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difference between average I.Q.'s of the two groups. Another limiting factor would be that each group had a different teacher.

#### RECOMMENDATIONS

In order for the study to be more valid, it should be continued for a longer period of time on students with matching I.Q.'s or with very little difference in I.Q.'s. Also, one teacher should teach groups being used in the study to be certain that instruction of both groups is equal.

## An Analysis of the Outcomes of Special Summer Programs for Secondary Students of High Ability

ROBERT E. YAGER AND GERALD KROCKOVER<sup>1</sup>

*Abstract:* The National Science Foundation has supported special training programs for secondary students of high ability since 1959. This is the report of a study of the outcome of such programs upon the participants. Specific values of the programs were reported to be: 1) renewed interest in the remaining year of high school, 2) development of better study habits, 3) better oriented for college, 4) development of confidence, 5) verification and depending of vocational plans, and 6) general stimulation from a superior academic experience.

In 1959 the National Science Foundation sponsored and supported the first Summer Science Training Program for High-Ability Secondary School Students. The number of these programs has grown to about one hundred fifty each summer and they have been held in nearly all of the fifty states and the District of Columbia and Puerto Rico. The purpose of the programs is "to provide the superior high school student with educational experience in science and mathematics beyond that normally available in high school courses." The scope of the programs is great as is the diversification in approach. The programs are largely operated by colleges and universities when they are selected following submission of a proposed program to the National Science Foundation. The students receive more intensive training in science content, laboratory experiences, and research participation than is available in high school. This training presumably intensifies interest in science and provides a better background for career choices in science.

The programs generally are believed to be worthwhile. How-

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ever, there have been few attempts to identify exactly what the chief values are. Now that a sizable group of the 1959 participants is in the pursuit of undergraduate degrees, interest is great concerning their feelings concerning their experiences in a Summer Program. A considerable amount of time, effort, and funds have been spent for these programs. Plans include continuing the programs for the next few years at least. This will allow for conclusive evaluation and the final vocational choices will be made by a significant number of previous participants.

The National Science Foundation has financed a study by Edgerton to discover some of the preliminary outcomes of the Summer Science Programs (3). It is a detailed account of participant, staff, and impartial observer reactions concerning eighteen programs selected at random from the total number. The great diversity of these programs, however, tends to alter the effects of a given approach and a given program. This is a study of two programs of a specific type which were held at the State University of Iowa during the summers of 1960 and 1961. A similar study was completed in 1961 by Bradley concerning a single program held at Morgan State College during the summer of 1959 (1).

#### THE NATURE OF SPECIAL PROGRAMS

The programs at Iowa have been previously described by Yager (4) (5). They were course oriented programs concerning the fields of botany, chemistry, mathematics, physics, and zoology. In addition, there were several formal and informal seminars as well as opportunities for research observation and participation. The nature of the participants and the methods used for their selection have been reported by Dessel and Yager (2). In general, all participants ranked in the upper five percent of their classes and were judged to be very science prone. Specifically, the objectives of the programs at Iowa were: 1) to provide a stimulating educational experience for superior high school students interested in science; 2) to supplement the science and mathematics curricula present in high schools, especially the smaller schools; 3) to interest superior student in scientific careers; 4) to offer comprehensive instruction in several fields of science in order that some idea of the depth and breadth of a field could be secured by the students; and 5) to enable the students to approach the threshold of research in the various areas of science.

#### PROCEDURES

One hundred thirty-seven students were involved in the two Iowa programs. At the completion of each program the students all completed an evaluation form prepared for the National Science Foundation by Richardson, Bellows, Henry, and Company, Incorporated, especially for the purpose of evaluation of the Summer Science Programs. It asks for much factual information

concerning high schools, parents, and participant's interests. In addition, there are several questions, requesting student opinions and reactions. These open-ended questions requesting information concerning the operation of the program and anticipated effects of the program have been analyzed for each participant and reported in this article. In addition, another questionnaire was prepared and mailed to each participant a year following the particular Summer Science Program of which he had been a part. These questions were also open-ended, requiring written responses and opinions. The results of this questionnaire are also reported in this study. Ninety-five of the one hundred thirty-seven participants responded. This represents approximately seventy per cent response to the questionnaire and the accompanying letter. This high response indicates something of the cooperative nature of the participants in both of the programs.

A group of students judged to be equally competent by the participants who did not attend the Summer Program were identified by the participants on the initial evaluation form. A random group of these students was selected to act as a control group in a continuing study. However, in this early analysis of the outcomes the comparison group was of little value. It was learned that most of them plan to enter college and many are interested in science or science related areas as majors. It was determined that many of these students are less aware of the nature of college and the existence of many vocational possibilities in the field of science. Obviously they could not express opinions concerning the effects of the Summer Program since they were not a part of it. However, it will be interesting to follow this group of students as they and the participant group proceed through college and actually make vocational choices.

