial background. For purposes of this analysis, the item was dichotomized into white ("1") or nonwhite ("0"). For those cases in which the student did not respond to the item, the test administrator's observation of the student's race was used.

RESULTS

All of the home and background variables (see Table 1) are significantly associated at the zero-order level with achievement, and with the exception of sex the same is true with participation. In distinct contrast the home and background variables tend to have extremely low correlations with the three attitude indicators: importance of math activities, easiness of math activities, and liking of math activities. This pattern of intercorrelations contributes to the pattern of explained variance given in Table 2; 53 percent of the variation in achievement was accounted for by six predictor variables while only 18% of the variance in participation was accounted for by five predictor variables and a mere 2% of the variation in attitude (liking) was explained by three variables. The attitude indicator is a significant predictor of both participation and achievement, otherwise the significant predictors of achievement (sex and race) and participation (home print, TV time, parents' education, and attitude) are identical to the previous analysis of Test Package 8, which contained the Likert-type attitude scale. As before, only race is a significant predictor of attitude. Of the three status variables, only race has a significant effect on home print and only parents' education has a significant effect upon TV time. These structural equations are graphically depicted in the path diagram (figure 1). The empirical adequacy of the model is assessed by the computation of reproduced correlations as shown in Table 3. The sum of the direct effect, the indirect effect, and the noncausal correlation component gives the reproduced correlation, which should approximate the observed, zero-order correlation. The mean of the absolute differences across all pairs of reproduced and observed correlations is .027, which indicates that the model is adequate with respect to this data.

DISCUSSION

The results clearly show a predictive advantage for an attitude indicator which is based upon specific, concrete aspects of mathematics. While the more specific indicator of attitude toward mathematics has lower reliability (internal consistency) than the Likert-type scale, the more specific attitude indicator has greater predictive validity as evidenced by higher regression weights in the prediction of participation and achievement. The increase in the magnitude of the standardized regression coefficient produces a statistically significant path from attitude to achievement, which may account for the improved fit of the model as measured by the fit between the observed and the reproduced correlations.

In this analysis the effect of parents education upon home print is not significant at the .001 level so the corresponding path was omitted from the path diagram. In the analysis of Test Package 8 the path coefficient was only .10 so this discrepancy could easily be due to sampling error.

As shown in Table 1, the intercorrelations among the importance, liking, and easiness dimensions of attitude for mathematical activities are all rather high, i.e., .43 or greater. Liking and easiness are especially closely linked with a correlation of .59. This pattern of association may help to account for their similarity in prediction. Although not reported here, path estimates were made for the importance and easiness as well as the liking scales, and the results were very close to those described here for the liking dimension. One difference of note is that parents' education significantly predicts importance and easiness of attitude but not liking. Apparently the evaluative (liking) dimension is a more personal, idiosyncratic attitudinal component than assessment of importance and difficulty.

SUMMARY

Extending the status-participation analysis with the inclusion of an activity-specific attitude indicator demonstrates that the role of attitude is more important than was suggested by previous research which used less specific measures of attitude toward mathematics. This empirical investigation provides solid evidence that attitudinal factors not only influence the process of coursework participation but they also directly affect performance on tests of mathematics achievement. The data reaffirm the main tenant of the status-participation model: the dominant influence of social status occurs through its impact upon participation, which is the major determinant of mathematics achievement. Several minor features of the previously reported path model were disconfirmed; specifically attitude attitude has a direct effect upon achievement and secondly, parents' education fails to have a significant effect upon "home print." Except for these minor departures the basic structure of the status-participation model is reaffirmed and given additional support.

The results of this investigation have important implications for the measurement of attitudes toward mathematics and other academic subjects. Attitude questions which are directed toward specific, concrete aspects of the subject tend to have greater predictive validity than measures that are more general and difuse. The more concrete items may well evoke affective states that are more closely associated with academic performance or at least with learning behaviors critical to academic performance.

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FIGURE 1

PATH DIAGRAM WITH PATH COEFFICIENTS FOR
ANALYSIS OF TEST PACKAGE 6, AGE 17, YEAR 78
(N = 1116)

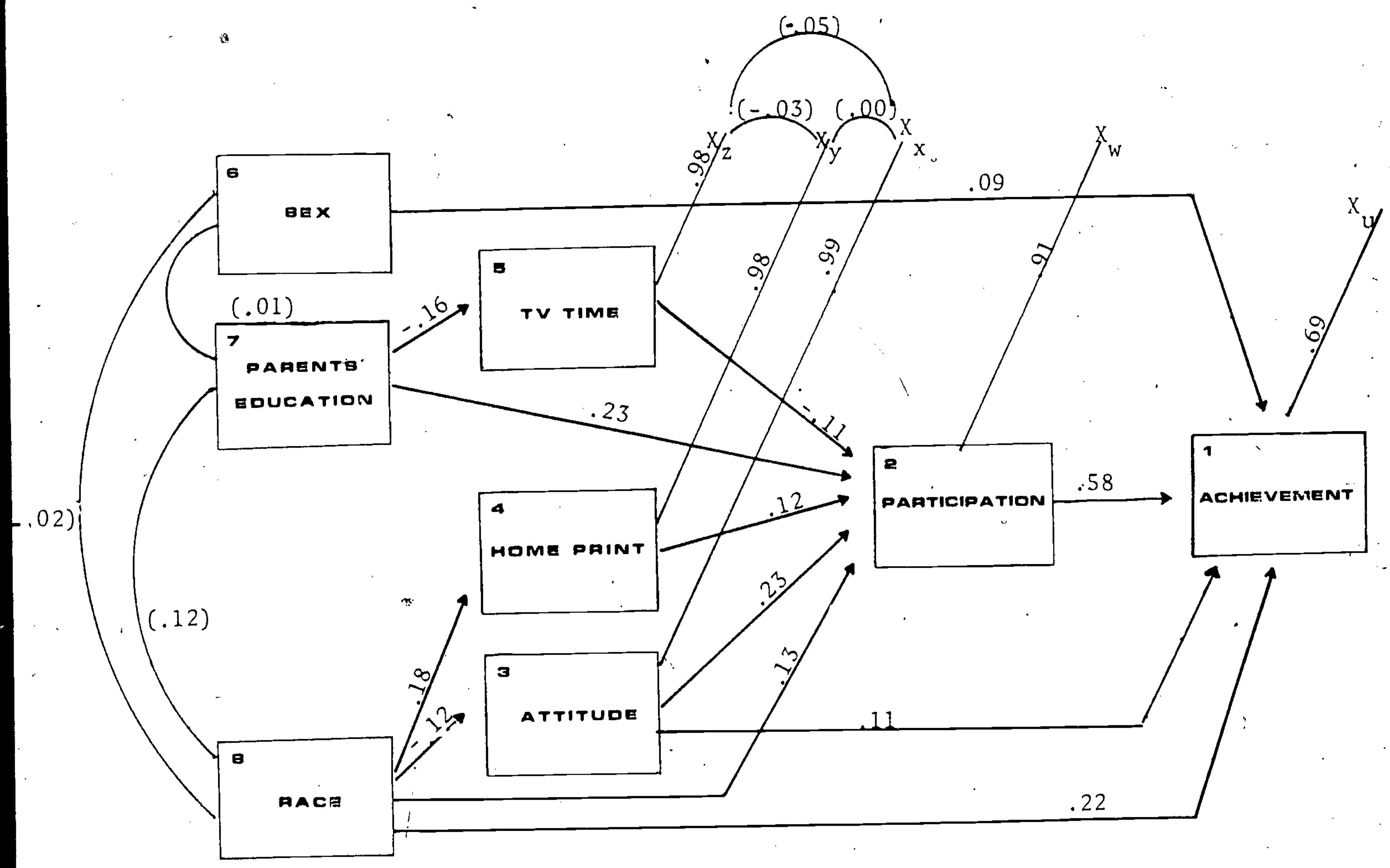

TABLE 1

CORRELATION COEFFICIENTS

MATH ASSESSMENT

Test 6, Age 17, Year 78
(N = 1116)

