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ABSTRACT

Attrition among urban engineering students at Stevens Institute of Technology was studied. At the time of the student's college entry, various ability, achievement, personality, interest, and biographical factors were analyzed in an effort to predict student persistence, withdrawal, or academic failure. For the 381 male students who entered the college in September 1969, 259 graduated and received their B.S. degree, 82 failed, and 40 voluntarily left for nonacademic reasons and transferred. Among the findings are the following: the average Scholastic Aptitude Test scores on the verbal and mathematics tests were lowest for the fail group and highest for the group that left the college and presumably transferred elsewhere; there were no significant differences between the three groups on the Brown-Holtzman Survey of Study Habits and Attitudes; students who persisted to graduate differed statistically from transfers on 22 of the occupational scales of the Strong Vocational Interest Blank for Men; significant differences between those who graduated and those who transferred were found on the F, Mf, and Sc scales of the Minnesota Multiphasic Personality Inventory (MMPI) (transfers obtained higher mean scores); the fail group obtained higher mean scores than the persisters on the Ma, Pd, Sc and F scales of the MMPI; and greater number of students who failed came from homes in which the parents were widowed, divorced, separated, or both deceased. An extensive literature review, a bibliography, and a sample student personal data record questionnaire are included. (SW)

Differences between persisting, transfer and failing students at an eastern engineering college

by

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Laboratory of Psychological Studies

Research Monograph

Stevens Institute of Technology

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CHAPTER I

INTRODUCTION

American business has long been concerned with the problem of labor turnover and a number of studies over the years have indicated that labor turnover and attrition rates are very costly. Little of this type of evaluation has shown itself in American higher education, although even a cursory review of professional literature reveals a concern about the college "dropout" as a problem. Davis (1962) is the only writer who apparently has suggested that the dropout represents a financial loss to an academic institution and that this loss was estimated at $1,000 per student to the institution. If the typical view that tuition pays only about one-third of college costs is correct, there is little reason to doubt that student attrition is costly to a college which has fixed costs in buildings, facilities and furnishings, as well as faculty. Were it possible to reduce the college drop-out rate, it would then follow that the cost of producing a final product -- the graduate -- would be lessened.

The recent years have brought increased financial pressures and a tendency towards lowered enrollments at private institutions of higher education and particularly those with rather specialized and limited curricula. The high unemployment rate of aero-space engineers a short time ago and reduced governmental spending for scientific research have especially struck at

the enrollments of a number of engineering-science colleges. For these institutions, then, the problems of efficiency and costs relating to production seem especially important.

Extent of Problem

Statistics on the extent of college student attrition have shown variations dependent upon the type of institution and the criteria used to define the "drop-out". A typical report is that of Iffert (1958) who reported a national average drop-out rate of over 60%. He further suggested that private institutions showed a rate of only 52% compared to an average rate of 67% for public institutions of higher education. Specialized institutions showed variations in rate also from 58 per cent for men attending technological institutions to a high of over 71 per cent among men attending teachers colleges. Iffert's figures as reported are based upon students who leave the college of their initial enrollment.

Davis (1965) reports on almost 7400 engineering freshmen studied and concluded that only 51% were still enrolled in engineering as seniors. He further suggests that engineering is the college major that exhibits the largest loss of students during the college years. Feldman (1969) also reports that approximately 49% of freshmen choosing engineering transfer out of engineering by their senior year.

Marland, U. S. Commissioner of Education, recently indicated

in a speech that only about 33% of students enrolling for post-secondary education on a nationwide basis eventually graduate.

Marsh (1966) finds conflicting results of some of the descriptive studies of college drop-outs in rates and causes. Marsh suggests that these differences indicate variations among colleges, as well as the likelihood of change from year to year even on the same campus.

Summerskill (1962) also suggested the need for local data since attrition rates vary from 12% to 82% among different colleges. With regard to the drop-out rates of collegians, Summerskill concluded only 40 per cent of students enrolled in college graduate on schedule -- but, he adds, another 20% do eventually receive their degrees.

The most recent and informative study on the drop-out is that of Astin (1972). Astin indicates that there is much concern with student drop-outs but that these studies have either been conducted at single institutions or in individual states. By contrast there have been very few published national studies and these have tended to be limited due to incomplete sampling of institutions, inadequate data input or over-reliance on student responses to mail questionnaires. Astin suggests that many of these earlier studies are also dated.

