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Relation of biographical inventory responses to curricular choice and academic success

Robert Lee Lathrop

Iowa State College

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RELATION OF BIOGRAPHICAL INVENTORY RESPONSES
TO CURRICULAR CHOICE AND ACADEMIC SUCCESS

by

Robert Lee Lathrop

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Major Subject: Vocational Education

Approved:

Signature was redacted for privacy.

In Charge of Major Work

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Head of Major Department

Signature was redacted for privacy.

Dean of Graduate College

Iowa State College

1957
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I. INTRODUCTION

Historically, personal history forms have been one of the most common aspects of application to formal social, educational and vocational groups. Originally, most of these biographical forms served merely as classification or description devices. However, as the needs of industry and education became more and more specialized, due to their tremendous growth during and following World War II, the problems of selection, training and placement of personnel became of primary importance. As an attempt to solve many of these personnel problems, military, industrial and educational institutions turned to the use of psychological tests and evaluation devices.

Although testing has been very useful in many instances, psychological tests have not proved to be the panacea to all academic and personnel problems. It is reasonable, then, that attempts should be made to supplement test data with such other information as would increase the sensitivity of predictions. Since personal history data were often already available, or at least easily obtainable, the armed forces and a number of industrial concerns developed objectively scored personal history data forms in an attempt to improve their predictions. Although the results of investigations using personal history data forms have not always proved conclusive,
the results are definitely encouraging and investigations concerned with quantitatively scored life history forms will undoubtedly spread into other areas of research, possibly as explanations of behavioral phenomena such as interest and personality.

The use of the personal history form as an instrument for describing or predicting behavior involves the theoretical point of view that behavior is, at least in part, a function of previous experiences. The degree to which one is willing to subscribe to this point of view will largely determine the amount of faith one places in the biographical approach to explaining behavior. It shall by no means be the intention of this paper to debate the theoretical question of behaviorism, either pro or con, but rather to point out that such an assumption is involved in the personal history approach to predicting behavior.

From a strictly research point of view, personal history, often called biographical data, has many obviously desirable features. First, the data involve only the description of historical events; this is to say, events or experiences which have already occurred rather than speculation about the future. Second, the data do not depend upon training nor handicap an individual for lack of information. Questions asking for such decisions as, would you like to be a doctor, presuppose that the information is available to make such a deci-
sion. This is not usually the case. Third, biographical inventory responses are not easily subject to falsification. This is due to two main reasons; 1. The tendency to distort a factual question is not as great as to distort an opinionated response (17, 26); and, 2. Since the keying of the items is usually empirical, the direction to distort the response is not always obvious. Fourth, the information is easily obtained administratively, often as a part of an application form. Fifth, although reliability is reflected in the previously mentioned advantages, biographical data are highly reliable; assuming questions are asked concerning events or factual information which can reasonably be expected to be known by the individual.

The present research is one of the first exploratory investigations in determining the quantitative usefulness of biographical inventory data in an academic setting. The specific purpose of this study was to answer two questions concerning the usefulness of biographical inventory responses. First, is it possible to discriminate between certain curriculum groups on the basis of an objectively scored biographical inventory; and second, is it possible to differentiate between two achievement groups on the basis of biographical inventory responses?

These two questions concerning the value of biographical data are only two of the multitude of questions concerning the
use of such informational data. It is hoped, that, if the results of the present research prove encouraging, the usefulness of biographical data for explanatory, descriptive and/or predictive purposes in other contexts will be investigated.
II. REVIEW OF LITERATURE

Upon review of the literature, it was found that a substantial number of studies had been conducted using either a biographical inventory or some variation of a personal history data form. In addition to the research directly dealing with biographical data, a vast amount of literature exists concerning the methodology of personal-history and/or item analysis. Since the literature dealing with the methodology and analysis of biographical data has been so adequately and recently surveyed by Clark and Gee (7), no attempt will be made to include reviews of the methodological literature except for topics of specific interest to this study that were omitted by Clark and Gee. As a result, this review will be confined to articles and publications in which a biographical or personal history form was used.

The studies dealing directly with biographical data can be broadly grouped into three types of studies, depending on the nature of the group being studied. The first type of study deals with the use of biographical data for commercial or industrial selection and placement. In an attempt to introduce continuity, the studies will be reviewed in chronological order beginning with a paper by Kurtz (21) read to the Psychometric Society in 1939. Undoubtedly, industrial concerns had been using personal history data obtained from
application forms previous to Kurtz's study, however the re-
port by Kurtz presented one of the earliest descriptions of a
controlled study of the usefulness of such data for selection.
Kurtz's paper described an investigation using biographical
data in which he reported that it was possible to discriminate
effectively between potential salesmen who would remain with
the concern being studied for one year or more from those
salesmen who would leave the company before the one year
period. Kurtz also reported that the biographical data would
discriminate between high and low volume salesmen.

In a second study, Ohmann (30) reported, that by means
of an objectively scored biographical inventory, he was able
to discriminate with 70-80% effectiveness those persons who
would be successful salesmen for a light manufacturing com-
pany. Stead and Shartle (40), in their book, reported on a
study of sales personnel in which correlations of .19 to .29
were found between an objectively scored personal data blank
and sales success. Stead and Shartle further reported finding
correlations of .30 between the personal history blank and a
personality inventory.

As early as 1943, in a review of studies dealing with
selection of salesmen, Bolanovich and Kirkpatrick (3) reported
that the most effective "tools" for identification of poten-
tially successful salesmen were personality, interest, and
personal history inventories. This conclusion was confirmed
later by Husband (16) in 1949, with special emphasis on the value of objectively scored personal history forms.

In a study conducted by Tiffin et al., (14,2) to determine if it was possible to identify applicants to an optical manufacturing concern who would remain with the company long enough to balance their training costs, Tiffin reported that certain biographical factors did separate workers on the above criterion. Tiffin reported that such factors as age, number of dependents, and education appeared to be related to the length of time a worker would remain with the company. No mention of cross-validation was made, so evidence of reproducibility of findings was not furnished. Kerr and Martin (19) conducted a study in which biographical history data were found to correlate .35 with supervisors ratings of job success. On the basis of their findings, Kerr and Martin suggested that the use of an objectively scored biographical inventory become a standard part of personnel testing. Again, no mention was made, in the report, of cross-validation of the correlation between job ratings and personal history data.

It was not until about 1950, that a study relating to the validity of biographical inventory responses themselves was conducted. Keating, Patterson and Stone (18) investigated the distortion (falsification) or rather lack of distortion, of personal history responses by applicants concerning previous work experiences. The assumption underlying the study was
that applicants would be motivated to provide distorted reports in order to get better jobs. Results of the study, however, indicated that there was remarkably little tendency for workers to supply false information and that the errors reported did not consistently favor the workers. In a subsequent study by Mosel and Cozan (27), Keating's results were verified with the exception that, in the few errors reported, there was a tendency to favor the workers.

In a second study by Mosel (26), it was found it was possible to discriminate between the high and low sales personnel when a criterion of employee-cost per sales-dollar was used. It appeared that a great deal of care was used in arriving at a criterion measure free from interdepartmental variability. Mosel found that 12 personal history items discriminated between the high and low employees and that these differences held up under cross-validation. The author (Mosel) concluded that biographical data were useful for selecting potential department store sales personnel.

Spencer and Worthington (39) reported on the results of a study with a light manufacturing concern that if they had used the personal history form alone, they (Spencer and Worthington) could have selected salesmen who would have shown a gain in sales volume over unselected salesmen of 34%. Specifically, correlations with the biographical data of .34 and .31 were reported for tenure and sales volume, respec-
In a somewhat different context, but still dealing with employee selection, Parker (32) reported that several personal history correlates were found with truck drivers having so-called non-preventable accidents. The relationship was, however, quite low and Parker did not mention cross-validation.

Clark and Owens (5), using a sample of subjects from a large midwestern publishing company, made an evaluative study of the Worthington Personal History Blank. They found it less highly correlated with supervisors ratings, on a number of traits, than certain commonly employed standardized psychological tests and questionnaires allegedly measuring the same characteristics. Peck and Stephenson (33) pointed out, with justification, that the criterion employed was less than ideal. However, as Owens (31) replied, criterion fallibility limited personal history validity no more than test validity. The Worthington blank, however, is atypical in that it is interpreted projectively and subjectively rather than objectively and empirically. Thus, it only superficially resembles scored life histories.

In an interesting and rather well controlled study by Dunnette and Maetzold (10), an attempt was made to identify seasonal workers who were most likely to remain with a large food processing concern during the entire work-season. The study was carried out over a two year period of time with the
biographical inventory scoring keys developed during the first year and cross-validated during the second year. Results of the study indicated that the scored personal data form would discriminate between good and poor employee risks and the authors of the study suggested, since the scored biographical inventory had previously proved effective for selecting sales and other skilled personnel, such an instrument could now prove useful for selecting workers for certain unskilled occupations.

Soar (38), in a study designed to select potentially successful service station managers, found that 14 of the original 39 biographical inventory items discriminated among his criterion groups; and he reported a triserial correlation of .47 against a criterion of supervisor ratings. As a result of an extremely small sample, Soar used an interesting cross-validation technique suggested by Katzell (17).

In a recently completed study by Shearer (35), it was reported that biserial correlations of .75 and .30 were found between a personal history form and a truncated upper-lower, one-fourth dichotomy of foremen. As suggested by Shearer, these correlation coefficients are undoubtedly inflated. However, they do suggest the worth of objectively scored personal history for foremanship selection. The absolute value of such data is, as yet, not determined.

In summary, reports in the literature of the industrial
and commercial studies which used objectively scored biographical inventories present overwhelming evidence in favor of the use of such data for personnel selection. Although such evidence does not necessarily prove that biographical data would be of value in the selection of a vocational choice, they do present strong evidence in favor of personal history correlates to vocational success. If one can assume that vocational success and choice are functionally related, then the use of biographical data for making vocational choices is inferred from the usefulness of such data in predicting vocational success.

The second type of study reported in this review, of research using personal history forms, deals with studies of military personnel. Actually, the problems precipitating the use of personal history data in a military context are very similar to the placement problems of industry. Since some time has already been devoted to discussing selection and placement uses of personal history forms; and further, since the military studies essentially confirm what has already been described in connection with industrial studies, only brief mention will be made of the military research with biographical inventories. This is not to infer a lack of such studies. As a matter of fact, the development of the biographical inventory as a psychological tool came into its greatest prominence as a result of the extensive research
programs of the military services during and following World War II.

Perhaps the greatest contribution of the military projects to the use of biographical data has been in the areas of methodology. Although mention of methodology has been made in connection with the review by Clark and Gee (7), two studies of particular interest to the present research are the study by Clark (6) and the study by Lecznar (22).

Mention should also be made of a study by Ellis and Conrad (11) in which a very comprehensive review of the use of personal history data in the services was made.

One final study of military personnel which presented itself in connection with the question of achievement and personal history data was conducted by Levine and Zachert (23). It was reported by Levine and Zachert that personal history data correlated with final achievement in 24 air force technical schools from .00 to .54 with a median correlation of .26.

The third group of studies reviewed dealt with the use of biographical inventories in academic settings.

One of the earliest studies was reported by Asher and Gray (1) in which a personal history blank was validated against two criteria of college success, survival and point-hour ratio. Asher and Gray reported correlations between personal history scores and survival, and personal history
scores and point-hour ratio of .398 and .309, respectively. When the personal history scores were combined with an intelligence measure, the multiple correlations with survival were .521, and .585 with point-hour ratio.

In an attempt to predict tendency to enter college, from a personal history form, Bittner (2) found eight of his original 33 items were related to the dichotomy of entrance or non-entrance to college. By use of a multiple regression technique, Bittner combined the eight items, found to discriminate, into a prediction equation having a multiple biserial correlation of .536.

In a more recent study by Myers (28) of the relationship of biographical factors to academic achievement in a women's liberal arts college, it was reported that seven items were related to achievement. In an attempt to determine if the biographical inventory data would contribute to a multiple correlation with high school grade point average and the College Board Scholastic Aptitude Test, the three predictors were combined; the multiple coefficient of correlation was .65. When only the grade point and College Board Scores were combined, the multiple correlation was .62. Although the loss from .65 to .62 was of little practical consequence, it was significant, statistically, at the .01 level. The author, Myers, then concluded that the biographical inventory did make a contribution to the multiple regression equation. Although
the increase was small, it was never the less an indication, and might have been of more practical significance had more than seven discriminating items been found.