VARIABLE	MEAN	STANDARD DEVIATION									
ACHIEVEMENT	.56	.17									
PARTICIPATION	3.30	2.60	.68								
IMPORTANT	12.63	3.21	.24	.22							
EASY	14.89	3.25	.44	.39	.43						
LIKE	16.66	3.44	.22	.23	.52	.59					
TV TIME	3.49	1.83	-.18	-.18	-.10	-.11	-.05				
HOME PRINT	4.00	1.57	.19	.17	.04	.07	.00	-.03			
PARENTS ED	4.41	1.22	.26	.28	.13	.13	.03	-.16	.08		
SEX	.48	.50	.11	.04	.02	-.05	.01	.00	-.03	.01	
RACE	.83	.39	.32	.16	-.02	-.03	-.12	-.08	.19	.12	-.02
			ACH	PART	IMP	EAS	LIK	TV	HOME	PAR	SEX

TABLE 2

PATH REGRESSION COEFFICIENTS

Test 6, Age 17, Year 78

DEPENDENT VARIABLE	PREDICTOR VARIABLE	PATH COEFFICIENT (BETA)	PATH REGRESSION COEFFICIENT (B)	STANDARD ERROR OF B
ACHIEV.	PARTICIPATION	.578*	.038	.0015
(R^2 = .53)	ATTITUDE (LIKE)	.113*	.006	.0011
	HOME PRINT	.045	.005	.0023
	TV TIME	-.045	-.004	.0020
	SEX	.090*	.031	.0070
	PARENTS ED	.059	.008	.0030
	RACE	.222*	.099	.0096
PARTICIPATION	ATTITUDE (LIKE)	.229*	.173	.0207
(R^2 = .18)	HOME PRINT	.122*	.202	.0459
	TV TIME	-.113*	-.161	.0392
	SEX	.040	.207	.1415
	PARENTS ED	.231*	.494	.0594
	RACE	.133*	.916	.1930
ATTITUDE (LIKE) (R^2 = .02)	SEX	-.004	-.029	.2050
	PARENTS ED	-.043	-.123	.0850
	RACE	.120*	1.090	.2726
HOME PRINT	SEX	-.024	-.076	.0925
(R^2 = .04)	PARENTS ED	.058	.075	.0383
	RACE	.183*	.759	.1230
TV TIME	SEX	-.003	-.009	.1083
(R^2 = .03)	PARENTS ED	-.156*	-.235	.0448
	RACE	-.057	-.277	.1440

* Significant at the .001 level.

TABLE 3

COMPONENTS OF REPRODUCED CORRELATIONS OF

PREDICTOR VARIABLES ON EACH DEPENDENT VARIABLE

Test 6, Age 17, Year 78

DEPENDENT VARIABLE	PREDICTOR VARIABLE	DIRECT EFFECT	INDIRECT EFFECT	NONCAUSAL CORRELATION COMPONENT	REPRODUCED* ZERO-ORDER CORRELATION	OBSERVED ZERO-ORDER CORRELATION
ACHIEVEMENT	PARTICIPATION	.58	-	-	.58	.68
	ATTITUDE	.11	.13	-.00	.24	.22
	HOME PRINT	-	.07	.01	.08	.19
	TV	-	-.07	.00	-.07	-.18
	SEX	.09	.15	-.00	.09	.11
	PARENTS ED	-	.15	.04	.19	.26
	RACE	.22	.07	.02	.31	.32
PARTICIPATION	ATTITUDE	.23	-	.01	.24	.23
	HOME PRINT	.12	-	.00	.12	.17
	TV	-.11	-	-.02	-.13	-.18
	SEX	-	-	.03	.03	.04
	PARENTS ED	.23	.03	.01	.27	.28
	RACE	.13	.00	.00	.13	.16
ATTITUDE	HOME PRINT	-	-	.00	.00	.00
	TV	-	-	.05	-.05	-.05
	SEX	-	-	.00	.00	.01
	PARENTS ED	-	-	.02	.02	.03
	RACE	-.12	-	.00	-.12	-.12
HOME PRINT	TV	-	-	.00	.00	-.03
	SEX	-	-	-.00	.00	-.03
	PARENTS ED	.06	-	.02	.08	.08
	RACE	.18	-	.01	.19	.19
TV TIME	SEX	-	-	-.02	-.02	.00
	PARENTS ED	-.16	-	.00	-.16	-.16
	RACE	-	-	-.02	-.02	-.08
SEX	PARENTS ED	-	-	.01	.01	.01
	RACE	-	-	-.02	-.02	-.02
PARENTS ED	RACE	-	-	.12	.12	.12

*The average discrepancy of reproduced and observed correlations is .027.

NONRESPONSE AND "DON'T KNOW" RESPONSE PROBLEMS IN TESTING

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NONRESPONSE AND "DON'T KNOW" RESPONSE PROBLEMS IN TESTING

Not only does nonresponse affect the level of sampling error, but it also produces possibilities for systematic error or bias due to differential propensities for nonresponse by various social groups. Similar response bias may result from differential proneness to give "don't know" (DK) responses to both test items and survey questions. Sherman (1975) studied the problem of bias from "don't know" responses in the NAEP assessments of 1975-76 and concluded that a significant portion of the differences between males and females, whites and nonwhites, and other subgroups were due to differential proneness to give DK responses. Anderson, Smith-Cunnien, and Krohn (1982) investigated the problem of differential nonresponse in a statewide assessment of computer literacy and found some social groups much more likely to give nonresponses to background questions. These problems of bias in DK and nonresponding are serious because they may distort, if not account for, the group differences reported by NAEP and others in the popular and the scientific literature. This study consists of a partial replication of the earlier studies by searching for evidence of bias in two 1978 NAEP assessments of mathematics.

METHOD

Two test packages, booklets 8 and 10, for 17-year olds were examined for bias due to nonresponse and DK response patterns. First the distributions across all items in the booklets were examined for unusual patterns, then the DK bias was estimated, and finally the nonresponse to background questions was examined.

The first step in estimating the DK bias was to contruct a mathematics achievement score that was corrected for DK responses in that it did not penalize those who follow directions and check "I don't know" instead of guessing when they truly don't know the answer to a test exercise. The method of adjusting for differential DK that was used by Sherman (1975) appears to give those that give DK responses too great an advantage, so we used a new, less complex procedure as follows. Anytime a student gave a DK answer, the student's test score (sum of correct answers) was incremented by a fraction corresponding to the probability of getting the item correct by random guessing. This probability was estimated as

$$1/c$$

where c = the total number of response alternatives to a given question (excluding the DK alternative).

Since the number of response alternatives varies from two to five within NAEP test booklets, a DK-adjusted score was computed as follows:

$$\text{Adjusted score} = \frac{\text{no. correct}}{\text{no. possible}} + \sum_{c=2}^{5} \sum_{c=1}^{n} \frac{1}{c}$$

where c = the number of response alternatives,
n = the number of DK responses for a given c.

It should be noted that this adjusted score is equivalent to a proportion of the number correct out of the total possible. This adjusted score can be directly compared to the actual proportion of correct answers (without the DK adjustment). The adjusted proportion is slightly greater than the actual proportion correct because it contains incremental fractions corresponding to the advantage lost from not guessing. NAEP methodological policy is to include DK response alternatives on fixed-choice items but no correction is made for guessing, hence the above formula is an appropriate adjustment for the DK response. Response bias due to the DK response can be determined for any given pair of x,y subgroups as

$$d(\text{correct/possible}) = p(x) - p(y)$$

$$a(\text{DK adjusted}) = a(x) - a(y)$$

$$b\ (\text{DK bias}) = \frac{d - a}{d}$$

The difference in performance for any two groups, x,y, is denoted as "d" and the adjusted difference in performance for the two groups is identified as "a;" thus the bias due to DK is the difference between these two differences as a proportion of the unadjusted group difference. This "DK bias" is the amount of the original group difference that is due to the differential tendency to use the DK response.