Astin reports on a representative sample of 217 institutions who participated in the Cooperative Institutional Research Program of the American Council on Education. Students at these institutions completed a 150-item information form. A sample of over 51,000 students constituted the major data pool. Astin did not limit his definition of "drop-out" as had been done in other studies. Instead, he considered that (in theory at least) almost any student who entered college could potentially return to complete a degree even if they once left. From a practical standpoint he used as his measures those who received a bachelor's degree or were still enrolled, and finally those who received a bachelor's degree, were still enrolled or had requested transcripts be sent elsewhere. Using these various measures as criteria, Astin concluded that the drop-out rate for students entering four-year colleges and universities is below 50 per cent even after only four years and this rate will continue to

decline as additional students complete their degrees. In his study, 61% of men received their degrees from their first institution or were still enrolled after four years. An additional 15 per cent of men were still actively enrolled four years after matriculation. Astin concludes that the data show that persistence rates for college students in the United States are in fact substantially higher than have been reported in other studies. One other conclusion arrived at by Astin is that, in spite of the many independent variables used in the analysis for the study, it is still not possible to predict very accurately whether a given student will drop-out.

One last observation seems in order. Marsh, to whom reference was made earlier concludes that the data from all

sources indicate that the freshman year is the most critical drop-out period.

The tentative conclusions from the foregoing are that college attrition is rather widespread throughout institutions of higher education in the United States but that attrition rates are perhaps not as high if we consider as persisters those students who continue their education at different institutions from that in which they initially enrolled or who return to the educational setting after varying periods of absence. The conclusion must also be reached that most of the attrition occurs during the first year of college and seems most marked for students attending technological institutions. For the engineering colleges the problem is made more acute by declining interest in engineering as a career and college major. An MIT report (1973) reports a decline from 18% in 1948 (all male college freshmen) to 9% in 1972.

Persistence Factors - Abilities

The ability of students who persist and do not persist in college has been a frequent and was one of the earliest areas of investigation.

Generally, the data have reflected the relationship of high school academic performance and ability test

scores to college achievement. Astin (1972) has reported that aptitude test scores and high school grades contributed independently to the prediction of persistence in the national college sampling. Yet, research results have not always shown a one-to-one relationship between ability and persistence. Halladay and Andrew (1958), for example, reported that fifteen per cent of the drop-outs from Arkansas colleges were above average on achievement and ability tests. In fact, some 36% of drop-outs had been progressing satisfactorily at the time they terminated schooling. Slater (1957) showed persistence as unrelated to American Council on Education test scores for the drop-out group.

Eells (1961) investigated the possibility of using different test batteries to predict the academic performance of students in four curricular groups at the University of Illinois. Prediction of engineering grades proved to be the least effective of all the groups. The elements which best predicted the grades of engineering students were the School and College Ability Test (Quantitative sub-test), and the Essential High School Content Battery's science and mathematics subtests.

Reid and associates (1962) reported on a study of the members of a class at Newark College of Engineering. Those who graduated within four years of matriculation (36%) had higher mean scores on the College Entrance Examination Board SAT Mathematics test, had higher high school class rank, and

obtained higher scores on the Educational Testing Service's College Ability Test (Quantitative), the Cooperative Intermediate Algebra test, the Cooperative English Test (Reading Comprehension) and to a slightly lesser degree on the ETS College Ability Test (Verbal). Graduates also significantly had lower literary interests than drop-outs. The group which withdrew voluntarily and was scholastically eligible to return revealed significantly less interest in mechanicl activities and somewhat higher interest in clerical-office detail activities. Those who were dismissed for unsatisfactory scholastic performance did show lower test scores on the average compared to graduates, and were lower in mechanical and artistic interests. Those dismissed also showed significantly greater interest in persuasive and social service activities.