In another study, Myers and Schultz (29), using a biographical inventory, high school average and College Board Examination Scores, found that the personal history data raised a multiple correlation from .63 to .64. Although the increase was conceded, by the authors, to be small, they state that the increase was independent of the other predictors. In which case one would have to conclude that biographical data also had little relationship to the criterion. As a second phase of the study, Schultz and Green (34) administered the biographical inventory to a new sample of entering students and found a nonsignificant contribution to the multiple relationship with College Board Scores and grade point average. As a new innovation, the Schultz-Green study used a method of item selection outlined by Gulliksen (15); however, the new method proved to be less stable than the original method when subjected to cross-validation. Schultz and Green concluded that, although the results of their study did not verify the value of biographical data for predicting academic achievement, they felt that further study should be made of this problem.

Malloy (25) conducted a study at Nebraska designed to,

1. Determine the effectiveness of a biological inventory to
predict college marks when combined with pre-registration test data, 2. Determine the relative effectiveness of two inventory scoring methods, and 3. Identify biographical responses and attitudes associated with first semester achievement. Malloy's study, using a 201 item inventory, found that personal history data made a significant contribution to a multiple regression equation when combined with ACE and English placement scores. The multiple relationship with grades was raised from .494 to .555 for men and from .515 to .587 for women.

Siegel, (36, 37) in a two part study, attempted to construct a personal history form which was composed of a number of independent clusters of items each of which was designed to measure some personality trait. Siegel's inventory consisted of 10 clusters having low intercorrelations and high reliability. Upon validation of the instrument against grades, he found a curvilinear relationship (Eta = .48) between one of the clusters (action) and grade point average. When Siegel correlated personal history clusters with standard personality measures, he reported correlations from .22 to .60.

In summary, the studies reviewed dealing with biographical data in an academic setting, are not as conclusive in favor of such data for predicting achievement in college as were the studies predicting vocational success. Although multiple correlations of .52-65 were reported for the rela-
tionship of personal history data, test scores, and previous achievement, with grades, the specific contribution of the biographical data to the multiple appears to vary depending on the other test data used.

Although a large number of studies were found in the literature concerning interest measures and college program selection, it was interesting to note that no study of the biographical inventory being used for college curriculum choice was found. This fact, plus the lack of conclusiveness concerning personal history correlates of achievement, encouraged the investigator to attempt an exploratory study of the relation of personal history factors to curriculum choice and, as a secondary consideration, to attempt to contribute the literature concerning achievement correlates of biographical data.
III. METHOD OF PROCEDURE

A. Development of the Inventory

The items used in the present biographical inventory originated from three main sources. A number of the items were suggested, in part, by items used in Shearer's (35) study of industrial foremen. Since the items used by Shearer were originally developed for use with a non-college group, most of these items were revised to be more appropriate for a college population. A second group of items was written directly by the investigator. Most of the items in the second group pertained to previous educational experiences and activities.

The third source of items was a committee of staff members who edited the items from the two previous sources and made helpful suggestions concerning additional areas of inquiry.

A total of 179 items was included in the final questionnaire form. Each of the items consisted of a statement (or question) and five non-mutually exclusive response choices. The fact that the response choices were not always mutually exclusive, often allowed opportunity for more than one response choice to be marked for a given item. Similarly, it was not always necessary to respond to an item, if none of
the response choices was appropriate. A copy of the inventory is included in the Appendix.

In order to simplify the analysis, it was decided to use separate IBM machine scored answer sheets. In addition to expediting the analysis, using separate answer sheets allowed the possibility of re-using the inventory booklets.

B. Selection of the Sample

Since the purpose of the present study was to answer two different questions concerning the value of biographical data, it was necessary to use two different criteria. In order to evaluate the inventory for discriminating between curriculum groups, it was necessary to define the curriculum groups to be compared. Somewhat arbitrarily it was decided to use juniors and seniors in each of the curricula being compared. In defense of such a decision, there is good evidence that after a student becomes a junior in a given curriculum, there is little tendency to shift to another curriculum.

In order to evaluate the use of biographical data for discriminating between achievement groups, it was decided to divide the sample at median grade point average. The decision to divide the sample at the median was made in the interest of conservatism, as a dichotomous division at the median is the most difficult separation to demonstrate.
At this point a brief comment concerning the organization of Iowa State College would be helpful. The academic organization consists of five major areas of study called divisions. Specifically these divisions are, Agriculture, Engineering, Home Economics, Industrial Science and Veterinary Medicine. Within each of these divisions exist a number of major programs called curricula. The present inventory was administered to juniors and seniors in the following eight curricula at Iowa State College:

1. Aeronautical Engineering
2. Agricultural Engineering
3. Chemical Engineering
4. Civil Engineering
5. Electrical Engineering
6. Industrial Administration
7. Industrial Engineering
8. Mechanical Engineering

Arrangements were made with the chairmen (heads) of the various departments concerned to distribute the inventories to the juniors and seniors in their departments. In order to assure at least a minimum amount of uniformity in the directions given during the administration of the inventory, a sheet of instructions was provided to each of the persons distributing the inventories. A copy of this instruction sheet is shown in the Appendix. Practically none of the departmental chairmen was willing to insist on 100 percent return of the inventory but rather preferred to ask for voluntary co-operation on the part of the students. As a
consequence, it was not possible to obtain 100 percent return of the inventory.

In a study such as the present one, inability to obtain 100 percent returns would allow the possibility of introducing a bias into the criterion. This bias, however, will not be serious if it is reasonable to assume the reasons for not returning the inventory were not a function of the curricula being studied. That is, the reasons for students not responding was essentially the same regardless of curriculum. Although the assumption of no bias can quite reasonably be made in regard to the curriculum differences, such an assumption is less tenable with respect to achievement differences. It is entirely possible that refusal to return the inventories may be related to the achievement grouping. Even though it was not possible to obtain 100 percent returns, it was decided to perform a preliminary analysis recognizing that such a bias could exist.

A summary of the number and percentage of inventories returned is shown in Table 1. The answer sheets for each curriculum group were divided into two achievement groups on the basis of their reported grade point averages. At Iowa State College, grade point averages are reported according to the following system: A = 4, B = 3, C = 2, D = 1 and F = 0. The point of division was 2.50, the median grade point for the entire group disregarding curriculum classification. Table 2
Table 1. Number and percentage of returns classified by curriculum

<table>
<thead>
<tr>
<th>Curriculum</th>
<th>Inventories distributed</th>
<th>Inventories returned</th>
<th>Percentage returned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aeronautical Engr.</td>
<td>60</td>
<td>45</td>
<td>75</td>
</tr>
<tr>
<td>2. Agricultural Engr.</td>
<td>29</td>
<td>28</td>
<td>97</td>
</tr>
<tr>
<td>3. Chemical Engr.</td>
<td>73</td>
<td>48</td>
<td>66</td>
</tr>
<tr>
<td>4. Civil Engr.</td>
<td>134</td>
<td>103</td>
<td>77</td>
</tr>
<tr>
<td>5. Electrical Engr.</td>
<td>232</td>
<td>180</td>
<td>78</td>
</tr>
<tr>
<td>6. Industrial Admin.</td>
<td>201</td>
<td>154</td>
<td>77</td>
</tr>
<tr>
<td>7. Industrial Engr.</td>
<td>129</td>
<td>108</td>
<td>84</td>
</tr>
<tr>
<td>8. Mechanical Engr.</td>
<td>171</td>
<td>119</td>
<td>69</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1029</strong></td>
<td><strong>785</strong></td>
<td><strong>76.3</strong></td>
</tr>
</tbody>
</table>

is a summary of the number of answer sheets classified by both achievement group and curriculum. Upon examination of Table 2, it can be observed that achievement data were not available for 14 respondents and these 14 answer sheets were eliminated from the achievement comparison.
Table 2. Number of inventory answer sheets classified by achievement and curriculum

<table>
<thead>
<tr>
<th>Curriculum</th>
<th>G.P.A. 2.50 or above</th>
<th>G.P.A. 2.49 or below</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aeronautical Engr.</td>
<td>27</td>
<td>18</td>
<td>45</td>
</tr>
<tr>
<td>Agricultural Engr.</td>
<td>12</td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td>Chemical Engr.</td>
<td>27</td>
<td>12</td>
<td>39</td>
</tr>
<tr>
<td>Civil Engr.</td>
<td>37</td>
<td>66</td>
<td>103</td>
</tr>
<tr>
<td>Electrical Engr.</td>
<td>124</td>
<td>56</td>
<td>180</td>
</tr>
<tr>
<td>Industrial Admin.</td>
<td>55</td>
<td>98</td>
<td>153</td>
</tr>
<tr>
<td>Industrial Engr.</td>
<td>39</td>
<td>68</td>
<td>107</td>
</tr>
<tr>
<td>Mechanical Engr.</td>
<td>63</td>
<td>56</td>
<td>119</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>384</strong></td>
<td><strong>387</strong></td>
<td><strong>771</strong></td>
</tr>
</tbody>
</table>

*This total does not include 14 answer sheets which were irregular with respect to achievement data and were omitted from the achievement comparison.

C. Method of Analysis

As suggested by Thorndike (41), each of the five options for each of the 179 items in the inventory was analyzed separately, making a total of five times 179 or 895 item response per answer sheet.

For some types of tests, such as biographical data questionnaires, it will be appropriate to analyze each response option for each item separately,
and to key any response option which has a validity coefficient whose absolute size without regard to sign comes up to the specified minimum.

The answer sheets were assembled into achievement, curriculum combinations and the total number responses to each item option for each achievement, curriculum group were summarized by use of the graphic item counter attachment on a type 805 IBM test scoring machine. The frequency counts for each item response were then transferred to IBM cards for each curriculum-achievement group. This transfer to IBM cards made it possible to obtain the total number of responses made to any item option for any combination of curriculum and/or achievement grouping.

It was decided to use, as a measure of item discrimination, the difference in percentage of response to each item choice between the groups being compared. Findley (12) had shown by both logical and mathematical derivation, that the use of the number of responses right in the top group minus the number right in the bottom group is equivalent to the percent of maximum possible discriminations. Since, when dealing with a biographical inventory there are no "right" or "wrong" answers, it is necessary to use the percentage of the total group selecting, or not selecting, an item option. Findley had shown that use of response difference as an item discrimination index was not subject to the inflation incurred by biserial coefficients when the percentages of response are at
the extremes of the percentage range but is constant throughout this range for any given percent difference.

The percentage differences for each item option were computed for each of the three discriminations to be made.

1. Industrial Administration vs. Industrial Engineering
2. Industrial Administration vs. Engineering Student in General
3. High vs. Low Achievement Groups

Although Findley did not suggest the practice, the standard error of the difference between the group responses was computed. From the item difference and the standard error of the item difference, it was possible to compute a confidence interval for each item difference. Originally, it was decided to compute 84% one-tailed, confidence intervals. Items with 84% confidence intervals greater than zero would have less than one chance in six of being included in the scoring key just by chance factors. In the interest of conservatism, it was decided to select only items for the scoring key that had differences at least two standard errors above zero. The restriction to items having differences of two standard errors or more above zero would allow the expectation of an item being included in the scoring key, which would be included due to random chance factors alone, of less than one in 20. The requirement of two standard
errors above zero was essentially the same as selecting items significantly different from zero at the 95\% level.

The items to be included in the scoring key were identified and IBM test scoring machine keys were punched for each of the three comparisons to be made. In making the scoring keys, it was necessary to punch two sets of keys for each of the comparisons to be made, one set for the items to be scored +1 and a second set for the items scored -1. The plus and minus signs serve merely to identify in which of the two groups the response percentage for that particular item option was larger. The decision to use unit weights (*1) was made on the basis of work done by Clark (6) on weighting of a vocational interest inventory for the Navy. Clark's work found no significant advantage in using a key weighted by Strong's formula over using a unit weight key. This finding by Clark was in agreement with Thorndike (41), who stated:

> In the usual test blank, refined weighting of items is not possible. In most cases, the only point at issue is whether to include an item or not (i.e., whether to weight the item 1 or 0). Practical convenience in test administration and scoring argues against differential weighting of items, and evidence for the value of such refined weighting has not been sufficiently convincing in most cases to overcome considerations of practical convenience.