The assessment of bias due to differential nonresponse tendencies follows the approach outlined and proposed by Anderson, Smith-Cunnien, and Krohn (1982). In brief, it consists of constructing a criterion for classifying each respondent as prone to NR or not. The criterion used with the NAEP data sets was whether or not a student gave a nonresponse(NR) to any one of the background questions. For both test packages 8 and 10 there were 31 background items. For tests 8 and 10 there were 28% and 25%

respectively who gave an NR to at least one of these 31 items. This subgroup was identified as NR-prone and the remainder as "nonNR-prone. The next step was to crosstabulate or breakdown each of the background items as well as the attitude and cognitive scales on the NR-proneness dichotomy. An NR response bias exists if a statistically significant difference occurs on any of these variables for the NR-prone versus the nonNR-prone. If we find both an NR and a DK bias for a given pair of sub-groups, we can not assume that each biasing effect will extend the other, because each may cancel out the other.

RESULTS

Each of the tests for the 1978 NAEP mathematics assessments contained the following structure: the test leads with a series of "affective" (attitudinal or experiential) items followed by the main body of cognitive exercises or questions; the final section--is called "background" and includes a variety of questions on home and school life as well as the standard questions on parents' education and race. This three step structure is outlined on Figure I to IV giving the number of non-responses(NR) and the number of "don't know responses"(DK) for tests 8 and 10 from year 1978. The number of nonresponses is quite low for the affective and cognitive section except for a few cognitive items. These cognitive items were open-ended or free-response items lacking a "don't know" response category, thus an NR response would imply an inability to produce the answer rather than unwillingness or disinterest. In both tests

(Figures I and III) the nonresponse profile reveals a fatigue factor with a steadily growing level of NR. The DK responses (see Figures II and IV) in contrast reveal a difficulty factor--the peaks in the DK line graphs are unusually difficult items. Two other factors underly these profiles: ambiguity and applicability. The extreme peak in the Test 8 DK line graph is an item that was ambiguous. The first peak in the Test 10 DKs was a set of items about computer experience. If the respondent lacked computer experience, s/he was to skip some items, however a number of such persons checked the DK response. Some of the background items had DK options and others did not, which accounts for the uneven pattern of DK answers.

The structure of items was different in the 1975-76 assessment and the profiles in Figures V and VI demonstrate this. One major difference was the short introductory section of cognitive items and the other was the last section of attitudinal questions. This assessment year was very unusual for NAEP with many more affective items than normal. Of special note is the extremely large number of NRs collected in the last section (see Figure V), which tends to render this data unusable. Further clarification of these problems can be found in a report by Harris, Anderson, and Welch (1982).

The average number of DK responses and evidence for DK bias is given in Tables 1 and 2, which give breakdowns for only two pairs of groups: gender and race. The average number of DKs per student is 3.80 in test 8 and 3.07 in test 10. This test booklet difference largely reflects a greater level of difficulty in test 8 than in test 10 as evidenced by a proportion correct (unadjusted) of .557 and .611 respectivly for the two tests. As revealed in both Tables 1 and 2, females are much more likely than males, and nonwhites more likely than whites, to give DK responses. Because of this differential tendency we find that the adjusted p-value (proportion correct) differences are less than the unadjusted ones. For test 8, the b(DK bias) is .158 for the gender groups, which means that 15.8% of the difference in achievement between males and females is accounted for by the difference between the two groups in the use of the DK response. For test 10 the DK bias is less, with only 7.7% of the gender difference attributable to the female proneness to give DK responses. The race difference is considerably less; not only is the difference in average DK responses not large but the percent of the subgroup difference in performance attributable to DK proneness is only 2.5% for test 8 and x.x% for test 10.

Rather than present the large volume of statistical results produced in testing for the occurance of NR bias, the overall findings will be summarized in terms of a profile of the characteristics of those who tend to be NR-prone. This profile is based only upon those attributes which on the basis of statistical significance ($p < .01$) differentiate the NR-prone from the nonNR-prone. The NR-prone are more likely to be:

* lower achievers (about .10 lower on cognitive test)
* lower participators (about 1.2 semesters less of courses)
* in a lower grade
* reporting less textbook use in classes
* reporting more TV lecturing in classes
* reporting less "listening to lectures"
* in a home with relatively little reading material
* in home where a nonEnglish language is spoken
* in a school with relative high percent nonwhite students
* nonwhite race or ethnic group
* located in a Western region.

With the exception of region and race, these characteristics provide a profile of the NR-prone as educationally disadvantaged. The variable differentiating the two groups the most was the amount of reading material reported in the home.

IMPLICATIONS

These data demonstrate that neither NR nor DK response distributions can be ignored without risking the possibility of flaws in the interpretation of results in large-scale testing programs. Although we did not find that differential use of DK accounted for all of the sex differences in mathematics achieve ment, we did find that it does accounts for a noteworthy share of the male advantage in mathematics testing. This finding that upon adjusting for DKs we can reduce as much as 15% of the difference between 17-year-old young men and women, is especially impressive in light of the fact that nearly half of the tests that we analyzed consisted of open-ended items lacking DK response alternatives. In tests that are totally machine-scored we would expect to find considerably more DK response bias and hence disadvantage for female test takers.

In light of the gender-related findings the results for ethnicity are surprising. Almost none of the large difference in mathematics achievement between whites and nonwhites can be attributed to differential DK response bias. On the other hand, we found ethnicity to be related to NR bias in that nonwhites are much more likely to give nonresponses to background questions. This implies that such estimates as mathematics participation and calculator use, which are inferred from these background questions are subject to systematic error and most likely these estimates are inflated. To generate unbiased estimates of these characteristics the researcher must use missing value substitution with parameter estimates from the NR-prone, as outlined in Anderson, Smith-Cunnien, and Krohn (1982). The correlation between race and NR-proneness raises the question of whether or not NR-proneness is an artifact of the fact that many nonwhites refuse to answer race-related questions.This possibility was tested by excluding the race/ethnicity items from the operational definition of NR-proneness. The breakdowns of all relevant variables were re-examined with this revised criterion of NR-proneness. Essentially the same pattern of associations were found, so on this basis we can rule out race as the major explanation for the propensity to give nonresponses. If it were the case that the tendencies to give NRs to background items is highly correlated with the tendency to give NRs to cognitive test items, then we would find that subgroups that are NR-prone are also likely to be disadvantaged in the same way that DK-prone subgroups are disadvantaged on achievement tests. Fail-ure to guess, whether it be from propensity to give DK or NR responses, generally places testees at a disadvantage from those that guess when they do not in fact "know" or have a good chance at getting the answer. We examined the correlation between NR response to background versus cognitive test items and found it to be very low. Therefore we can conclude that the nonwhite propensity to give NRs to background items does not mean that racial subgroup test differences are underestimated.

In this investigation we have isolated two largely distinct processes that not only weaken the quality of test results but threaten the validity of findings on subgroup differences. In scrutinizing the association between DK-proneness and gender differences we have identified a major explanatory factor d of unequal sex performance on tests which are not corrected for guessing or adjust for use of the DK response. While we did not find gender groups to differ on NR-proneness, many other sub-groups do differ and this may yield to not only unstable but inaccurate estimates of subgroup differences. In light of these findings it is surprising that so little research has pursued these issues. In the future NR and DK problems can not continue to be ignored.