Another study of factors associated with attrition of engineering students was conducted at the University of Wisconsin by Greenfield (1964). Greenfield investigated areas which might be relevant to the attrition of engineering students who withdrew, transferred or were dropped for poor scholarship during or immediately following their first semester in residence. The entrance data for students who withdrew, transferred or wished to transfer, or were dropped after one semester showed lower average scores on the College Qualification Test, Pre-Engineering Ability Test, & mathematics achievement tests. The students also had lower high school academic rank than the

total freshman group. It was also found of the students who were dropped at the end of the semester, that all but three had at least one failing grade at the first six-week marking period and half had two or more failing grades. Greenfield makes reference to several other findings. For example, she noted that one-fifth of the dropped students rated their high school preparation as poor and stated that they should have had more mathematics, English and chemistry in high school. Interestingly, only one-third of the students who transferred or were dropped knew the kind of work they would be expected to do as engineers.

Boe (1964) conducted a study whose purpose was to determine the efficiency of a battery of ability and achievement tests and high school grades in predicting the academic performance of engineering students. The results indicated that the correlations of tests with engineering and science grades were quite low, both absolutely as well as relatively, and that multiple correlations added little to predictive efficiency.

A group of freshmen at Indiana University served as subjects for Chase's (1960) study using a battery of tests and a personal history questionnaire as predictors. A comparison of data was made between the students who did not drop-out and those who did. The non-drop outs scored significantly higher on all tests

but the data show a very conspicuous overlap of scores between the two groups.

Wood and Lebold (1968) made an attempt to relate test scores and high school rank to the academic success of a group of engineering freshmen at Purdue University. The multiple correlations ranged from .32 to .58. These correlations are rather typical of the relationships found in many similar studies. It should be noted, however, that even the highest correlations only accounts for one-third of the variance at best.

Gallessich (1970), studying University of Texas engineering students, found ability and past school performance to be consistently associated with college academic performance but the size of the relationship accounted for about one-quarter of the variance. By adding measures of non-intellectual dimensions to the predictor set of academic aptitude test scores and high school grade point average, the multiple correlation was improved.

Hanson and Taylor (1970) have reported on various studies of University of Minnesota engineering students. In their cited report they indicated that previous high school achievement did contribute to differentiating successful from unsuccessful students. They also found, however, that there were personality dimensions which differentiated between persisters and students who withdrew.

Although evidence has existed showing that high school academic performance and ability tests are among the better individual predictors of college academic performance, especially during the freshman year, there has been increasing evidence that non-intellective or non-cognitive factors may play significant roles in college student performance but especially with regard to persistence or non-persistence in college work. Mayhew (1965), Fishman and Pasanella (1960), Brown and Dubois (1964) and Grande and Simons (1967), make reference to the need to consider such other factors. Elton and Rose (1967) and Holland and Nichols (1964) also indicate that many students with superior academic ability and ability to handle engineering training leave the study of engineering early in their college experience. Thus, factors other than ability must be involved. A contributory hint to this conclusion is found in a pilot study of a sample of Stevens Institute of Technology undergraduates by Kovenklioglu and Minck (1973). The investigators found no differences in the College Entrance Examination Board SAT scores between persisters and non-persisters but significant differences were found on three scales of the Minnesota Multiphasic Personality Inventory and differences were suggested in the area of some study habits indicators.

It would seem appropriate at this point to look at some of the other factors which have been investigated.

Persistence Factors - Interests

In the study by Greenfield to which earlier reference was made, students who withdrew from an engineering program to transfer reported doing so because of lack of any other goal or of any definite goal.

Taylor and Hanson (1970) report on the responses of a group of University of Minnesota, Institute of Technology freshmen to the Strong Vocational Interest Blank. The students were divided into four groups a year after enrollment. One group was labelled the "successful transfer", a second the "successful persist", a third the "unsuccessful persist", and the fourth the "unsuccessful withdraw". The successful persisters had interests which were considered engineering related (interests in mathematics and science, and like those of veterinarians, carpenters, printers and farmers). The group also rejected social service and verbal-expressive-persuasive interest. By contrast the successful transfer student had higher scores on the social service scales (Personnel Director, School Superintendent, Sociologist) and also the verbal-expressive (Advertising Man, Lawyer, Journalist and Political Scientist). The successful transfer group rejected technical interests and scored significantly lower on the Farmer, Math-Science Teacher, Veterinarian and Printer scales. The unsuccessful groups (those with grade point averages below 2.00) were different from the successful students. The unsuccessful withdraw, for example, generally

had unclear, undifferentiated interests and scored lower on the Chemist and Psychologist scales with only the Mortician and Social Science Teacher scales receiving high scores. The unsuccessful persisters were found to have technical, physically active interests.