The answer sheets involved in each of the three comparisons were then scored using the punched keys and the means and standard deviations of the resulting distributions of
scores were computed. Tests of significance of the difference between the means of the various groups being compared were computed. Although tests of significance are inflated when computed for the same sample upon which the keys were developed, due to chance factors, t-values widely divergent from the usual levels for significance are indicative of separations not due to chance. As a further descriptive measure, the separation of the means was described in terms of the standard deviation of the total group.
IV. DIFFERENTIATION BETWEEN INDUSTRIAL ADMINISTRATION STUDENTS AND ENGINEERING STUDENTS-IN-GENERAL

For purposes of this investigation, the engineering, students-in-general group will be defined as juniors and seniors from the seven following engineering curricula:

1. Aeronautical Engineering
2. Agricultural Engineering
3. Chemical Engineering
4. Civil Engineering
5. Electrical Engineering
6. Industrial Engineering
7. Mechanical Engineering

The engineering students-in-general group was composed of 619 students. The industrial administration group consisted of 153 juniors and seniors from the industrial administration curriculum. The item response frequencies were obtained and item response percentages for each group were computed by dividing the item response frequency by the total number in that group. From the item response percentages, it was possible to compute the differences in response percentage for the two groups being compared. It was also possible to compute the standard error of the difference in response percentage and thus select items for the scoring key in terms of their probability of discriminating due to chance factors. Items
were chosen for the scoring key which had less than one chance in 20 of appearing in the key just due to chance fluctuations in the criterion sample.

The scoring key consisted of 118 item options of which 62 were scored as positive, indicating the larger item response percentage in the industrial administration group, and 56 items were scored negatively, indicating the larger item response percentage in the engineering in-general group. Table 3 is a listing of the identification number and sign of each of the items on the scoring key. The answer sheets for the 772 students were scored and the frequency distributions of the scores are presented in Table 4.

It was observed that the scoring key achieved a definite separation of the criterion groups. The mean score of the industrial administration students was 12.20 and the mean of the engineering students-in-general was -7.09. The difference in the means was 19.29 points. A t-value of 24.61 was calculated for the significance of the difference between the means of the two groups. This value was significant far beyond the 1% level. To calculate an index of the separation of the means in terms of the variability of the total group, the standard deviation was found to be 11.59 points and the separation was calculated to be 1.66 standard deviation units. It was, therefore, concluded that the evidence from this research would confirm the hypothesis, that it was possible to
Table 3. Identification number and sign of item options scored on the industrial administration and engineering in general key

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discriminate industrial administration students and engineer-
ing students-in-general on the basis of objectively scored biographical inventory data.

In Table 4, examination of the frequency distributions indicated the curriculum group within engineering having the least separation from industrial administration students was the industrial engineering group. However, the difference of 10.95 points between the industrial administration and industrial engineering group means was also highly significant.

An attempt was made to logically group the item responses, found to discriminate, into clusters of similar responses. A first cluster of items dealt with the respondents' personal characteristics. In the interest of brevity, industrial administration will be shortened to IA and engineering students-in-general to EG.

1. The IA reported a larger percentage of students between 20-21, while the EG reported more students over 25 years of age (1c, 1e, 86e).

2. The IA reported a larger percentage of students between 5'5" - 5'7" in height than did the EG group (4b).

3. A larger percentage of the IA group reported having gambled and played golf while the EG group reported a larger percentage of group having repaired an appliance and taken care of a garden.
4. A larger percentage of EG reported hobbies, such as electronics, radio, hi-fi, etc., repairing or making furniture, while more IA reported sports and athletic hobbies (50a, 51a, 52c).

5. Concerning use of leisure time activities, the EG reported a larger percentage were interested in "puttering around." While the IA group reported being interested in "being around people" (95b, 95c).

6. A larger percentage of EG students found their personality difficult to describe than did the IA students (108a).

7. A larger percentage of IA students reported themselves as "fairly relaxed" persons than did EG students; however, they also reported a higher incidence of allergies (118d, 123a).

8. The EG group reported a larger percentage of people being able to fall asleep within 15-30 minutes, as well as having grown, physically, at an average rate during teens (117c, 122c).

9. In listing preferences, the EG reported more people who disliked meeting strangers and winning them over, while the IA reported more dislikes for reading (144d, 144e).

10. In terms of reading choice in newspaper, the IA group
reported skipping no section of newspaper consistently and preferred such things as current and political events (146b, 154b) and reported reading 2-4 serious non-fiction books last year, and 3-4 fiction books, while the EG group reported a larger percentage having read no fiction books (158c, 164a, 164c).

11. A larger percentage of EG reported owning one suit, while more IA reported owning 4 or 5 suits (152a, 152c).

12. A larger percentage of EG reported personally buying some, but less than $5,000 life insurance and owning cars two to three years old (151b, 153c).

13. The EG group felt they "did least well" talking and best when working with numbers while just the opposite was true in the IA group (165c, 165d, 166c, 166d).

Another cluster of items dealt with the individuals' family history.

1. A larger percentage of the EG spent most of their first 18 years in a rural background, while a larger percentage of IA group came from good (not best) section of town (7a, 11b, 11e, 56a, 111a).

2. In regard to parental occupation, the EG group reported more fathers farming while the IA group
3k reported more fathers as salesmen (17b, 17c).

3. The EG group reported more fathers helping learn to use tools than did IA group (19a).

4. A higher percentage of the IA group reported their parents were quite lenient, while the student was in high school (29d).

5. A larger percentage of EG group felt that all the children in the family were treated alike and that they quarreled occasionally; that of the persons with whom they came in contact, their parents "picked on" them the most. While the IA group felt they had fewer quarrels with brothers and sisters (30b, 41b, 41c, 42c).

6. The IA group were given first responsibility for choosing their own clothing while in junior high school (107a).

7. A substantially larger percentage of IA group reported that they had spent their last vacation in northern United States (112a).

8. A larger percentage of IA students reported discussing difficult problems with a friend or wife (128c, 155b).

9. The EG group reported as children they had tried to hide their feelings when angry and would prefer to discipline children by spanking or punishing the
child to let him know why he is being punished (109e, 129c).

A third cluster of items were concerned with the individuals' present and previous academic experiences.

1. The IA group report the school years as being the happiest period of their lives (38b).

2. A larger percentage of the EG group reported themselves as considerably above average students in high school and specifically the IA group reported more grade point averages between 2.00 and 2.50 (59a, 60d).

3. A larger percentage of the EG group reported enjoying physical science, chemistry, physics and mathematics subjects most, and history, economics and civics subjects least, while just the opposite trend was reported by the IA group (61a, 61c, 62a, 62b, 62c).

4. Essentially, the same pattern held true with regard to difficulty with school subjects. The EG group reported least difficulty with sciences and mathematics and most with history, economics and civics, while just the opposite was true with the IA group (63a, 63c, 63d, 64a, 64c).

5. In regard to actual achievement, the EG group reported making more A's in mathematics and science
courses and the IA group reported more C's (66a, 66c, 68a, 68c).

6. The EG group also reported a larger percentage of persons who had taken chemistry (67d).

7. More of the IA group felt that their high school preparation for college was weak in certain areas than did the EG group (69b).

8. In regard to the type of course preferred, the IA group preferred discussion courses and the EG group preferred problems, mathematics courses (70a, 70d).

9. A larger percentage of the IA group participated in school clubs, as chairman and in class offices than did the EG group (71d, 72b, 74c).

10. In regard to solving hard school problems, the IA group asked school mates for help while the EG group reported that they "dug" for themselves (78b, 78e).

11. A larger percentage of the IA group reported that, they have always planned on attending college, they would choose the same curriculum in another school, they have considered quitting school at least once, while a larger percentage of the EG reported that they would choose the same curriculum "here" if they were to enter college now (80a, 82a, 82b, 83b).

A fourth group of items relate to the individuals' past and present vocational plans and experiences.
1. More of the EG group felt that the opportunities for graduates in their field were better than in most others, while the IA group felt opportunities were "about the same" as most other fields (84a, 84b).

2. A larger percentage of the EG group plan to take part time graduate work, and more of the IA group planned to go into the service upon graduation (85c, 85d).

3. A larger percentage of the IA group reported having the least difficulty on previous jobs with lack of friendlessness of fellow workers and disliked most their inability to plan future around their job (193a, 173a, 173e).

4. A larger proportion of the IA students reported that they felt they would eventually take sales, management or personnel jobs, while a larger proportion of the EG reported planning to take jobs in design or research (168a, 168b, 168c, 168d, 168e).

5. The EG group reported a larger percentage of students who said that they had not changed their vocation plans since high school, while the IA group reported changing their plans two or three times (169a, 169c).

6. In terms of rating themselves, the IA group reported more persons who felt they could be in the top five percent as a supervisor, while the EG group rated
themselves between the upper half and less than upper 20 percent. In terms of working speed, the EG group rated themselves as somewhat slower than most people (175a, 175c, 177c).

7. The IA group reported a greater preference for working with people, while the EG group reported preferring working with ideas and things (178c, 178d, 178e).

8. In describing the profession which their parents would like them to enter, the IA reported either business or no preference, while the EG reported a profession (179a, 179c, 179d).

A fifth group of items was concerned with the individuals' social contacts.

1. The IA group reported a larger number of persons indicating that they had "many" close friends while in high school (89d).

2. In regard to being selected for teams and leadership responsibilities, the IA group reported usually being picked near the first for games and being the leader in social groups more often than their share of the time. In contrast, the EG group reported usually being picked about the middle for games (98a, 98b, 102c).

3. While in high school, the IA group reported "going
out" three nights per week while the EG group reported less than one per week (99a, 99d).

4. In regard to organizing various activities, a larger number of the IA group reported assisting or personally organizing an athletic team, sports competition, literary, debating, choral or social club (156a, 156c).

5. Two miscellaneous items of a social nature in which the EG group reported a larger percentage were, number of new friends made in the last year (three to five), and number of speeches made in past year (none). (91c, 167a).

In summary, the items scored on the industrial administration vs. engineering students-in-general key when clustered rationally, fell rather nicely into five groups. A first group of items dealt with personal characteristics of the individual, age, height, hobbies, leisure time activities, personality evaluation, reading habits, and several miscellaneous personal items. A second group of items was concerned with the individuals' family history, home location (urban-rural), parental occupation, amount of independence, relations with siblings and reports of impression of their childhood. The third group of items related to the individual's previous and present educational experiences, reaction to school, previous achievement, choice of subject, easy and difficult
subjects, specific course grades, impressions of high school preparation, types of courses preferred, clubs and activities participated in, and college program plans. A number of items were included in a fourth group which dealt with the individual's vocational and work experiences, future vocational plans, and type of working conditions they preferred. The final group of items dealt with the individuals' social relations, number of friends, group leadership, amount of social activity while in high school, and several miscellaneous items of a social nature.

If all 895 item responses were independent, and the decision concerning the allowable chance error was made as five percent, then one could theoretically expect 45 items to appear in the scoring key just due to chance factors. In fact, all 895 item responses are not independent (the exact number is difficult to establish) and many of the items were selected at chance levels of less than one percent, depending upon the standard error of that specific item. As a consequence, the exact number of items included in the scoring key, just by chance, would be very difficult to determine from rational considerations, and in the final analysis would not be nearly as meaningful as an empirical cross-validation. Even if one could determine the exact number of items included in the scoring key by chance, there is no way to identify which of the keyed items these chance inclusions would be. Thus, al-
though a great deal of logical care was exercised in keeping chance items from appearing in the scoring key, one must resort to cross-validation to determine the empirical consistency of the key to discriminate.
V. DIFFERENTIATION BETWEEN INDUSTRIAL ADMINISTRATION STUDENTS AND INDUSTRIAL ENGINEERING STUDENTS

The biographical inventories of the 153 industrial administration and 107 industrial engineering students were item-analyzed to determine if there were differences between the percentage of students responding to each item choice in the two curriculum groups.