FIGURE 1

NUMBER OF NONRESPONSES

Test 8, Age 17, Year 77-78

(N = 2219)

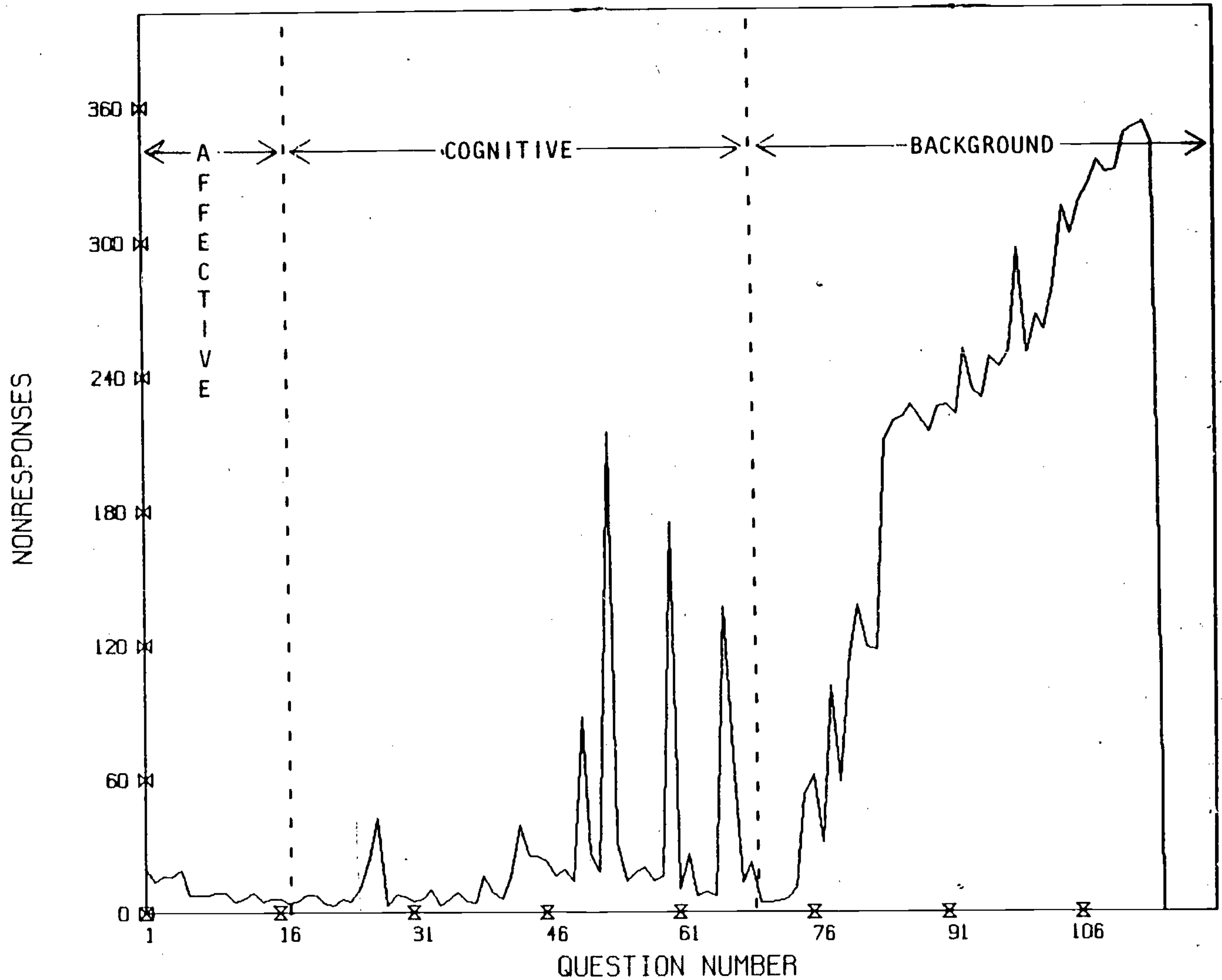

FIGURE 11

NUMBER OF DON'T KNOWS

Test 8, Age 17, Year 77-78

(N = 2221)

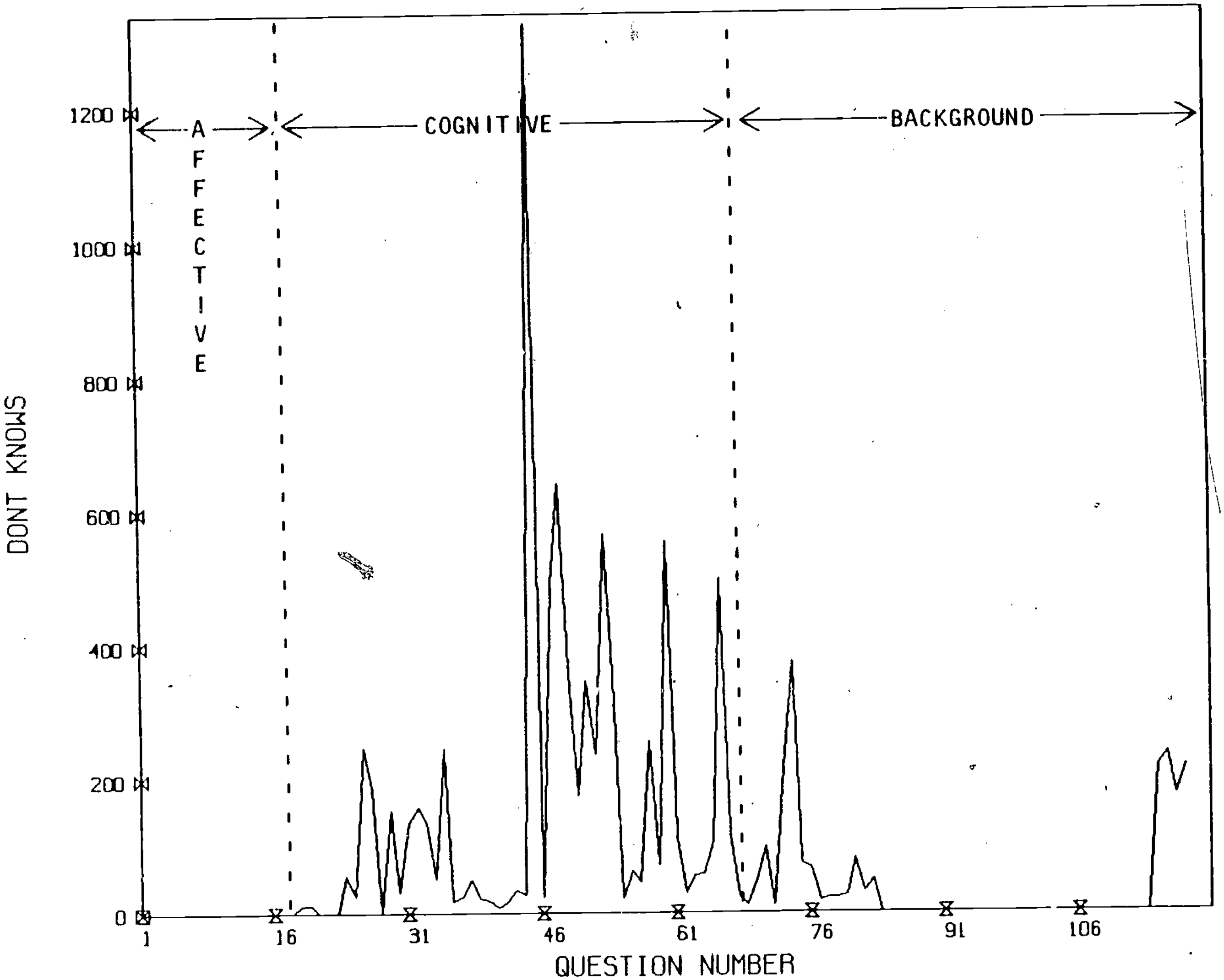

FIGURE III

NUMBER OF NONRESPONSES

Test 10, Age 17, Year 77-78

(N = 2216)