In a later study, Taylor and Hanson (1972) reported on a follow-up study of another group of the University of Minnesota engineering students. Only those students who persisted after two years of college work and those persisters and transfers who repeated the Strong Vocational Interest Blank were included. The persisters showed little change in interest patterns (6 of 81 scales) whereas the transfer student showed major changes through decreasing physical science interests and increased interests in social service occupations, business management and sales. Taylor and Hanson report that the eventual transfer students differed from the persisters on eleven of the 81 scales on their freshmen interest profiles. The authors conclude that the decision to persist or transfer from a college of engineering is related to interests.

Korn (1962) investigated the patterns of interests of engineering and physical science majors. The physical science group was a combined group of chemistry, mathematics and physics majors. A third group of general studies freshmen was also included in the data analysis. Students were from Stanford University's 1959 freshman class and who completed the Strong

VIB. A comparison was made of predominance of responses to the seven groupings or families of occupations on the SVIB. The engineers were found to have significantly fewer than chance "primary" patterns in the bio-medical science grouping but did show a greater predominance of both "primary" and "secondary" patterns on the technical occupations. The physical science majors showed more "primary" interest patterns in the bio-medical sciences, the social service and the verbal-linguistic occupations and significantly fewer showed technical interests. Thus, the physical science majors had a broader range of interests.

A study of Purdue engineering students originally tested in 1935 and retested in 1966 was reported by Clemens (1970). An additional group of 1966 freshmen was included. Although Clemens was more concerned with the long range value of the Strong blank, a perusal of the interest profiles suggests that the predominance of high scores were in the technical-supervisory and technical-skilled occupations with a fairly consistent rejection of the social service interests.

Smith (1971) studied entering freshmen engineering classes for four years at Alfred University. A comparison was also made to a group of engineering students at Purdue University. His study was not concerned with persistence but is interesting in that about half the students tended to have "primary" or "secondary" interest patterns in the occupational groupings

for the physical sciences and the technical-skilled occupations.

Gehman and Gehman (1968) also were not directly concerned with the question of persistence although they did investigate the interest patterns of Duke University engineering students who expressed a clearly defined major and continued to pursue the major in four years of study. The relationship of freshmen and senior interests was significantly high but little change in means was noted thus indicating that students did not change significantly with regard to vocational interests over the four year period.

Persistence Factors - Personality

Early research relating personality factors and college work seems to have concentrated most upon personality in relationship to academic achievement. Harris (1940) listed over 300 studies conducted over an eight year period. The factors which were most frequently mentioned in the studies as important to academic success were ambition, cooperativeness, emotional maturity, a sense of responsibility and seriousness.

Berg (1947), reporting on a study of student nurses, concluded that those individuals who experienced some incongruence of perceptions of the chosen occupational role with their self-perceptions tend to change their vocations. With this as a foundation, Olive (1969) studied the values and occupational role perceptions of freshmen and senior engineers at the University of Nebraska and concluded that the seniors had greater congruence between their personal values and perceptions of

their occupational role than did the freshmen.

In a study of University of Florida students, Barger and Hall (1964) divided students into "low" and "high" achievement groups. They noted, among other things, that a fairly large number of drop-outs had ability equal to that of some students achieving passing grades. Using the Minnesota Multiphasic Personality Inventory the investigators noted that the drop-outs who had achieved high grades had high point codes on scale 5 (MF) whereas the low achievement group more frequently had high point codes on scale 9 (Ma). The high scale 5 group appeard to place a high value on intellectual pursuits; thus, the investigators proposed that this group may need a quieter atmosphere for living and studying and in which there is a down-playing of some of the non-intellectually related extra-curricular aspects of college life. The high scale 9 group, they propose, may need a diversity of activities to keep from experiencing boredom in college but also may need special counseling to help them channel an adequate proportion of their energy into academic endeavors.

Stevens (1955) reported an investigation of sophomore students at Stevens Institute of Technology in which he examined the achievement of the students and the relationship to self-concept. The "achievers" were honor roll students; the "non-achievers" were probationary students. All the students placed within the upper quarter on a general mental ability measure, were full-time students and were living on campus. Academically

successful students showed better self-insight into their intellectual abilities when they were asked to estimate their intellectual abilities when they were asked to estimate their intelligence test performance. The high achievers also showed a greater degree of self-acceptance. Non-achievers reflected social interest and outgoingness as their most important traits.