A scoring key, made up of items having response differences of at least two standard errors above zero was made and was used to score the industrial administration and industrial engineering students' answer sheets. This key, hereafter called the 95% key, consisted of 46 items. A list of the item numbers and the scoring, plus or minus, is shown in Table 5. The sign merely indicates which of the two curriculum groups in the sample had the larger response percentage. In this case, a positive sign indicated that the industrial administration students gave the larger number of responses and a negative sign indicated that the industrial engineering students gave the larger number of responses.

The frequency distributions of scores for the two curriculum groups scored on the 95% key are shown in Table 6. The mean score for the industrial administration students was -1.63 with a standard deviation of 4.54. The mean score for the industrial engineering students was -9.12 with a standard
deviation of 4.10. The difference between the two mean scores was +7.49. A t-value of 13.63 indicated that the difference between the low means was significant beyond the .01 level. On the basis of the magnitude of this t-value, it was concluded that it was possible to differentiate between the two curriculum groups by means of a biographical inventory.

Although it was not the purpose of this study to attempt
Table 6. Frequency distribution of scores obtained from the 95% scoring key for the industrial administration and industrial engineering comparison

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to identify the most efficient scoring key, it was decided to compare the effectiveness of the key using only the twenty-one items having response differences of at least three standard errors above zero. Items included in this key, hereafter referred to as the 99% key, are shown in Table 7. When the answer sheets were re-scored on the shortened key, it was

Table 7. Identification number and sign of items included in 99% scoring key for industrial administration and industrial engineering comparison

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<td>52c</td>
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<tr>
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<td>+</td>
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<tr>
<td>118a</td>
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</tr>
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<td>154b</td>
<td>-</td>
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<td>166d</td>
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<td>179a</td>
<td>-</td>
</tr>
<tr>
<td>179c</td>
<td>+</td>
</tr>
</tbody>
</table>
found that the mean of the industrial administration students went from -1.63 to -0.66 and the standard deviation from 4.54 to 3.25. The mean of the industrial engineering students raised from -7.49 to -5.07; and the standard deviation decreased from 4.10 to 2.79. The difference between the two means on the 99% key was 4.41. This, too, was significant at the .01 level and indicated that the shortened key may be slightly less efficient compared to the original key as reflected in the two t-values 13.63 for the original key and 13.11 for the shortened key. This decrease in efficiency was not reflected in terms of separation of the mean scores of the industrial administration and industrial engineering students' scores. The 95% scoring key resulted in a separation between the means of 1.3 standard deviation units and the 99% scoring key also resulted in a separation of 1.3 standard deviation units. The frequency distributions of the scores obtained from the 99% key are shown in Table 8.

A biserial coefficient of correlation was computed between the inventory scores and the dichotomy industrial administration and industrial engineering and was found to be .82. This correlation will undoubtedly drop when the scoring key is cross-validated; however, the correlation does suggest a high relationship between the scores obtained from the biographical inventory and tendency to choose either industrial engineering or industrial administration.
Table 8. Frequency distribution of scores obtained from the 99% scoring key for the industrial administration and industrial engineering comparison

<table>
<thead>
<tr>
<th>Score</th>
<th>Industrial administration frequency</th>
<th>Industrial engineering frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
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<tr>
<td>6</td>
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<td>5</td>
<td>9</td>
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<tr>
<td>4</td>
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</tr>
<tr>
<td>3</td>
<td>16</td>
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<tr>
<td>2</td>
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<tr>
<td>-2</td>
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<td></td>
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<tr>
<td>-12</td>
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</tbody>
</table>

Examination of the items included in the scoring keys, for logical relationships, suggested several clusters or groups of items that appeared to be related. The first cluster, which also had the largest number of items, dealt with items pertaining to previous school experiences. For brevity, the industrial administration group will again be referred to as IA and the industrial engineering group as IE.

1. A larger percentage of the IE group reported them-
selves as: above average students in high school, indicated that they enjoyed high school science, physics, chemistry and mathematics, took more of these courses in high school, and that these were their easiest subjects. The IE group also reported making A's "on the average" in high school mathematics courses, enjoyed problem-type courses, and did best when working with numbers. The IE group also reported that their most difficult subjects, and subjects which they enjoyed least, were history, economics and civics, reported a higher percentage of high school honors and did not read well. (59a, 61a, 62c, 63a, 64c, 65b, 66a, 67d, 70a, 71c, 165a).

2. An almost opposite picture was presented by the IA group in which a larger percentage of students reported their most interesting and easiest subjects were economics, history and civics and that their most difficult subjects and the subjects which they enjoyed least were, science, physics, chemistry and mathematics. The IA group also reported more high school grade points between C and C+, and reported making more C's in mathematics and chemistry courses than did the IE group (60d, 61c, 62a, 63c, 64a, 66c, 68c).

A second cluster of items related to the respondents'
personal and family characteristics.

1. A larger percentage of the IA group reported ages of 20-21 as college juniors and seniors, while the IE group was somewhat older. The IA group reported more persons between 5'-5" and 5'-7" than the IE group, more persons with allergies, more persons who found their personalities "hard to describe," and more persons who had been happy with their family "most of the time." (lc, 4b, 36b, 108c, 123a).

2. A larger number of the IE group reported one parent deceased, reported parents objected to a few friends but allowed them about as much freedom as their friends, reported that their family home was 100-200 miles from Iowa State College, reported owning a car two to three years old, had as a hobby at one time, (but not now) woodworking, camping, hunting, and fishing, and consider themselves as nervous (26b, 28b, 29c, 52c, 53b, 77d, 118a, 153c).

A third group of items related to the respondents' vocational choice and experience.

1. A larger percentage of the IA group felt that the opportunities for graduates in their field were about the same as other fields; however, the IE group felt that opportunities in engineering were better than most other fields. A larger percentage
of the IA group reported that their parents either had no choice concerning the respondents' vocational choice or, wanted the student to enter business. Parents of the IE group wanted their sons to enter a profession. The IA group also reported that they had seriously considered quitting school once and that if they were to enter college "now", they would choose the same program at another school (82b, 83b, 84a, 84b, 179a, 179c, 179d).

2. The IE group reported that they had not held jobs while in high school and that of jobs which they had previously held, none of the disadvantages listed disturbed them (142e, 173e).

A final group of items consisted of miscellaneous questions of a social or recreational nature (49e, 90a, 101c, 112-a, 154b).

Although some question can be raised regarding the arbitrary grouping and assignment of items to groups, it was felt that a more refined cluster analysis would not be appropriate at this early stage of exploration. If the inventory's usefulness is verified by cross-validation, further analysis and refinement would then be in order.
VI. DIFFERENTIATION BETWEEN STUDENTS ABOVE AND
BELOW THE MEDIAN GRADE POINT AVERAGE

As a part of the instructions given during the administration of the biographical inventory, the students were asked to indicate their cumulative grade point average at the beginning of the spring quarter 1957. Upon examination of the answer sheets, it was found that, of the 785 returns, 54 students had not provided the grade point data. Of these 54 students, 14 also neglected to provide their name and these 14 answer sheets were dropped from further consideration in the achievement analysis. Grade point averages for the 40 students who did not provide achievement data, but did supply their names, were obtained from the Registrar's files.

Analysis of the 771 answer sheets, for which grade point data were available indicated that the median grade point was approximately 2.50. Division of the students' answer sheets into groups having grade point averages of 2.50 or above and students reporting grade point averages of 2.49 or below resulted in placing 384 answer sheets in the high achievement group and 387 answer sheets in the low achievement group.

Differential item response was obtained by sorting the IBM cards on the appropriate column and computing the percentage of each achievement group responding to each item choice. The difference in response percentage was computed
along with the standard error of the difference.

A scoring key was made of all items having a response difference of two standard errors or greater. Of the 65 items scored on the key, 34 were scored as positive, indicating the larger response percentage occurred in the high achievement group and 31 were scored as negative, indicating the larger response percentage occurred in the low achievement group. A list of the identification numbers and sign of each item scored in the achievement key appears in Table 9.

The answer sheets for the high and low achievement groups were scored on the achievement key and the frequency distributions for the two groups, ignoring curriculum differences, are shown in Table 10. Analysis of variance difference between the means of the two achievement groups is shown in Table 11.

The F-value with 1 and 769 degrees of freedom is significant far beyond the 1% level. Interpretation of this value would allow the conclusion that there was a difference between the means of the two achievement groups which cannot reasonably be attributed to random sampling variation. More specifically, this significant difference would allow the conclusion that it was possible to discriminate between achievement groups on the basis of responses from a biographical inventory. Although it is unlikely that the present scoring key is the key which would maximize the differentiation, it was possible to demonstrate a separation between the mean of the
Table 9. Identification number and sign of items included in scoring key for the achievement comparison

<table>
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<th>Identification number</th>
<th>Sign</th>
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<tr>
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</tr>
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</tbody>
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53
Table 10. Frequency distribution of scores obtained from use of achievement key for all students with G.P.A. 2.50 or above and 2.49 and below, ignoring curriculum

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<th>L. A. G.(^b)</th>
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</table>

\(^a\)Refer to the high achievement group.

\(^b\)Refer to the low achievement group.
Table 11. Analysis of variance of scores obtained from 5% scoring key for achievement comparison

<table>
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<th>Mean square</th>
<th>F</th>
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<td>8842.868</td>
<td>253.09</td>
</tr>
<tr>
<td>Within achievement groups</td>
<td>769</td>
<td>26871.560</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>770</td>
<td>35714.428</td>
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</table>

high achievement group (7.43) and the mean of the low achievement group (.65) of 1.0 standard deviation unit. Because discriminations made in the middle of a symmetrical distribution are the most difficult to demonstrate of any possible dichotomous split, the evidence, that the means of the achievement groups can be separated one standard deviation using a relatively unrefined scoring key, is justification for concluding that some predictive achievement information can be obtained from the use of the biographical inventory.

Data provided in Table 12, are the frequency distributions of the high and low achievement groups by curriculum. Examination of the distributions would indicate that in addition to the achievement differences discussed previously, there were also large differences among the various curriculum groups. This observation is demonstrated more objectively in the analysis of variance shown in Table 13.
Table 12. Frequency distributions of scores from the achievement key, unadjusted for curriculum differences

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<th>+2.50</th>
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<td>Elec. engr.</td>
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| d-value | 5.19 | 4.37 | 5.66 | 6.49 |
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Table 13. Analysis of variance of scores obtained from the achievement scoring key when classified by curriculum

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<th>Sum of squares</th>
<th>Mean square</th>
<th>F</th>
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<td>7</td>
<td>8430.782</td>
<td>1204.397</td>
<td>33.68</td>
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<td>Within curr. groups</td>
<td>763</td>
<td>27283.646</td>
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The F-value shown in Table 13 with seven and 763 degrees of freedom is significant beyond the 1% level. This finding would indicate that there is a difference among the mean scores of the various curriculum groups when averaged over both levels of achievement. Although, as mentioned previously, the scoring key is probably not the optimum key in terms of differentiation; examination of the differences among the curricula would suggest that after the optimum key is developed, it will be desirable to use some constant adjustment for each curriculum group. The relative differences between the two achievement groups within each curriculum, as indicated by the d values in Table 12, would suggest that there was little interaction between achievement and curriculum. If the interaction can be assumed to be negligible, it is possible to adjust for curriculum differences by merely adding a constant to the scores for each curriculum group. For
example the mean score for the industrial administration students was -1.50 and the mean for the total group was 4.03. By adding approximately 5.5 points to each industrial administration student's score the average scores for the two groups would be comparable. Similarly, scores can be adjusted for each curriculum group by adding the following constants:

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<td>Agricultural Engineering</td>
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Analysis of the specific items scored on the achievement key showed some overlap with the curriculum keys and is undoubtedly responsible for some of the curriculum difference found in the achievement key.

The following items were scored on the achievement key: (High achievement group will be abbreviated to HAG and low achievement group to LAG for the description of the items

1. H. A. G. were somewhat younger (1c, 1d).
2. H. A. G. had a larger % of respondents between 151-170 pounds than did L. A. G. (3c).
3. L. A. G. had more cars while H. A. G. used parent's car when parents were not using it (14a, 14d, 47d).

4. L. A. G. reported higher percentage of mothers were 8th grade graduates (25c).

5. H. A. G. reported more deceased parents while L. A. G. more often grew up with both parents in home (26a, 26b).

6. L. A. G. reported parents objected to a few friends (28b).

7. H. A. G. reported higher percentage of hobbies in electronics, hi fi, etc. while L. A. G. reported more hobbies such as hunting and fishing (50a, 51c).