RESULTS

Tables I through VII are a tabulation of responses from the questionnaires and represent the results of the study. It can be noted from Table I that the greatest anticipated effects of the Summer Programs upon the remaining year in high school are improvement of study habits and improvement of opportunities for scholarships. Eighteen per cent of the participants also anticipated that high school would be easier after experiencing the competition and challenge of the Summer Program. Other immediate anticipated effects involve a clarification of vocational plans, a greater desire to continue with a college education, and the development of broader interests.

TABLE I

| Anticipated Effects of Program on High School the Following Year |                          |
|--|--------------------------|
| Response   | Per Cent Making Response |
| Make it Easier   | 18                       |
| Improved Study Habits  | 30                       |
| Improve Grades   | 8                        |
| Develop confidence   | 4                        |
| Improve Sense of Direction                                       | 8                        |
| Improved Chance for Scholarships                                 | 21                       |
| Encourage Science Fair Participation                             | 4                        |

Tables II and IV list the major likes and dislikes of the participants concerning the programs. These lists indicate rather simply some of the specific outcomes of the programs. The learning experience afforded by the overall program and the stimulation gained from associating with the other participants were the items listed most often as outstanding features of the programs. The association with the members of the program staff and the

TABLE II

| Other Anticipated Effects of Program Upon Return to High School Response | Per cent Making Response |
|--|--------------------------|
| Bring Vocational Plans into Focus  | 11                       |
| Broaden Interest   | 9                        |
| Develop Desire to Continue Formal Education                              | 1                        |

TABLE III

| Outstanding Features of the Summer Program as Listed by Participants Response | Per Cent Making Response |
|---|--------------------------|
| Staff   | 21                       |
| Learning Experience   | 34                       |
| Other Participants  | 34                       |
| The Overall Challenge   | 9                        |
| Trips   | 5                        |
| Freedom of Action   | 1                        |
| Preparation for Future  | 3                        |
| Taste of College  | 20                       |
| Organization of Program   | 6                        |
| Friendly Atmosphere   | 4                        |
| "Everything"  | 3                        |

TABLE IV

| Features Liked Least by Participants Concerning Summer Program Features | Per Cent Making Response |
|---|--------------------------|
| Location of Housing Facilities  | 17                       |
| Lack of Opportunity to Earn Money                                       | 4                        |
| Lack of Time to Work Effectively  | 1                        |
| Weather   | 8                        |
| Activities  | 1                        |
| "Nothing"   | 26                       |

TABLE V

| Program Meeting Expectations of Participants Response | Per Cent Making Response |
|---|--------------------------|
| Yes   | 88                       |
| Yes, and More   | 10                       |
| Yes, but Different                                    | 2                        |
| No  | 0                        |

opportunity for experiencing the life of a college student were the features which were also often listed by the participants as outstanding. It is significant to note that the most common feature liked least by the participants was "nothing". The only adverse comments listed by more than one percent of the participants involved such items as the location of the boys' dormitory, the weather, and the lack of opportunity for earning money during the summer. None of these items is concerned with the learning procedure or organization of the programs. From Table V it is at once apparent that the programs were generally successful from the students' viewpoint and that their expectations

were at least equalled. Only one of the hundred thirty-seven students stated that he would not attend the program if he had the decision to make again.

Table VI provides interesting information regarding tentative career choices. The participants demonstrate a wider variety of interests and anticipated vocational preferences. The most frequent choice is physics where a total of eighteen percent selected the general area. This is followed by medicine where thirteen and one-half percent of the participants list it as a vocational choice. Significantly four and one-half percent of the participants express a vocational preference other than in the area of science and five and one-half per cent are undecided.

| TABLE VI  |          |             |
|---|----------|-------------|
| Vocational Choices at Close of Summer Science Program |          |             |
| Occupation Named                                      | Per Cent | with Choice |
| 1. Aeronautical Engineering                           | 1.5      |             |
| 2. Biology  | 4.5      |             |
| 3. Botany   | 1.5      |             |
| 4. Business Administration                            | 3        |             |
| 5. Chemical Engineering                               | 6        |             |
| 6. Chemistry  | 1.5      |             |
| 7. Civil Engineering                                  | 1.5      |             |
| 8. Dietetics  | 1.5      |             |
| 9. Electrical Engineering                             | 3        |             |
| 10. Electronics                                       | 1.5      |             |
| 11. Engineering (General)                             | 4.5      |             |
| 12. Lawyer  | 1.5      |             |
| 13. Mathematics                                       | 3        |             |
| 14. Mathematics Teaching                              | 4.5      |             |
| 15. Medicine  | 13.5     |             |
| 16. Nuclear Physics                                   | 3        |             |
| 17. Nursing   | 3        |             |
| 18. Physics   | 16.5     |             |
| 19. Psychology  | 4.5      |             |
| 20. Science Teaching                                  | 12       |             |
| 21. Space Science                                     | 1.5      |             |
| 22. Theoretical Physics                               | 1.5      |             |
| 23. Undecided   | 5.5      |             |