Marsh summarized the findings of a number of studies by characterizing the drop-out as "more rigid and fearful of change, less willing to accept the responsibility of adult independence, lacking internalized goals and values, and somewhat of a social misfit." Marsh also stated that the drop-out tends to be the type of person who feels easily, and perhaps hopelessly defeated when faced with the prospect of possible failure or disappointment. In addition, he tends to rationalize his failings in an unrealistic manner. (Marsh, 1966 p. 478).

Johnson (1970), in another study of University of Minnesota students, found that non-persisters received high scores on the Minnesota Counseling Inventory Conformity scale. According to the usual interpretation, high scorers are irresponsible, impulsive, rebellious, individualistic, self-centered and they learn little from experience.

Rossmann and Kirk (1970) compared data on persisters, voluntary withdrawals and failures (based on first year

cumulative grade point average) of students enrolled at the College of Letters and Science of the University of California at Berkeley. The voluntary withdrawals were found to have higher verbal ability and to be more intellectually oriented than the persisters, and as expected were significantly better in verbal and mathematics abilities compared to failing students. No differences in grade point average were found between persisters and withdrawals. When persisters were compared to students who withdrew in their responses to a personality inventory (Omnibus Personality Inventory), the latter were found to prefer reflective or abstract thinking and to be more interested in artistic activities. The withdrawal students tended to be more tolerant of ambiguites and uncertainties and more ready to express their impulses. Thus, the withdrawing student is more likely to seek gratification in conscious thought or action, to be less interested in the practical or applied approach to life, and to be more intellectually oriented. The male student who withdraws was found to more typically anticipate transfer or leaving the college before graduation (23% compared to 8% for persisters) and to be less likely than persisters to see athletics as important. No differences were found between withdrawals and persisters in family income, parental education or occupation, parents' level of aspiration for child or parental reactions

to the students achievements, students' level of aspiration, objective in college or attitudes about enrolling at the college initially. Some of these findings are similar to those of Heist (1968) who suggested that many freshmen of high ability and with an interest in intellectual matters are among the early voluntary withdrawals from college.

Holland and Nichols (1964) report on National Merit finalists. Their finding was that those who leave engineering appear "irresponsible, original, tolerant of ambiguity, and complex in outlook." The investigators speculated about the possibility that the attrition was because engineering attracted students who did not belong in engineering by virtue of their personal attributes.

Grande and Simons (1967) examined the personal values and academic performance of engineering students. No difference in socio-economic status was found between the successful and unsuccessful students. The higher achieving students (Dean's list) were described as having a stronger need for achievement, a deeper involvement in the struggle for good performance, a belief in planning ahead as important for academic success, and they exhibited a considerable degree of self-control through avoidance of the distrations of "wild parties". In many cases the successful students were seen by others as introverted because of their preference for working by themselves.

Elton and Rose (1967) concerned themselves with personality correlates of transfer out of engineering among University of Kentucky students. The Omnibus Personality Inventory (O.P.I.) was administered to all entering freshmen and the results were examined for those who transferred during the first three semesters. Analysis was made of scores of a randomly selected group who remained in engineering and those who transferred to the College of Commerce or the College of Arts and Sciences. The results indicated that "the engineering student who transfers to the liberal arts program prefers reflective thought of an abstract nature, appreciates freedom of thought, and is interested in scientific and artistic problems." (p. 914). The student who transfers to business from engineering displays characteristics opposite to those who transferred to liberal arts and he takes a more practical orientation than do students remaining in engineering. The transfer to business is similar to the engineering student in his conventionality, conformity to socially approved standards of behavior and in his reaction to authority. The students who transferred to liberal arts possessed more ability than those who transferred to business. Elton and Rose suggest that it is the more mature student who appeared to rebel against the rigidly structured engineering curriculum. The investigators characterized the engineering student as being interested in practical matters.