8. H. A. G. were generally 13 when they finished 8th grade (would relate to item 1) (54c).

9. H. A. G. reported coming from smaller grammar schools (56a).

10. H. A. G. considered themselves considerably above average in high school while L. A. G. considered themselves as average (59a, 59c).

11. H. A. G. reported high school averages of 4.00-3.50 while the L. A. G. reported averages of either 2.99-2.58 or 2.49-2.00 (60a, 60c, 60d).

12. H. A. G. reported a higher percentage of students enjoyed physical science, chem and math in high school and that these subjects were their easiest
13. A higher percentage of L. A. G. reported most difficult subjects were science, math and chem while H. A. G. reported more difficulty with history business and economics (64a, 64c).

14. H. A. G. generally reported receiving A's in math in high school while L. A. G. reported more B's and C's (66a, 66b, 66c).

15. Similarly, the H. A. G. reported a higher percentage of A's in science courses while the L. A. G. reported more C's (68a, 68c).

16. A higher percentage of the H. A. G. reported that their high school preparation was very adequate (69a).

17. H. A. G. reported preferring problems and mathematics course over other types of courses (70a).

18. H. A. G. reported a higher percentage of persons being member of honor societies (71c).

19. A higher percentage of L. A. G. reported having been student body or class officers in high school (73c).

20. A larger proportion of the H. A. G. reported that when they had difficult problems, they "dug" at problem until it was solved, rather than asking for help (78e).
21. A higher percentage of the H. A. G. reported if they were to start college over again they would choose the same curriculum here while more of the L. A. G. report they would choose the same curriculum in another school (82a, 82b).

22. A larger proportion of the H. A. G. reported that they had never seriously considered quitting school while the L. A. G. reported that they had considered quitting occasionally (83a, 83c).

23. The H. A. G. seemed to feel that opportunities for graduates in their field were better than in most others while the L. A. G. seemed to feel that the opportunities were about the same as most other fields (84a, 84b).

24. The L. A. G. reported that upon finishing college they did not plan to take any further graduate work while the H. A. G. reported that they planned to take graduate work on a part time basis while on the job (85b, 85c).

25. A higher percentage of the H. A. G. reported that they would be 20-21 years old upon graduation (again relating to items 1c, 1d, and 54c) (86b).

26. A larger proportion of the L. A. G. reported that they see some of their high school acquaintances regularly (92d).
27. Persons in the H. A. G. reported having spent 4 or more evenings a week "going out" (99e).

28. A larger proportion of the respondents from the H. A. G. reported having responsibility for choosing their own clothing while in junior high or senior high school (107a, 107b).

29. The persons in the L. A. G. reported having more friendly and easy-going personalities but reported that they are nervous (108c, 118a).

30. A large percentage of the L. A. G. reported having had some financial difficulty during the past 6 months while the H. A. G. reported no special difficulties (126a, 126e).

31. A higher percentage of the L. A. G. reported a low interest in reading (114e).

32. A larger proportion of the H. A. G. reported that they had never found it necessary to keep a budget while a large percent of the L. A. G. reported no keeping a budget but managing expenses according to a plan (150c, 150e).

33. More of the L. A. G. reported having organized an athletic team or sports competition (156a).

34. Respondents from L. A. G. reported that they felt they talked better than worked with numbers while the opposite was true of H. A. G. respondents
A larger proportion of the L. A. G. reported that they would eventually take sales or management jobs while more of the H. A. G. reported that they planned to take design or research jobs (168a, 168b, 168d, 168e).

Persons who were in the H. A. G. reported that in a list of 100 typical people in the kind of job that they did best they would be in the upper third (but not in the best 5%) while persons in the L. A. G. reported themselves in the middle third (174b, 174c).

Respondents from the H. A. G. reported that they work somewhat faster than most people (177b).

The respondents from the L. A. G. reported that they prefer working with people while a larger percentage of respondents from the H. A. G. reported that they prefer to work with ideas (178c, 178e).

Examination of the content of the items in an attempt to group them into logical clusters reveals several such groups. As one might expect, one cluster was related to previous or present school experiences (items 56a, 59a, 59c, 60a, 60c, 60d, 61a, 63a, 64a, 64c, 66a, 66b, 66c, 68a, 68c, 69a, 70a, 71c, 73c, 78e, 82a, 82b, 83a, 83c, 85b, 85c, 144e). A second cluster dealt with vocation choices and preferences (items...
A third cluster dealt with personal characteristics either physical or psychological (items 1c, 1d, 3c, 54c, 86b, 107a, 108c, 118a, 174b, 174c, 177b). A fourth group of items related to the students' family background (items 14a, 14d, 47d, 25c, 26a, 26b, 28b). A smaller group of items were concerned with the students' social contacts and hobbies (items 50a, 51c, 92d, 99e, 156a). Four items dealt with finances (126a, 126e, 150c, 150e).

Again, the need for cross-validation is apparent. Although some question concerning the arbitrary cluster grouping can be raised, a more formal cluster analysis would still present the problem of logical interpretation of the factors. For the purposes of this first exploratory investigation, it was felt that a more formal cluster analysis was not warranted.
VII. DISCUSSION

On the basis of the results of the present study, there was strong evidence to support the hypotheses that it is possible to discriminate between industrial administration and engineering students-in-general; between industrial administration and industrial engineering students, and between students who have grade point averages above the median and students who have grade point averages below the median, by means of objectively scored biographical inventory responses.

Examination of the scoring keys revealed that several items were scored on all three of the discriminations. These items were 60d, 64a, 66c, 82b, 84b, 59a, 60a, 63a, 64c, 66a, 70a, 84a. The commonality between the industrial administration and the industrial engineering and the engineering students-in-general was probably due to the commonality of industrial engineers and engineers-in-general and the fact that the industrial administration group was the same in both comparisons. This conclusion was strengthened by the observation that several more items were also common to both curriculum comparisons (1c, 4b, 61c, 62a, 63c, 83b, 112a, 123a, 179c, 179d, 52c, 61a, 62c, 67d, 153c, 166d, 173e, 179a).

The similarity between the achievement and curriculum keys was not as great as between the two curriculum comparisons and, as was pointed out in the discussion of results of
the achievement key, there were curriculum differences in the scores received from using the achievement key that would suggest the use of a constant adjustment for each of the various curriculum groups.

From a strictly theoretical point of view, one would expect if the curriculum-achievement comparisons were entirely independent, there would be no systematic overlap between the two scoring keys. There were, however, 12 items scored on both the achievement and curriculum keys; six of which were scored as positive, and six scored negative with respect to the achievement key (positive indicating larger response in high achievement group and negative indicating larger response in the low achievement group). These same 12 items, when scored on the curriculum key, indicated a definite tendency for the high achievement items to be associated with the engineering curricula. This tendency may have occurred because the engineering curricula made up the bulk of the group upon which the achievement keys were made.

In order to demonstrate quantitatively, if a curriculum by achievement interaction exists, it would be necessary to compute an analysis of variance testing the hypothesis that such an interaction was equal to zero. Since the scoring with the present keys is only exploratory in nature, it was felt that only an approximate indication of the interaction was needed. This approximation was obtained by examining the
differences between the achievement group means within curricula. Excluding the agricultural engineering curricula, based on only 25 cases, the differences between the achievement means within curricula were 5.19, 4.37, 5.66, 6.49, 5.51, 5.78 and 5.14. Although a test of the variance among the differences between the means might prove statistically significant, little practical difference could be shown on the first exploratory key. It would, however, be advantageous to remove as much achievement bias from curriculum discriminations on subsequent scoring keys as is practical. Although the separations obtained in the present research were relatively large, some of the differences could be expected; since the scoring keys were developed to maximize the separation with this sample. That is, the keys were made not only to capitalize on any true differences between the groups, but also chance differences peculiar to this sample. Undoubtedly, the scoring keys would produce smaller separations on a cross-validation sample and the long term usefulness of the present findings can only be assessed after the scoring keys have been applied to a new and independent sample.

All practical precautions have been taken to avoid the inclusion of items in the scoring keys which showed differences in the original sample due to chance fluctuations. If, upon cross-validation, the findings of the present study are verified, it would then be appropriate to refine the scoring
keys so as to pick the items which would consistently maximize the separation between the groups being compared. This could be done by the use of a technique developed by Clark (6). The method suggested by Clark involves the empirical selection of the scoring key which minimizes the "percentage overlap." The "percentage overlap" was defined as, "the number of persons per hundred in one distribution whose scores can be matched by scores in the other distribution." Perfect separation would, therefore, have a "percentage overlap" of zero. Briefly, the technique of selection of the optimum key involves arranging the item response differences in rank order and then making scoring keys for each successive percentage difference and scoring the criterion group answer sheets until the key is identified which maximizes the separation and minimizes the "percentage overlap." Clark had shown that the discrimination power of a key increases as one adds items, only as long as these additional items contribute more uniqueness than error. As soon as the error contribution of an item outweighs the discriminatory advantage of that item, the increase in the variability of the scores from the addition of that item will result in a decrease in the discriminatory power of the key. Thus, the optimum key would not ordinarily be composed of only the most discriminatory items individually, nor would it include all of the items found to discriminate different from zero, but would rather fall at some point between these two
extremes. This point of maximum separation can be empirically
determined by Clark's method of analysis and was generally
found, when using unit weights on his interest data, to be
between 40 and 60 items. When fewer or more items were
scored, the discriminatory power of the key was reduced.

If, after cross-validation, the results of the present
study are confirmed, two types of studies involving a per­
sonal history form are suggested. The first type of study
would be concerned with investigations parallel to the pre­
sent research. As a first step, a study could be conducted to
determine if intra-divisional discriminations are possible;
for example, industrial engineering vs. mechanical engineer­
ing. The number of curriculum discrimination studies is
limited only by the number of curriculum combinations of
practical interest.

A second type of study could be concerned with a long
range, systematic approach to explaining and interpreting
personal history correlates of attrition-survival, curriculum
changes, social adjustment, interest patterns or changes,
personal or health problems, under and over achievement,
ability and other factors related to college adjustment. Such
an ambitious undertaking would involve the administration of a
personal history form as part of pre-registration testing and
periodic evaluations of the data at prearranged time intervals
throughout the student's college career.
The two research problems, here suggested, are only two of the many that could be outlined. Undoubtedly, as more research evidence concerning biographical data is accumulated, the use of such information for explanatory purposes in many other contexts will be suggested and pursued.
The present research was undertaken to resolve two questions concerning the use of biographical inventory data for discriminating between certain curriculum groups and between certain achievement groups at Iowa State College. Specifically, the comparisons involved the attempt, using an objectively scored biographical inventory, to differentiate between:

1. Industrial administration and engineering students-in-general.

2. Industrial administration and industrial engineering students.

3. Students achieving above and students achieving below the median grade point average.

The biographical inventory used in the present study consisted of 179, five response items. The responses to an item were not mutually exclusive, that is, more than one item response could be marked. This inventory was administered to 1029 students from seven curricula in engineering and in the industrial administration curriculum. Of the 1029 inventories distributed, 785 were returned for analysis.

The analysis of the answer sheets was facilitated by the use of IBM machine scored answer sheets. The summary of the number of students responding to each of the item choices for
each of the criterion groups being compared were tabulated by the IBM graphic item counter. From the item response data, it was possible to calculate response percentages and differences in percentages for each item choice. Item choices to be included in the various scoring keys were chosen so as to allow less than one chance in 20 of an item being included which was not actually discriminating between the groups being compared.

The answer sheets were then scored and the means and standard deviations of the resulting distributions of scores were computed. Tests of significance between the means in each of the three comparisons were computed.

It was found that the key designed to discriminate between industrial administration students and engineering students-in-general, separated the two groups 19.29 points. This difference was significant far beyond the 1% level. Taking into account the variability of the total group, the separation between the means was 1.66 standard deviation units. From examination of the data, as well as logical considerations, it was decided to determine if it was possible to make a more sensitive discrimination between industrial administration students and students in industrial engineering. When a separate key was made specifically for the industrial administration and industrial engineering comparison, it was found to separate the two means 7.49 points, with a
t-value of 13.63. As was expected, examination of the two keys revealed a very substantial overlap of items scored on both the industrial administration, engineering-in-general and the industrial administration, industrial engineering keys.