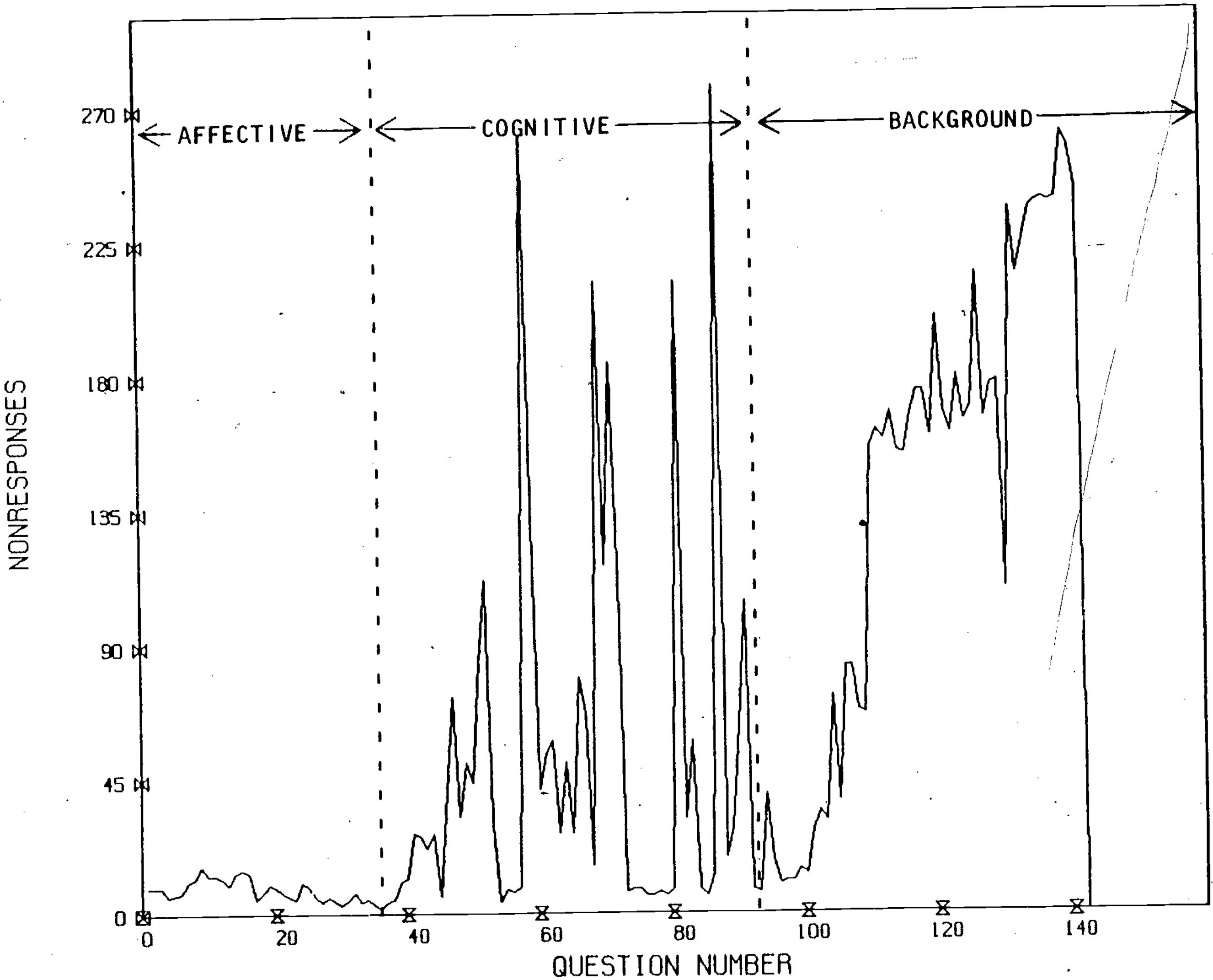

FIGURE IV

NUMBER OF DON'T KNOWS

Test 10, Age 17, Year 77-78

(N = 2216)

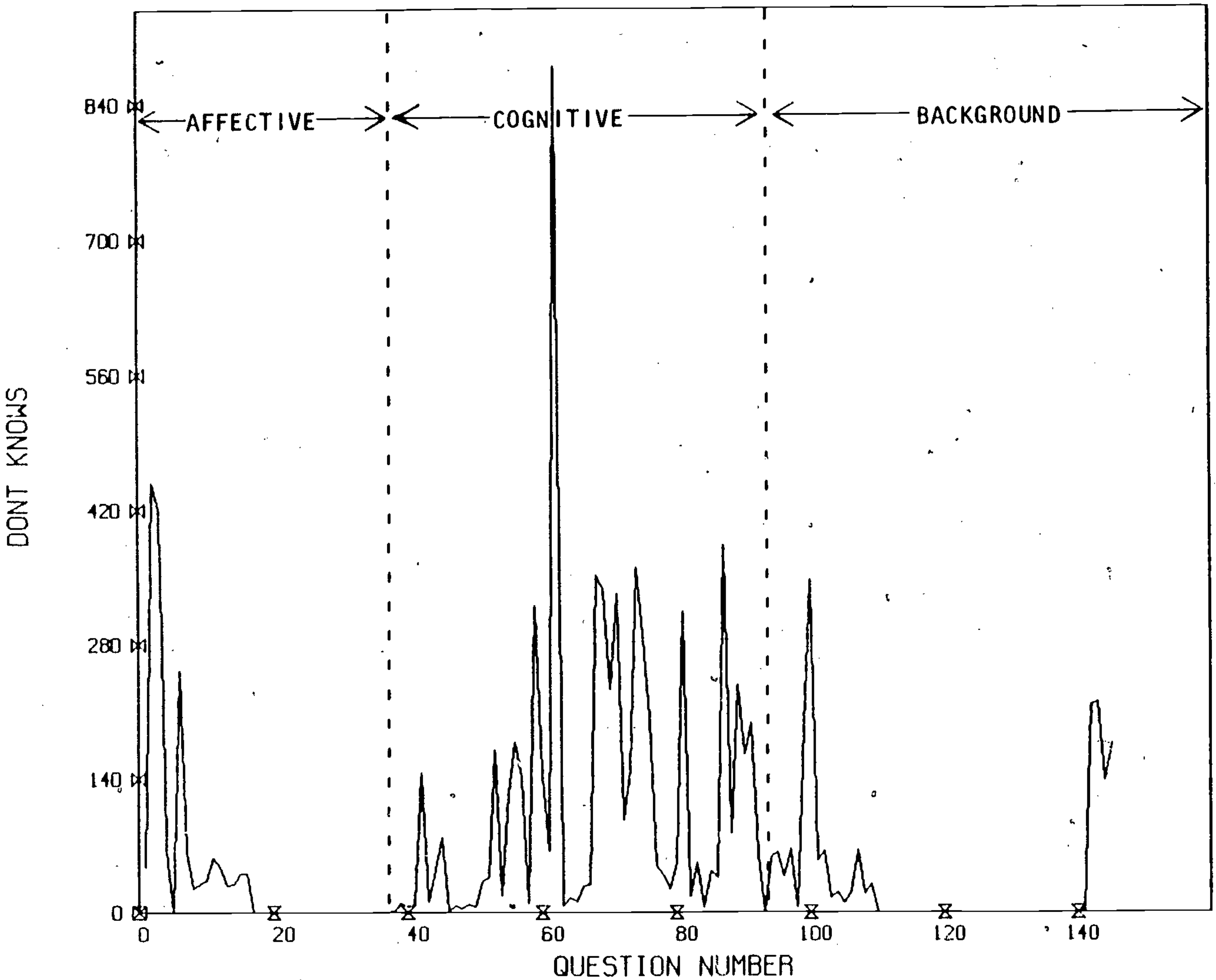

FIGURE V

NUMBER OF NONRESPONSES

Test 1, Age 17, Year 75-76

(N = 5268)