Further, they describe the engineering student as "dependent upon authority and unable to rebel against the strictures of family, school, church or state; unlikely to protest the infringements of individual rights; inflexible, intolerant, and unrealistic in his dependence upon rules, rituals and authority for managing social relationships; immature, conventional, religious, rigid, prejudiced and emotionally suppressed." (p. 195)

A study concerned with the relationship of personality and persistence in engineering specifically turned its attention to authoritarianism as the correlate to be investigated. Athanasiou(1968) suggests that engineering education, in structure and content, favors authoritarian ways of thinking and behaving. A group of persisting engineers was compared to another constituted of students who had transferred out by the sophomore year. When the groups were compared, the transfers were found to have rated themselves (prior to entry as freshmen) as more spontaneous than rigid, more politically liberal than conservative, more unconventional than conventional, and more "open" than "closed." In addition to the foregoing, Athanasiou also noted that more transfers were "only" children than was true of the persisters and that it was the brighter, more liberally oriented student who tended to leave for "greener pastures."

The Gallessich (1970) study included in the data collection some personality and biographical factors as possible correlates of academic success of engineering freshmen. The grade point averages of the students were found to be negatively correlated with scales of the Edward Personal Preference Schedule; specifically, the Exhibition, Nurturance and Change scales. Thus, high achievers among engineering students preferred status quo, avoiding the limelight and staying more to themselves, and also showed little inclination to involve themselves in helping others or providing sympathy or understanding to others.

Elton and Rose (1971), in another study of University of Kentucky students, compared persisters in the engineering college with those who transferred. The Omnibus Personality Inventory was one of the predictor instruments. Differences were found. The leavers scored higher on "personality scales which indicate that they like reflective thought, prefer to use the scientific method in thinking, prefer to deal with diversity and complexity in thought, are tolerant of other peoples' viewpoints and are independent of authority as it is traditionally imposed through a social institution such as a college curriculum." (p. 31). Elton and Rose suggest that there is a striking similarity between their findings and those of Snyder* at M.I.T.

*Snyder, B. Creative students in science and engineering. Universities Quarterly, 1967, 21, 205-218 (not available for direct review).

They report that Snyder found persisters in engineering to score low on the Thinking Introversion, Complexity, and Impulse Expression scales. The M.I.T. persister, then could be described as not liking reflective thought and not having a broad range of ideas. Further, they are not likely to have an active imagination, value sensual reactions, or wish to seek out and enjoy unusual, ambiguous events and experience. By contrast, persisters prefer simplicity and structure. Snyder is also reported to have found science majors to prefer dealing with diversity and complexity more than engineering majors.

Hanson and Taylor (1971) investigated personality correlates of attrition and persistence of engineering students at the University of Minnesota. At the end of the class of 1967's first year, students were divided into successful withdraw, successful persist, unsuccessful withdraw and unsuccessful persist groups. The "Unsuccessful" designation was for students with a grade point average below 2.00 quality points. The Minnesota Counseling Inventory was the predictor instrument. Students who persisted were found to have little interest in associating with others compared to the withdrawing students who enjoyed group activities. The students who were academically unsuccessful and withdrew indicated greater problems with family relationships and were less willing to conform to social demands. The academically successful students were basically well-adjusted, conforming and non-rebellious. Those who were in poor academic standing when

they withdrew were viewed as impulsive, socially outgoing and with poor family relations. The academically successful student who withdraws resembles the persister except that he is more socially oriented. Hanson and Taylor raise two interesting questions: 1. Does the institution structure programs to select or reward personality characteristics? 2. Does the institution impose on students conditions that perpetuate a stereotype of a given educational major or occupation? Such questions might be raised for any college.

Kovenklioglu and Minck (1973) found differences on several scales of the Minnesota Multiphasic Personality Inventory between "stays" and "drop-out" at Stevens Institute of Technology. The drop-out group had a high point code for scales 8 (Sc) and 9 (Ma). The investigators state that this configural pattern suggests that the drop-outs "tend to be more good tempered, verbal, enthusiastic, frank, fair-minded and courageous. These personality factors would probably be impressive to the S.I.T. admissions officer. On the other hand these drop-outs would be more prone to worry, be self-dissatisfied, and conscientious."

The final study to be mentioned in this section is that of Ayers and Rohr (1972) who used the Sixteen Personality Factor Questionnaire (16PF) to predict the achievement of college sophomores in several college majors, one of which was engineering. Only one scale was found to be a significant

correlate of success for the engineering students, Factor Q_1. The successful engineering student is described as critical, analytical, and experimenting based upon interpretation of the inventory scale.