One of the most interesting parts of the study is reported in Table VII. It represents the ideas of the participants concerning the effects that the Summer Programs had upon them one year following their participation. Concerning the effects of the programs on college attendance and career choice, it is at once apparent that the programs significantly affected the latter. Thirty-five percent of the participants indicated that the program had enabled them to focus their career choice in science to a greater extent. A little over half as many students indicated that they were undecided but stated that the Summer Programs had provided a better basis for making vocational choices. It is interesting to note that a year following the programs there are nearly three times as many participants who are undecided as to vocational plans than was true immediately following the program. The significance of this observation is not apparent. At

TABLE VII

|   |   | Per Cent |
|---|---|----------|
| A. Effect on College Attendance and Career Choice   | Caused to aim higher                                      | 4.7      |
|   | Strengthened former science career choice                 | 10       |
|   | Assisted in decision as to type of school                 | 6        |
|   | Caused a change to another science field                  | 8        |
|   | Focused career choice in science more                     | 35       |
|   | Undecided choice for career but improved basis for choice | 16.4     |
| B. Change in Attitudes, Interests, and Capabilities | More confidence in self                                   | 17       |
|   | Less confidence in self                                   | 3.4      |
|   | More negative feeling toward a particular science         | 2.5      |
|   | Better evaluation of own ability                          | 4.8      |
|   | Aware of need for hard work                               | 6        |
|   | Easier to adjust to college                               | 40       |
|   | Desire to improve socially                                | 3        |
|   | Develop broader interests                                 | 21.5     |
|   | Increased social maturity                                 | 11.7     |
| C. Effect on Completed High School Experience       | Failed to take it seriously                               | 2.3      |
|   | Did not wish to return                                    | 6        |
|   | Improved study habits                                     | 27       |
|   | Made high school seem easy                                | 6        |
|   | Made high school courses more interesting                 | 3.4      |
|   | Took high school work more seriously                      | 30       |
|   | Felt additional year of high school was wasted            | 7        |

the same time it is noteworthy to indicate that the control group of students were much less decided a year following the program than were the former participants. Ten percent of the participants indicated that the programs had significantly strengthened their previous career choices in science. Nearly all of the participants planned to enter college before their Summer Program participation. However, it is noted in Part A of Table VII that the program did have an effect upon choice of college, selection of a specific major, and formation of precise aims with respect to college enrollment.

One of the most significant changes in attitudes, interests, and capabilities identified in Part B of Table VII is the feeling that college adjustments will be easier as a result of program attendance. The development of broader interests and more personal confidence are other contributions of the Summer Programs as viewed by participants. Participants also felt that the program had increased their social maturity.

A year following the programs the participants felt that the greatest outcome of the programs with respect to effects upon their last year in high school was the fact that they viewed the high school work more seriously than they would have without participation in the Summer Programs. Also viewed as an important contribution to their senior year was the improvement of their study habits. It is interesting that this was the most often stated value that the group anticipated upon completing the Summer Programs.

## CONCLUSION

Although the actual effects of the Summer Programs will not be apparent for several years, there are definite indications that the following conclusions may be drawn:

1) The participants report that their last year in high school was taken more seriously than they had anticipated before program participation.

2) The study habits of the participants was much improved. This was anticipated at the completion of the programs and verified after spending the remaining year in high school.

3) Students were better prepared for college as a result of participation in the Summer Programs.

4) Participants believed that they had more confidence in themselves as a result of program participation.

5) The Summer Programs affected vocational choices. They strengthened choices in science for some, provided a basis for more realistic decisions concerning science for others, caused some to shift their interests to other science fields, and caused a few to decide against a college major in science.

6) Experiences in a Summer Science Program are viewed enthusiastically and are generally popular with participants. The stimulation from a learning experience at the college level, the stimulation from associating with other enthusiastic and competent students, the association with a competent staff, and the general taste of college life are all features of the Summer Programs which are viewed as desirable features by participants.

Evaluation of these programs as well as the one during the summer of 1962 will continue. Initial information regarding college choices and majors declared at college is available and will be reported later.

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