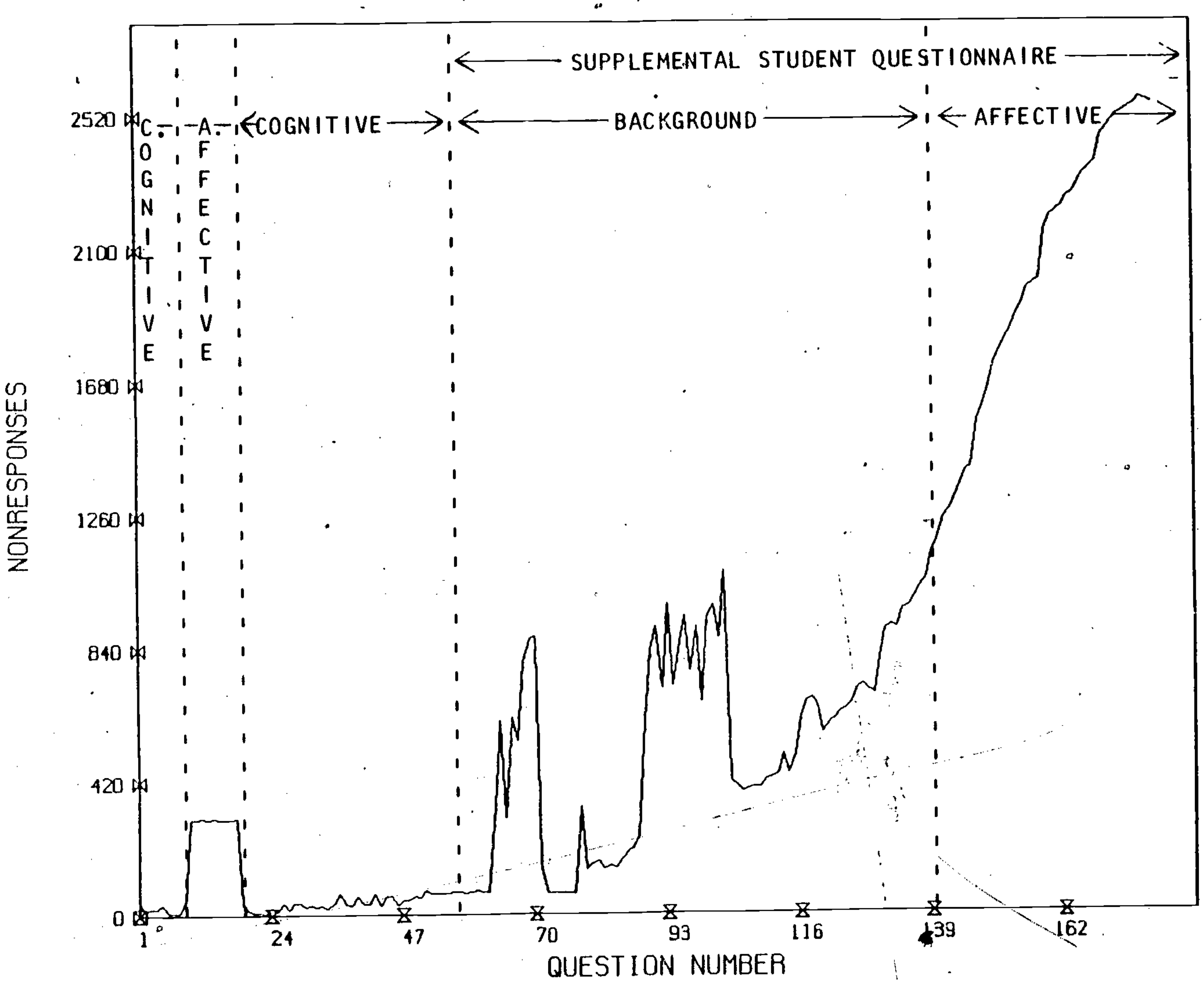

FIGURE VI

NUMBER OF DON'T KNOWS

Test 1, Age 17, Year 75-76

(N = 5268)