For the achievement comparison, the total group was divided at the median grade point (2.50) and a scoring key developed to discriminate between students having grade point averages of 2.50 or above, referred to as the high achievement group, and students having grade point averages of 2.49 or below, referred to as the low achievement group.

Scoring of the answer sheets produced a separation between the high and low achievement groups of 6.78 points, significant beyond the 1% level. Examination of the data by curriculum revealed substantial curriculum differences also significant beyond the 1% level. However, the differences between achievement groups among curricula appeared to be approximately equal suggesting the interaction between achievement and curriculum is of little practical consequence. This low order interaction would also allow for the adjustment for curriculum differences by addition of an appropriate constant to each score for a curriculum group.

Although the results of the present exploratory study are very encouraging, they still must be subjected to the empirical verification of cross-validation before they can be inter-
interpreted as conclusive evidence of the value of biographical inventory responses for discriminating between either curricular or achievement groups. From a methodological point of view, and in the interest of conservatism, every practical precaution was employed to guard against the possibility of chance factors entering into the discriminations as well as selecting criterion groupings which are not inherently widely separated.

Although the t-values obtained in this study cannot be interpreted at the usual levels of significance, because the tests of significance and scoring keys were obtained from the same sample, the magnitude of the t-values obtained did suggest certain non-chance items entering into the discriminations. Granting that the present evidence in favor of the objectively scored biographical inventory is not as yet definitive, the results of this, and other studies using similar data would certainly suggest that such a method of study would merit further investigation.
IX. LITERATURE CITED


44. Walker, Helen M. Item Selection by Sequential Sampling. Teachers College Record, 40:4-409. 1949.


X. APPENDIX
The purpose of this inventory is to obtain biographical information about you to be used in determining if there are differential biographical characteristics among majors in certain curriculum groups here at Iowa State College. It is recognized that many of the items in the inventory may seem irrelevant, but we would like to ask your cooperation in answering each item as best you can.

Directions

You will note upon examination of the inventory items that each item will have five responses. It is possible for you to mark more than one response per item if it applies to you. Similarly it is not necessary to choose a response to an item if none of the responses are applicable to yourself. The responses are merely grouped for convenience.

Once you have chosen a response, use one of the special pencils provided and mark the response by a dark vertical line on the answer sheet provided. Do not use any other type pencil and do not make any stray marks on the answer sheet. In the event you wish to change a response be sure to erase the old mark completely.

The information in this inventory will be considered as confidential and your name will be removed as soon as you turn the inventory in. The name will only be used to determine which inventories have been returned, and not in connection with the material herein.

Name______________________________
Dept.______________________________
Class______________________________
1. How old are you now?
   1. 17 or under
   2. 18-19
   3. 20-21
   4. 22-25
   5. over 25

2. What is your present marital status?
   1. single
   2. married, no children
   3. married, one or more children
   4. widowed
   5. separated or divorced

3. What is your weight?
   1. under 135 pounds
   2. 136 to 150 pounds
   3. 151 to 170 pounds
   4. 171 to 185 pounds
   5. over 185 pounds

4. What is your height?
   1. 5' to 5'4"
   2. 5'5" to 5'7"
   3. 5'8" to 5'10"
   4. 5'11" to 5'1"
   5. 6'2" or over

5. Were you in the Armed Forces of the U.S.?
   1. yes, as an officer
   2. yes, as an enlisted man
   3. yes, both as an officer and as an enlisted man
   4. no, but I was a civilian employee of the government
   5. none of the above

6. In what section of the country were you born?
   1. middle west
   2. northeast
   3. southeast
   4. northwest
   5. southwest

7. About how large was the town in which you grew up? (Spent most of your time up to age 18?)
   1. no town, rural area
   2. under 1,000
   3. 1,000 to 5,000
   4. 5,000 to 25,000
   5. over 25,000

8. In how many different cities, towns, or townships have you lived?
   1. 1-3
   2. 4-6
   3. 7-9
   4. 10-12
   5. 13 or more

9. How often has your family (parents) changed addresses in the last 5 years?
   1. not at all
   2. once
   3. twice
   4. three times
   5. more than 3 times

10. What arrangements do your parents have concerning their home or residence?
    1. own it
    2. rent apartment
    3. rent house
    4. is provided by employer
    5. other

11. In what section of town did your family live longest while you were growing up?
    1. lived in one of the most exclusive sections of town
    2. lived in a good but not the best section
    3. lived in an average section of town
    4. lived in one of the poorer sections of town
    5. lived in a rural area

12. Were there other relatives living with your family while you were growing up?
    1. no other relatives
    2. a grandparent
    3. an uncle or aunt
    4. a cousin
    5. one other than those listed

13. How old is your family car?
    1. 1 year
    2. 2 years
    3. 3 years
    4. 4 years
    5. 5 or more years
14. How often were you allowed to use the family car?
   1. had my own, did not use their car
   2. not at all
   3. as often as I asked
   4. as often as I asked and my parents were not using it
   5. parents did not own car

15. Which of the following do you have in your family home?
   1. have no home
   2. telephone
   3. television
   4. automatic washing machine
   5. air conditioner

16. Parental occupation
   1. doctor, dentist
   2. engineer
   3. teacher
   4. lawyer, journalist
   5. private business

17. Continued
   1. manager, supervisor
   2. salesman
   3. farmer
   4. skilled tradesman, carpenter, machinist
   5. unskilled laborer

18. At what age was your father when you were born?
   1. about 20
   2. about 25
   3. about 30
   4. about 35
   5. do not know

19. Which one of the following did your father help you with most?
   1. learning to use tools
   2. learning to play baseball, football, or some other sport
   3. homework from school
   4. getting out of trouble
   5. none of these

20. Which one of the following was most characteristic of your father while you were growing up?
   1. a strict person with strong moral principles
   2. a very stern person, but not too moralistic
   3. a person with fairly strong principles
   4. a person who was forced to modify his principles
   5. a person not disturbed about moral issues

21. How far did your father go in school?
   1. he didn't complete the 8th grade
   2. he finished the 8th grade but did not graduate from high school
   3. he graduated from high school
   4. he had some college work
   5. he graduated from college

22. In what kinds of organizations was your father most interested?
   1. athletic clubs (baseball, bowling, golf, etc.)
   2. fraternal societies, social and religious groups. (Elks, Masons, Knights of Columbus, Church Groups, YMCA, etc.)
   3. political and civic organizations (Democratic or Republican clubs, Rotary, Lions, etc.)
   4. trade, professional, or management associations (unions, Granges, etc.)
   5. None of these, or don't know

23. In what kind of social organizations was your mother most interested?
   1. Civic and business organizations (political clubs, professional societies, parent-teachers associations, etc.)
   2. cultural and religious societies (poetry, music, art, religious education, etc.)
   3. service clubs (Ladies Auxiliaries, Gray Ladies, Grange, etc.)
   4. social and recreational clubs (entertainment, sports, bridge club, etc.)
   5. none of these, or don't know
24. Was your mother employed and away from home, at least part time, while you were growing up?
   1. no
   2. yes, she started before I was 6 years old
   3. yes, she started between my ages of 6 and 11
   4. yes, she started between my ages of 12 and 18
   5. yes, but she started after I was 18 years old

25. How far did your mother go in school?
   1. she didn't complete the 8th grade
   2. she finished the 8th grade
   3. she graduated from high school
   4. she had some college work
   5. she graduated from college

26. Did your parents live together all of the time you were growing up?
   1. yes
   2. no, because one died
   3. no, because they both died
   4. no, because they separated
   5. no, because they were divorced

27. How often did you feel that you agreed with your parents concerning things in general?
   1. we never disagreed
   2. we rarely disagreed
   3. we disagreed occasionally, but not often
   4. we disagreed often
   5. we hardly ever agreed

28. How much influence did your parents exert over your choice of friends?
   1. none
   2. objected to a few
   3. objected to most
   4. chose my friends
   5. paid no attention to friends

29. How much independence do you feel your parents allowed you while in high school?
   1. practically none
   2. quite restrictive
   3. about as much as the rest of my friends
   4. quite lenient
   5. as much as I wanted

30. When you were a child, did you believe that your parents showed favoritism?
   1. no, I was an only child
   2. no, I thought we were all treated alike
   3. yes, I thought I was not the favorite, but did not think I was treated badly
   4. yes, I thought I was not treated as well as the others
   5. yes, and I thought I was the favorite

31. How do you feel about your parents today?
   1. I have (or had) great affection for both of them
   2. I am (or was) much more strongly attached to Mother than Father
   3. I am (or was) much more strongly attached to Father than Mother
   4. I am not (or was not) very strongly attached to either parent
   5. I never knew my parents well enough to feel strongly about them

32. During your youth, about how often did your parents include you in their leisure time activities?
   1. most of the time
   2. frequently
   3. occasionally
   4. rarely
   5. never

33. How much money did your family have while you were going to high school?
   1. about as much as my classmates
   2. more than most of my classmates
   3. less than most of my classmates
   4. a great deal more than most people I know
   5. do not know, or had not considered it
34. Would you like to live over any parts of your childhood?
   1. would enjoy living over again the time when I used to date
   2. would like to live over again the time before I started going to school
   3. would like to live over again the time when I was in school
   4. childhood was fine, but living it over again doesn't interest me
   5. dislike thinking much about my childhood

35. How do you feel about the way you were disciplined as a child?
   1. it was fair but harsh
   2. it was fair and mild
   3. it was unfair and harsh
   4. it was often unfair, but it was mild
   5. it was mainly non-existent

36. Looking back on the days you spent in your family or childhood home, were they:
   1. very happy
   2. quite happy, most of the time
   3. neither very happy nor very unhappy
   4. a little on the unhappy side
   5. very unhappy

37. In which of the following situations did you spend most of your life before the age of 16?
   1. with both parents
   2. with true mother, only
   3. with true father, only
   4. with one true parent and one foster (or step-) parent
   5. with relatives; or in an orphanage, foster home or boarding school

38. What period of your life do you remember as your happiest?
   1. early childhood
   2. school years
   3. the immediate past
   4. while in the armed forces
   5. now

39. When you were 15 years of age, how many living brothers and sisters did you have?
   1. none
   2. 1
   3. 2
   4. 3
   5. 4 or more

40. How often did you and your brothers play together?
   1. had none
   2. often - every day
   3. occasionally - when no one else around
   4. very seldom - less than once a week
   5. never

41. How did you get along with your brothers and sisters when you were growing up?
   1. I was an only child
   2. we got along very well
   3. we quarreled occasionally
   4. we rarely agreed
   5. we didn't quarrel, but we didn't have very much to do with one another

42. Who picked on you most during your youth?
   1. brothers and sisters
   2. friends, or others, my own age
   3. parents
   4. teachers
   5. none of these

43. Of the following, how many had you done by age 17?
   1. dance
   2. drink
   3. drive a car
   4. gamble
   5. have a full-time job

44. Continued
   1. have a part-time job
   2. make home repairs
   3. play cards
   4. smoke
   5. swim

45. Continued
   1. repair an electrical appliance
   2. handle a boat
   3. play golf
   4. take care of a garden
   5. build furniture
46. Continued
1. stay alone overnight on trips
2. operate heavy construction machinery or truck
3. paint a room
4. build or repair a radio
5. change a tire

47. Continued
1. participate in an exhibit or contest
2. use a shotgun or rifle
3. select your own tophat or suit
4. own a car of your own
5. play tennis

48. Which of the following have you repaired for yourself, or someone else, during the last 6 months?
1. electrical wiring or appliance
2. plumbing
3. furniture
4. refinishing, painting
5. none of these

49. Who did most of the home repair work around your home?
1. yourself
2. a brother
3. parent
4. someone hired to do the job
5. no special person

50. What are your present hobbies?
1. electronics, radio, Hi Fi, etc.
2. automobiles
3. camera and photography
4. astronomy
5. collections, stamps, insects, etc.

51. Continued
1. sports, athletics
2. drawing or painting
3. hunting, fishing
4. music
5. have none

52. Which of the following hobbies have you at sometime had? (But not presently following)
1. building model airplanes, boats, etc.
2. repairing an old car or other machine
3. making or repairing furniture, carpentry
4. printing
5. working metal

53. Continued
1. outdoor sports, football, baseball, soccer
2. fishing, camping, hunting
3. reading, stamp collecting
4. building things, woodworking, crafts
5. no special interests

54. How old were you when you completed the eighth grade?
1. 11
2. 12
3. 13
4. 14
5. 15

55. What kind of schools did you attend between the ages of 12 and 18?
1. military
2. parochial
3. private
4. public
5. vocational and trade

56. How many students were there in the grammar school which you attended the longest?
1. fewer than 100
2. between 100 and 500
3. between 500 and 1,000
4. between 1,000 and 2,000
5. more than 2,000

57. What size school (high school) did you attend?
1. fewer than 100
2. between 100 and 500
3. between 500 and 1,000
4. between 1,000 and 2,000
5. more than 2,000
58. As you grew up, how did you feel about high school?
  1. liked it very much
  2. liked it most of the time
  3. just accepted it as necessary
  4. was often a little unhappy with it
  5. cordially disliked it and was glad to finish

59. How would you classify yourself as a student in high school?
  1. considerably above average
  2. somewhat above average
  3. average
  4. below average
  5. poor

60. What was your high school average (approximately)?
  1. 4.00-3.50
  2. 3.49-3.00
  3. 2.99-2.50
  4. 2.49-2.00
  5. less than 2.00

61. Which of your high school subjects did you enjoy the most?
  1. physical science, chemistry, physics, mathematics
  2. natural science, biology, zoology
  3. history, economics, civics
  4. commercial courses, bookkeeping, typing
  5. shop courses

62. Which did you enjoy least?
  1. physical science, chemistry, physics, mathematics
  2. natural science, biology, zoology
  3. history, economics, civics
  4. commercial courses, bookkeeping, typing
  5. shop courses

63. Which of your high school courses were easiest?
  1. physical science, chemistry, physics, mathematics
  2. natural science, biology, zoology
  3. history, economics, civics
  4. commercial courses, bookkeeping, typing
  5. shop courses

64. Which were most difficult?
  1. physical science, chemistry, physics, mathematics
  2. natural science, biology, zoology
  3. history, economics, civics
  4. commercial courses, bookkeeping typing
  5. shop courses

65. Which of the math courses did you take in high school? (at least part of a semester)
  1. algebra - 1 year
  2. advanced algebra
  3. trigonometry
  4. plane geometry
  5. solid geometry or analytical geometry

66. What grades did you make in mathematics in high school? (on an average)
  1. A's
  2. B's
  3. C's
  4. D's
  5. do not know

67. Which of the science courses did you take while in high school?
  1. biology, zoology
  2. general science
  3. physics
  4. chemistry
  5. others not specified

68. What grades did you make in science courses in high school? (on an average)
  1. A's
  2. B's
  3. C's
  4. D's
  5. do not know

69. How do you feel concerning the adequacy of your high school preparation for college?
  1. was very adequate
  2. was weak in certain areas
  3. was very inadequate
  4. about like the average high school
  5. unable to answer
70. In school which type of courses did you most enjoy?
   1. problems, math
   2. lecture
   3. laboratory
   4. discussion
   5. had no preference

71. During your last year in high school were you a member of:
   1. an athletic team
   2. a musical group
   3. an honor society
   4. a school club
   5. none of the above

72. Which of the following offices did you hold at any time in high school?
   1. editor of a student publication
   2. chairman of an important student committee or club
   3. student body officer, or class officer
   4. captain of an athletic team
   5. never held any offices in high school

73. How many elective offices did you hold while in high school?
   1. none
   2. 1 or 2
   3. 3 to 5
   4. 6 to 10
   5. 11 or more

74. What school projects or activities did you participate in while in high school other than athletics?
   1. class plays, skits
   2. debate, public speaking
   3. student council, class offices
   4. yearbook or newspaper
   5. musical activities, band, chorus

75. During your last two years in high school, about how many hours a week, both in and out of school, did you spend on athletics?
   1. none
   2. 1-4
   3. 5-9
   4. 10-14
   5. 15 or more

76. What were your main subjects in high school?
   1. business or commercial
   2. trade or industrial
   3. agricultural
   4. fine arts or music
   5. academic or college preparatory

77. How close to Iowa State College is your home?
   1. less than 20 miles
   2. 20-50 miles
   3. 50-100 miles
   4. 100-200 miles
   5. 200 or over

78. What did you usually do during your school days when you found problems hard to understand?
   1. asked teachers or parents for help
   2. asked school mates for help
   3. gave closer attention in class
   4. did some background reading
   5. dug until the problem was solved

79. How much more difficult did you anticipate college to be compared to high school?
   1. much more difficult
   2. somewhat more difficult
   3. about the same
   4. did not expect it to be more difficult
   5. had not thought about it

80. When did you first consider entering college?
   1. have always planned to come to college
   2. began to consider it in junior high school
   3. senior high school
   4. while in the service
   5. after graduation but not in service

81. Who was most influential in your decision to go to college?
   1. yourself
   2. parents
   3. another adult, teacher, minister
   4. friends
   5. no special person
82. If you were to enter college now, would you:
   1. choose the same curriculum here
   2. choose the same curriculum in another school
   3. choose another curriculum here
   4. choose another curriculum in another school
   5. not enter college

83. How often have you seriously considered quitting school?
   1. never
   2. once
   3. occasionally
   4. frequently
   5. have quit once

84. How do you feel about the job opportunities for graduates in your field?
   1. better than in most others
   2. about the same as most others
   3. poorer than in most others
   4. had not seriously considered it
   5. good prospects for myself

85. When you finish college do you plan to:
   1. go to graduate school
   2. take a job full time and not take more college work
   3. take part time graduate work while on a job
   4. go to service
   5. had not decided

86. How old will you be when you finish college?
   1. less than 20
   2. 20-21
   3. 22-23
   4. 24-25
   5. over 25

87. When you were 16 years of age, how old were most of your friends?
   1. they were usually younger than I
   2. they were about my own age
   3. they were usually older than I
   4. they were mostly adults
   5. I did not have an opportunity to make many friends (work, isolated area, etc.)

88. How old are the majority of your friends today?
   1. about my own age, as a rule
   2. about 2 to 3 years older
   3. about 2 to 3 years younger
   4. more than 3 years older
   5. no consistent age pattern

89. How many close friends did you have during your last year in high school?
   1. none
   2. 1 or 2
   3. several
   4. many
   5. almost everyone in my class was a close friend

90. How many very close friends do you have today?
   1. none that fit that description
   2. 1 or 2
   3. 3-4
   4. 5-7
   5. 8 or more

91. How many new friends have you made in the past year?
   1. none
   2. 1 or 2
   3. 3 to 5
   4. 6 to 8
   5. can't remember exactly

92. To what extent are you still friendly with people you knew in high school?
   1. not at all
   2. friendly with a few of them on rare occasions
   3. friendly with some, but see them irregularly
   4. see some regularly
   5. close friends with quite a few

93. Which one of the following took up most of your unscheduled time before you were 18?
   1. dances, dates or parties
   2. sports
   3. making spending money
   4. music, art, reading
   5. school activities
94. To which of the following recreational activities have you devoted the most time in the past 5 years?
1. amusements (dancing, movies, television, etc.)
2. outdoor recreations (hiking, fishing, swimming, golf, etc.)
3. outdoor work around your house (gardening, painting, etc.)
4. reading (newspapers, books, magazines)
5. music, art, dramatics

95. Which one of the following do you look forward to most in your leisure time activities?
1. a chance to rest and relax
2. a chance to putter around
3. a chance to be with other people
4. a chance to get outdoors or be active
5. a chance to be alone with my thoughts

96. Which was the highest grade you reached in the Boy Scouts of America?
1. Tenderfoot or Second Class Scout
2. First Class Scout
3. Star Scout or Life Scout
4. Eagle Scout
5. Did not belong to the Boy Scouts

97. What has your experience with people been?
1. there is a lot of good in all people
2. there is some good in most everyone
3. people are about as good as they have to be
4. a surprising number of people are mean and dishonest
5. most people are just no good

98. During my youth when teams were being chosen for games, I was usually picked:
1. near the first
2. around the middle
3. near the end
4. I was usually one of those doing the choosing
5. I very seldom had time to play games

99. When in high school, about how many evenings a week did you "go out"?
1. less than 1
2. 1
3. 2
4. 3
5. 4 or more

100. When you were in school (grade or high school), where did you and your friends most often get together?
1. at a friend's home
2. at a club, dance hall, or public building
3. at your house
4. on the street corner
5. at church activities

101. If you had a choice do you prefer to associate in social groups of:
1. men of the same age as yourself
2. have no preference
3. groups of mixed ages
4. men older than yourself
5. men younger than yourself

102. In social groups do you feel a leader?
1. about as often as any one else
2. less often than your share
3. more often than your share
4. never
5. always

103. How much freedom did you have concerning your evenings while in high school?
1. no restrictions by parents
2. about the same as my friends
3. could not go out during the week
4. could not go out during the weekends
5. only restricted as disciplinary measures
104. If single, how often do you date, on the average?
   1. do not date
   2. only once in a while (less than once/month)
   3. one to three dates per month
   4. once a week
   5. more than 2 per week

105. Do you and your friends generally agree on politics?
   1. yes, all of them feel as I do about politics
   2. most of them feel as I do, as far as I know
   3. some of them feel as I do, as far as I know
   4. most of them feel differently than I do
   5. have no idea how they feel about politics, or rarely discuss politics; not interested in politics, etc.

106. Which one of the following has helped you most in getting along with people?
   1. following good human relations principles
   2. standing up for my rights
   3. giving others a lot of attention
   4. not changing my views if I think I am right, despite pressure
   5. recognizing when it is necessary to change my mind

107. How old were you when you had the first major responsibility for choosing your own clothing?
   1. in junior high school
   2. in high school
   3. after graduation
   4. while in the service
   5. do not remember

108. Which one of the following do you think is closest to describing your own personality?
   1. difficult to really get to know
   2. have some really close friends and a number of acquaintances
   3. friendly and easy-going; have a lot of friends
   4. very jolly; the "life-of-the-party" type
   5. find it extremely difficult to describe myself

109. Which one of the following techniques of disciplining a child would you use?
   1. denying the child some material pleasure
   2. encouraging the child by pointing out good behavior
   3. leaving decisions up to the child after discussion
   4. trying to reason with the child
   5. punishing or spanking the child, letting him know why he is being punished

110. Where did you get your early information about sex matters?
   1. from "the fellows"
   2. from parents
   3. from some member of the opposite sex
   4. from an older friend or counselor
   5. I didn't get any information

111. In what type of community is your family now living?
   1. in the country
   2. in a small town of under 2,500 people
   3. in a small town or city of between 2,500 and 25,000 people
   4. in a small city of between 25,000 and 100,000 people
   5. in a large city of over 100,000 people

112. Where did you go on your last vacation?
   1. Northern U.S.
   2. Southern U.S.
   3. Western U.S.
   4. Eastern U.S.
   5. Have never had a vacation trip

113. To what extent do you find that you get tired?
   1. only after a lot of extra work or pressure
   2. more frequently now than when I was younger
   3. to about the same degree as I used to
   4. when I am not feeling well physically
   5. never seem to feel tired
114. How much sleep do you average per night?
   1. less than 5 hours
   2. 5 to 6 1/2 hours
   3. 6 1/2 to 7 hours
   4. 7 to 8 hours
   5. more than 8 hours

115. On the average, how much sleep do you require to feel really good?
   1. less than 5 hours
   2. 5 to 6 1/2 hours
   3. 6 1/2 to 7 hours
   4. 7 to 8 hours
   5. more than 8 hours

116. When you are tired how do you act?
   1. just sleepy
   2. short tempered
   3. "punchy" - "slap happy"
   4. unhappy.
   5. some other way

117. How long does it usually take you to fall asleep?
   1. can go to sleep right away, at any time of the day or night
   2. can go to sleep within 15 minutes
   3. can go to sleep in 15 minutes to one-half hour
   4. usually need one-half hour or more to fall asleep
   5. no consistent pattern; depends on how tired, etc.