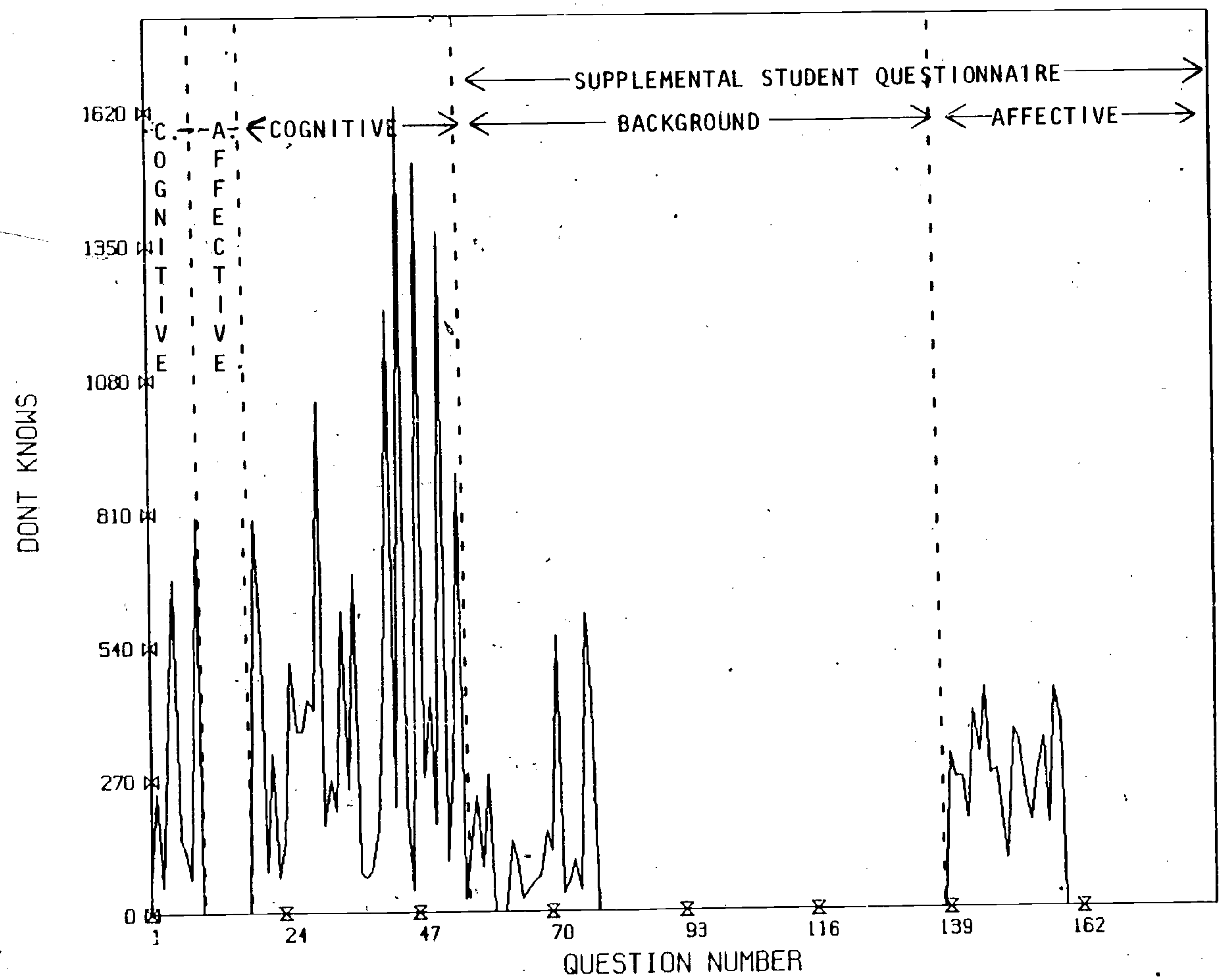

FIGURE VII

NUMBER OF NONRESPONSES

Test 1, Age 13, Year 75-76

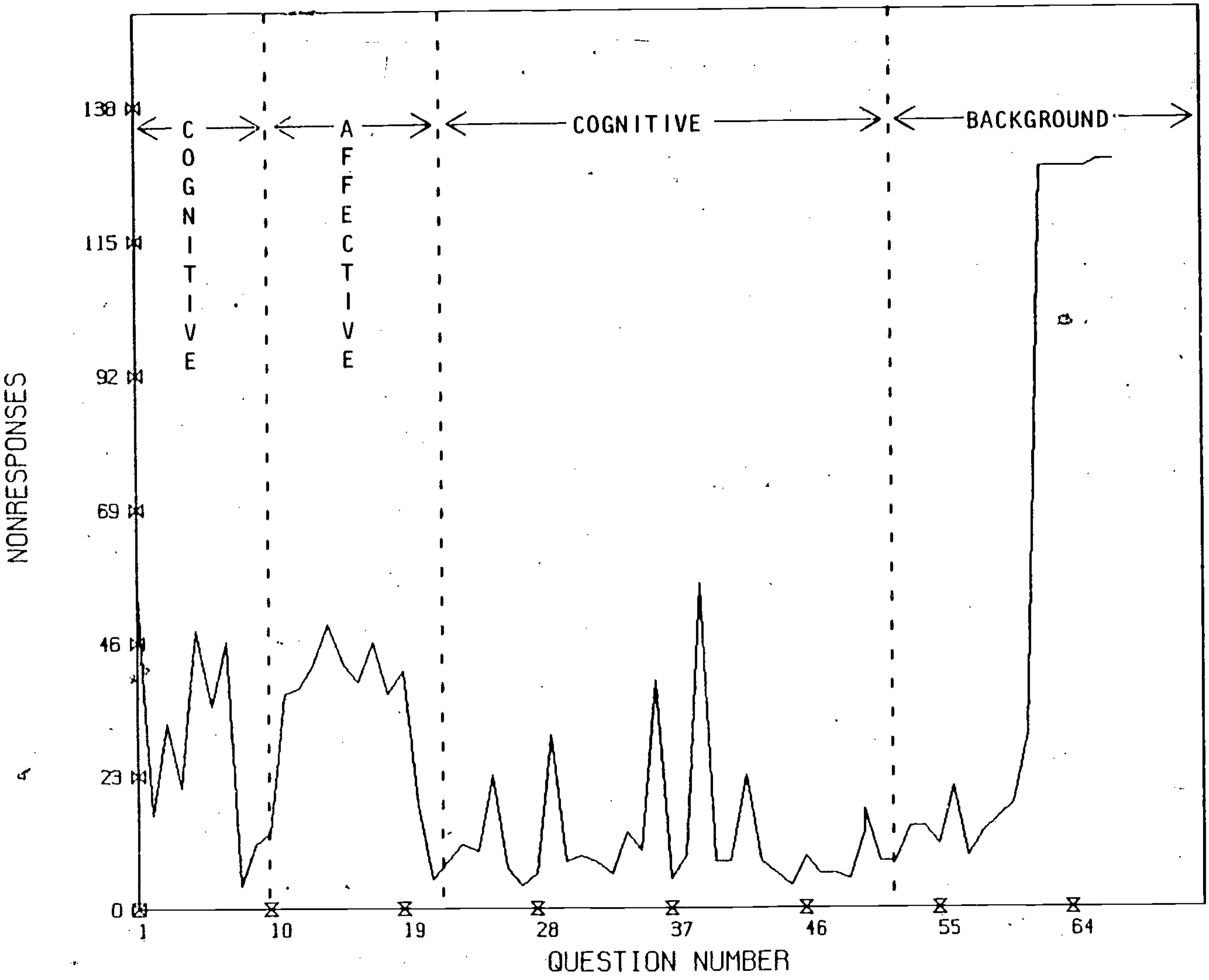

FIGURE VIII

NUMBER OF DON'T KNOWS

Test 1, Age 13, Year 75-76

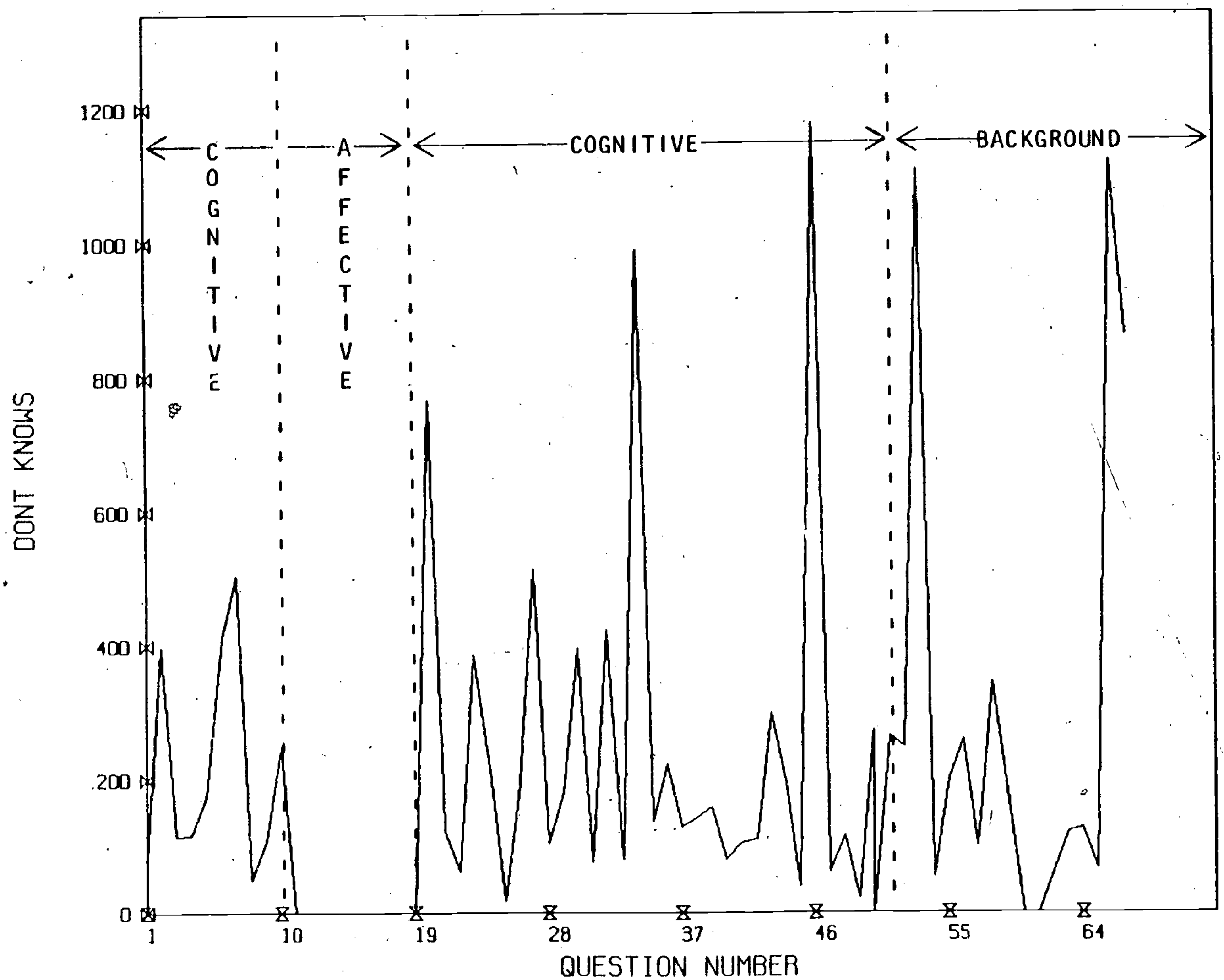

TABLE 1

ANALYSIS OF "DON'T KNOW" RESPONSES

Test S8, Age 17, Year 78 (N = 2216)

	MALE	FEMALE	MALE-FEMALE	WHITE	NON-WHITE	WHITE-NONWHITE	TOTAL
MEAN "DON'T KNOWS"	3.35	4.25	.90*	3.63	4.48	.85*	3.80
PROPORTION CORRECT ON COGNITIVE TEST	.568	.546	.022*	.590	.429	.161*	.557
PROPORTION CORRECT ADJUSTED FOR "DON'T KNOWS"	.578	.559	.019*	.601	.444	.157*	.569
DON'T KNOW BIAS (b)	--	--	.158	--	--	.025	--

* Significant at or beyond the .01 level

TABLE 2

ANALYSIS OF "DON'T KNOW" RESPONSES

Test S10+, Age 17, Year 78 (N = 2216)

	MALE	FEMALE	MALE-FEMALE	WHITE	NON-WHITE	WHITE-NONWHITE	TOTAL
MEAN "DON'T KNOWS"	2.57	3.54	.97*	2.89	3.07	.18*	3.07
PROPORTION CORRECT ON COGNITIVE TEST	.631	.592	.039*	.646	.484	.162*	.611
PROPORTION CORRECT ADJUSTED FOR "DON'T KNOWS"	.637	.601	.036*	.651	.492	.160	.618
DON'T KNOW BIAS (b)	--	--	.077	--	--	.002	--

* Significant at or beyond the .01 level.

Comments From a NAEP User

The "virgin" analyst planning on using the NAEP data is probably in for a larger task than he or she originally anticipates. If this hypothetical user believes the NAEP public use data tapes are roughly analogous to, for instance, the National Opinion Research Center public-use data tapes, they are in for a surprise. Because of the complexity of the entire NAEP design and data base, the process of understanding and using the NAEP data is lengthy and sometimes challenging. This report is intended to briefly document some of the joys as well as the trials and tribulations this research team encountered in three years of NAEP data use. Although the focus is more upon the trials and tribulations than the joys, by all means this should not be interpreted as a condemnation of the public-use data tapes produced by NAEP. Rather, these comments are meant to help NAEP staff further refine an already exemplary product. In the opinion of this research team, these public-use data tapes hold much potential for addressing many important issues relating to eduation in America.

I. The Instrument

Since this project focuses upon attitudes towards mathematics and related factors, it seems cogent to comment briefly upon the (currently) available set of instruments.

The attitudinal indicators included in the mathemathics test booklets provide the secondary analyst with relatively wide latitude in choosing measures. As we have demonstrated, most of the test booklets containing nine or more affective items will yield reliable attitude measures. Across the range of test booklets, there are different formats available for items (Likert, some open-ended), different attitude objects (math tasks versus mathematics in general), and also item sets not dealing with mathematics specifically (i.e., computers, self, school).

The analyses of the 1975-76 mathematics-attitude items demonstated the stability of response patterns across tests. A major criticism of much of the research pertaining to mathematics-attitudes has been the small samples and weak design of the studies, and consequently the lack of generalizability of results. Some of the major strengths of the NAEP design are the complex sampling design and the regulated testing conditions, yielding a high degree of generalizability of results.

Our major complaint with the attitudinal portion of the NAEP relates to the packaging of the items. Too often, attitude scales failed to achieve sufficient levels of internal consistency because only a couple of questions dealing with specific concepts (for example, perceived usefulness of mathematics) were included in an item set. General "attitudes toward mathematics" measures were obtainable from most test packages, but are probably less useful than the conceptually more specific measures.

Another problem of packaging is the lack of parallel item sets within age classes, or even across ages. It was useful and informative to examine the same set of items across four packages from the 1975-76 assessment. The potential for replication of research is an important facet. As far as we are aware, this is the only time NAEP has used parallel attitude item sets in a mathematics assessment.

The final criticism pertains to the lack of student background variables, and other important factors in the insturments. This is the single most limiting property of the NAEP data with respect to its potential for generating and testing theory-based models. Although the NAEP was not originally conceived for such research concerns, many secondary analysts may be frustrated by the omission of certain key variables.

II NAEP Procedures and Design

The very complexity of the NAEP's sampling design which permits a high degree of generalizability, can also be somewhat of an obstacle to many secondary analysts. The case-weighting process is relatively easy to perform for the analyst; however, the implications of using a weighted file are not always obvious. For instance, a researcher may wish to divide a sample into subsamples in order to replicate an analysis, or merely to save computer processing costs. Because each sample is actually a collection of subsamples of "PSU's" -- primary sampling units -- a technically correct approach to subsample generation would involve random sampling with PSU's. This becomes quite complex, operationally. Although the documentation includes a lengthy discussion of the sampling design, it is written in technical language not easily decipherable by those inexperienced with complex sampling designs. The sampling design also has a bearing on the choice of analysis procedures. Certain procedures, at least in SPSS, can not be performed on weighted files (i.e., generation of factor scores). Researchers may also be somewhat confused by something appearing on their computer output like "1094.2 cases."

III. The Documentation

We feel that without reading at least 80 percent of the extensive documentation provided with the public-use data tapes, it should be made illegal to access a data file. The information contained in the documentaton is essentail in preventing stupid and costly mistakes. Unfortunately, however, "documentation anxiety" is easily inspired by the reams of computer printout comprising one set of documentation including a test booklet, code book, data dictionary, user guide, and appendices one through eight. Everything you would ever want to know about the NAEP data is contained in the documentation; the completeness is unprecedented.

The major problem in using the documenation lies in determining where one should look for a specific piece of information. A concrete example would be helpful in illustrating these difficuties. In our earlier analyses of the mathematics data, we created cognitive subtests relating to specific topical areas in mathematics. In order to do this, it was necessary to categorize each cognitive test item into geometry, algebra, arithmetic, etc. This was accomplished using Appendix 4. We keyed the items into correct-incorrect codes using the codebook (our earlier version of Appendix 4 did not have correct response values listed). Finally, we used the microfiche listing of released items to examine the coding of open-ended items. This process has thankfully become much less tedious as the NAEP/ECS staff devises workable shortcuts.

In some places, the documentation is not entirely clear. For instance, in our attitude analyses of the 1975-76 data, being able to tell which items needed to be reflected (i. e., reversal of scoring), and which items already were reflected for purposes of scale construction was difficult. It was mentioned in one place in the user guide, but not in the codebook, which is the most useful and often-referenced piece of documentation included.

Outside of these minor problems, we feel there is basically very little NAEP could do that they are not already doing to improve upon the documenation. Considering the amount of information contained, it is fairly easy to use, due primarily to the organizational structure.

IV. Process and Problems From the User's Perspective

In preparing this report, the "methodology" involved laying out the steps we went throught to begin NAEP analysis. These are listed below, and a brief discussion of the problems encountered at each stage follows.

PROCESS:

1. Review documentation included with tapes from NAEP
2. Have tapes mounted, and read.
3. Copy codebook(s), user-guide, appendices, and SPSS (or other) control card file(s) onto disk, and then onto "hard copy."
4. Review more documentation.
5. Compute weighting factor.
6. Edit SPSS card file:
   - remove superfluous cards
   - add case-weighting statements
   - add creation cards for scales, etc.
7. Do a test run to check created variables.
8. Generate weighted system file.

PROBLEMS:

1,2 No problem, provided one understands computers well, or has a competent computer center to ask.

3. This involves several steps, and is relatively easy to do, after you've done it once. The major problem with printing out all of the documentation is the cost. At our university, each printed page costs about 4 cents, which means a complete set of documentation for analysis in one data file costs a substantial amount.
4. No problem, except as already discussed.
5. Also, no problem, once one understands where to look for the necessary information, and

how to calculate the weighting factor.

6. This is a time consuming process.
   - The "superfluous" cards include the somewhat "dangerous" FREQUENCIES GENERAL = ALL; and the value labels for the cognitive test items, which read "FOIL number 1," "FOIL number 2," etc. They are relatively useless from the user standpoint, and costly in terms of computer processing costs.
   - After you have calculated the case-weighting factor, you need to define a variable which weights the cases correctly. This is really no problem provided the "sum of weights" information in the user guide is accurate.
   - This is most time consuming, because of the tedious correct-incorrect recoding which needs to be done and any other scaled measures.
7. Performing tests, or "debugging" runs is not really a problem, provided you made minimal errors, and the informatin in the documentation is accurate and clear. The major problem here is the cost, which is enormous given the typical SPSS control card file of about 900 plus statements and a data file with at least 2,000 cases.
8. The system file generation is mostly a problem in terms of costs which for us typically ran between $25 and $45. We used quite a few computed variables and this inflated the cost substantially. Another problem which can occur at this stage involved successfully creating the save file, but exceeding allowable disk storage space and losing the entire file. This is the type of mistake you only make once.

Although most of these steps are cited as "nonproblematic," the virgin NAEP analyst can expect pain throughout the learning phase. The tapes are structured complexly, as are most things associated with the NAEP. After you have learned to deal with "documentation anxiety," various computer-related frustrations, and can come up with a feasible strategy for analysis, the NAEP data utilization is rewarding and productive.

...A team of seasoned

NAEP users