118. Do you consider yourself a:
   1. nervous person
   2. fairly tense person
   3. fairly relaxed person except when the job tension builds up
   4. fairly relaxed person
   5. relaxed person

119. When are you most likely to have a headache?
   1. when you are trying hard to do something right
   2. after one of "those" nights out
   3. after driving or looking at strong glare during the summer
   4. when you don't get to eat on time
   5. never have any

120. In the past few months, how often have you had to turn down, or break, a social engagement because you were tired?
   1. much more often than I wanted to
   2. occasionally, but not too frequently
   3. rarely; I usually snap back after a hard day
   4. never use tiredness as an excuse
   5. I have an extremely high energy level; almost never get tired

121. What is your usual state of health?
   1. never ill
   2. never seriously ill
   3. about average
   4. feel poorly from time to time
   5. often feel "under the weather"

122. During your early teens, how rapidly did you grow physically?
   1. much more rapidly than most
   2. a little more rapidly than most
   3. at about the average rate
   4. a little slower than most
   5. I was much slower than most

123. Have you ever suffered from:
   1. allergies
   2. asthma
   3. high blood pressure
   4. ulcers
   5. headaches

124. Which of these common complaints most often bothers you?
   1. inability to sleep
   2. poor digestion, irregular bowels, etc.
   3. headaches
   4. "jumpiness"
   5. shortness of breath

125. When you have had restless nights what is the most common reason?
   1. school
   2. family
   3. financial
   4. health
   5. other
126. Which one of the following has caused you the most difficulty in the past 6 months?
1. lack of finances
2. difficulty with parents
3. difficulty with friends
4. difficulty with girlfriend or wife
5. nothing special

127. When you need an excuse to avoid doing something, what excuse do you commonly use?
1. a conflicting date
2. a reasonable illness (headache)
3. some other work to do
4. just don't want to do it
5. something else

128. When some difficult problem is bothering you with whom do you usually talk it over?
1. father
2. mother
3. friend
4. older adult, not parent
5. no one

129. As a youngster, how did you "let off steam" when you got angry?
1. by fighting
2. by kicking or throwing something
3. by "cussing"
4. by talking it over with someone
5. I didn't - I tried to hide my feelings

130. To whom did you usually go for advice on important matters when you were about 16 years old?
1. friends of my own age
2. my father
3. my mother
4. teachers or ministers
5. didn't ask advice of anyone

131. How often do young people, outside of your immediate family, come to you for advice?
1. never
2. rarely
3. occasionally
4. quite often
5. constantly

132. How often do people tell you their troubles?
1. never
2. not very often; very few people do
3. about as often as they do to other people
4. quite often; a lot of people seem to want to tell me their troubles
5. constantly; almost everyone seems to come to me with his troubles

133. How do you usually act when you are angry?
1. storm around for awhile letting off steam
2. try not to show that I am angry at all
3. never let my temper get the best of me
4. talk it over with someone
5. try to keep away from everybody for awhile

134. Most people give me:
1. much more respect than I deserve
2. a little more respect than I deserve
3. as much respect as I deserve
4. a little less respect than I deserve
5. a lot less respect than I deserve

135. Which of the following best describes what you do in making important decisions?
1. take time to check with parents
2. make the decision then notify parents
3. do not notify parents
4. seek advice of other friends
5. work the decision out independently

136. What type of supervision do you prefer?
1. strict, with definite plans and assignments
2. lenient, with definite plans and assignments
3. lenient, where you are on your own
4. like to be left entirely alone
5. no preference
137. If it has been necessary to borrow money, whom have you asked?
   1. parent, relative
   2. friend
   3. bank, loan office
   4. boss
   5. other

138. How much money do you presently owe?
   1. none
   2. less than 25
   3. 25-100
   4. 100-500
   5. 500 or more

139. What is the largest amount of money you have ever owed to another person or organization?
   1. none
   2. less than $25
   3. 25-100
   4. 100-500
   5. over 500

140. How old were you when you first earned a little money of your own?
   1. under 10 years
   2. 10 to 12 years old
   3. 12 to 14 years old
   4. 14 to 16 years old
   5. over 16 years old

141. How many hours a week did you spend on a part-time job while a senior in high school?
   1. none
   2. less than 5
   3. 5-10
   4. 10-20
   5. more than 20

142. Did you work while in high school?
   1. yes, earned spending money
   2. yes, earned clothing money
   3. yes, earned board
   4. yes, earned room
   5. no

143. Which one of these has given you the least difficulty on any job you have held?
   1. lack of friendliness of fellow workers
   2. not being as fast as other workers
   3. not knowing the job well
   4. the boss' criticism
   5. none of these

144. Which of the following do you enjoy least?
   1. talking with friends
   2. spending time with your family
   3. physical activity
   4. meeting strangers and winning them over
   5. reading

145. Which of the following do you enjoy most?
   1. talking with friends
   2. spending time with my family
   3. physical activities
   4. meeting strangers and winning them over
   5. reading

146. Which one of the following do you prefer? Consider that this may be presented through books, magazines, movies, stage plays, radio, TV, etc.
   1. mystery or detective stories
   2. current and political events
   3. historical stories
   4. biographical stories
   5. science fiction

147. Which one of the following types of radio or TV programs do you like least?
   1. news, or sports events
   2. operas, symphonies, or concerts
   3. comedy or variety programs
   4. mystery plays
   5. practically never listen to the radio or TV
148. Which of the following types of radio or TV programs do you like best?
1. news, or sports events
2. operas, symphonies, or concerts
3. comedy or variety programs
4. mystery plays
5. practically never listen to the radio or TV

149. Where did most of your spending money come from during the years you were in high school?
1. allowance from family
2. my own earnings
3. partly allowance, partly earnings
4. other sources
5. had no spending money

150. Do you keep a personal budget and account of what you spend?
1. keep exact records and budget all expenses
2. keep exact records and manage the spending according to a general plan
3. do not keep exact records, but do manage expenses according to a plan
4. have tried keeping records or budgets, but have found them unnecessary
5. have never found it necessary to keep exact records or budgets

151. How much life insurance do you have which you have personally purchased?
1. none
2. less than $5,000
3. $5,000 to $10,000
4. $10,000 to $20,000
5. more than $20,000

152. How many suits (winter and summer) do you own at present?
1. 1
2. 2 or 3
3. 4 or 5
4. 6 to 10
5. more than 10

153. How old is your car?
1. do not own one
2. 1 year
3. 2-3 years
4. 4-6 years
5. over 6 years

154. Which part of the Sunday newspaper are you most likely to skip?
1. entire news section (not just front page)
2. business or financial section
3. amusement section, or comics
4. sports section
5. some other, or no section consistently

155. When you need to solve a tough work problem, what do you usually do?
1. sit down and figure it out myself
2. talk it over with my wife or friends
3. talk it over with some of the fellows at work
4. talk it over with my boss, or other superiors
5. let it ride for awhile, then tackle it with a fresh eye

156. Which of the following have you ever organized or assisted in organizing?
1. athletic team or sports competition
2. financial or charity campaign to raise funds
3. literary, debating, choral or social clubs
4. some other than the above
5. have never had an opportunity to organize or assist in organizing any kind of club

157. In comparison with your friends, what do you think of your personal appearance?
1. almost all of my friends are better looking
2. most of them are better looking
3. I am equal to most of them in appearance
4. I am better than most of them in appearance
5. I don't feel strongly one way or the other about my appearance
158. How many serious non-fiction books have you read in the past year, not counting text books?
1. none
2. one
3. 2-4
4. 5-8
5. 9 or more

159. How well do you drive an automobile?
1. still have a lot to learn before I will be confident of my ability
2. as good as most other drivers
3. better than most other drivers
4. one of the best drivers
5. do not drive

160. How many accidents involving more than $25.00 damages have you had while driving an automobile, truck, etc. (If you were a passenger during the last 5 years, do not count the accident).
1. have had no accidents
2. 1 or 2 accidents
3. 3 or 4 accidents
4. 5 or more accidents
5. have not driven during last 5 years

161. How old were you when you first went alone on a trip of over 100 miles?
1. younger than 10
2. 10 to 12
3. 13 to 15
4. 16 to 18
5. 19 or older

162. How do you want people to feel about you?
1. feel I'm capable
2. feel I'm tough but fair
3. feel I'm a "nice guy"
4. feel I have a sense of humor
5. none of these

163. If you visit a museum, how do you feel?
1. bored
2. thoroughly interested
3. neither bored nor interested
4. I don't go to museums
5. it's a good place to take children

164. About how many fiction books have you read in the past year?
1. none
2. 1 or 2
3. 3 or 4
4. 5 to 9
5. 10 or more

165. Which of the following do you think you do least well?
1. read
2. write
3. talk
4. work with numbers
5. other

166. Which of the following do you think you do best?
1. read
2. write
3. talk
4. work with numbers
5. other

167. How many public speeches have you made during the past year?
1. none
2. 1
3. 2
4. 3
5. 4 or more

168. What type job do you feel you will eventually take?
1. sales
2. management
3. personnel
4. design
5. research

169. About how often have you changed your mind about your future vocational plans since entering high school?
1. have not changed them
2. only once
3. two or three times
4. too many to remember
5. have still not decided
170. How do you feel about jobs requiring many routine operations, calculations, etc?
   1. rather enjoy routine once I get hang of it
   2. do not mind them once in a while
   3. indifferent, take it or leave it
   4. dislike them but would take one if well paid
   5. would not take one under any circumstances

171. Which of these do you dislike most in a job?
   1. confusion
   2. inefficiency
   3. personal bad feeling
   4. lack of a chance to progress
   5. dirt

172. Which of these do you dislike least in a job?
   1. confusion
   2. inefficiency
   3. personal bad feeling
   4. lack of a chance to progress
   5. dirt

173. Which one of the following have you disliked most in jobs that you have held?
   1. couldn't plan future around job
   2. couldn't use initiative
   3. no encouragement to put forth effort to better myself
   4. the people above me
   5. none of these

174. Where would you belong in a list of 100 typical people in the kind of job you can do best?
   1. in the best 5%
   2. in the upper third (but not in the best 5%)
   3. in the middle third
   4. in the lowest third
   5. haven't given it much thought

175. How good do you think you are, or could be, as a supervisor?
   1. in the top 5%
   2. in the upper 20% (but not the top 5%)
   3. in the upper half (but not the top 20%)
   4. in the lower half
   5. don't know

176. Of the following, which one do you do best?
   1. face-to-face interviews
   2. written reports
   3. group discussions or conferences
   4. lectures or speeches to groups
   5. getting my ideas across to my colleagues

177. How fast do you usually work?
   1. much faster than most people
   2. somewhat faster than most people
   3. somewhat slower than most people
   4. much slower than most people
   5. unable to tell

178. What sort of work do you like?
   1. indoor work
   2. outdoor work
   3. work with people
   4. work with things
   5. work with ideas

179. What sort of occupation would your parents like you to enter?
   1. profession: doctor, lawyer, engineer, teacher
   2. same as father
   3. have no preference
   4. business
   5. sales
Please make the following statements after handing out the Inventories.

We would like to ask your cooperation in filling out a Biographical Inventory for a study which is presently being conducted in several selected curricula here at Iowa State College.

The purpose of this study is to determine what personal or biographical traits characterize successful majors in certain selected areas. The idea being that you, as potentially successful majors in this particular curriculum, will serve as a criterion group. If results from this Inventory are found to successfully differentiate among majors in various areas, this will provide an additional basis for assisting students who are undecided concerning curricular choice or wish some indication of probable success in this curriculum.

The following are directions for filling out the Inventory: (Have them do this now.)

1. Although the directions state that special pencils will be provided, this will not be the case. You may use your own pencil. (any weight)

2. Do not fill in the blanks on the front sheet of the Inventory. Rather, provide the following information on the answer sheet:
   a. In the blank marked NAME, put your name.
   b. In the blank marked SCHOOL, fill in the name of this department. (E. E., K. E., Ind. Adm., etc.)
   c. In the blank marked 1., write Jr. or Sr.
   d. In the blank marked 2., put your cummulative grade point average up to the beginning of the present quarter. (If not known, estimate to 1 decimal place.)

3. You will be asked to fill out this Inventory and return here on or before ____________.

We appreciate your help in filling out this Inventory and hope that the results will be helpful to future students in this curriculum.

Any comments which you feel would emphasize the fact that we would like 100% returns, will be appreciated.