Persistence Factors-Biographical Data

Hannah (1969) reported on freshmen and sophomore college drop-outs from thirteen small colleges across the country. These students had completed personality inventories and questionnaires as entering freshmen. Those who were not enrolled the following year were mailed an "Attrition Questionnaire." The following spring students were surveyed about their intention to enroll the next fall and whether or not they felt this was certain, uncertain or unlikely to occur. The group indicating that future enrollment was uncertain or unlikely were interviewed and completed an "Interview Checklist."

Twenty per cent reported not expecting to finish their college work even before initial enrollment. For others, the "end-of-semester periods of stress and anxiety about examinations and of hard work completing papers and other course requirements" apparently provoked their thoughts of withdrawing (p. 400). The decision, however, was made when away from campus pressures. Few seemed to consult or involve college personnel in discussion of the final decision and typically were only consulted after the idea had almost fully jelled.

Only about one-third of those leaving college felt happy

about going, relieved or confident about the future. Forty per cent reported feeling strong anxiety. There was little reported anger or disillusionment and, in fact, most (75-85%) found college fairly stimulating or better and valuable in the various aspects of the college. In general, about half found explicit rules and religious services as the least valuable aspects of college.

Astin (1972) found several personal or biographical factors to be related to dropping out. Students who stated plans to marry while in college, who were employed during the school year or expressed concern about financing their college education, and those whose career choice was engineering were students with a higher probability of not persisting. There was a higher likelihood of persistence if college had been suggested by a relative, if the student received major financial support from parents or from personal savings, if the student had won a varsity letter in high school and if he had realistic degree aspirations.

Chaney and Owens (1964) administered a life history questionnaire to Purdue University engineering freshmen. As a result it was found that general engineering interest was negatively related to frequency of dating. Those with a high degree of engineering interest are not people who feel free to express their views to associates, they seldom tell their troubles to others, are uneasy meeting new people but do have a small number of close friends. These individuals tend to seek out positions allowing them to use their own ideas and they prefer activities with minimum interaction with others.

As Marsh (1966) suggests in his review of several studies, drop-outs have been shown to predominantly come from non-professional groups -- typically homes with skilled-labor parents.

Greenfield (1964) also includes a variety of biographical and other data in looking at attrition of engineering freshmen. Seventy-nine per cent of the engineering students studied who transferred within the first two weeks of their first

semester transferred to the College of Letters and Science. More than one quarter of this group of early transfers indicated that they did so because of a change of interest or a desire to study a broader field. At the end of the first semester more than half of the transfers had gone to the College of Letters and Science and almost one third transferred to the College of Agriculture. Of those transferring almost one-half reported a change of interest, one-third a dislike of engineering, almost one-fifth wanted a broader field of study and 12 per cent transferred because of academic difficulties. Students who withdrew during the first semester had the lowest per cent of fathers in clerical, sales and professional occupations whereas those who transferred had the lowest proportion of fathers in skilled, semi-skilled and military service occupations. Having a father in a skilled occupation was most typical of students who were dropped. Interestingly, a little over three-fifths of those who withdrew were the first in their respective families to attend college which was true of only 29 per cent of transfers. Among students leaving engineering less than 5 per cent of transfers and 21 per cent of withdrawing students listed financial difficulties as influential in their decision-making. First semester engineering students estimated spending almost 30 hours per week in study outside of class. The average weekly study time of students who withdrew was less

than one hour per week different. Transfers reported a little more than 27½ hours per week on the average while those who were dropped spent an estimated average of 27 hours in study.

Kulberg and Owens (1960) administered a life history questionnaire and the Strong Vocational Interest Blank to an engineering group. The writers concluded that the engineer has a) a history of painful or unsuccessful personal-social contacts and some adjustment problems; b) a history of superior achievement in and greater enjoyment of science courses; and, c) a history of long-career planning, of liking to work with things and ideas rather than people, and of enjoying creative work and disliking routine.

Persistence Factors - Others

Several other studies should be noted. These studies investigated factors which might more logically be considered personality factors but which are presented separately here to differentiate these motivational factors from the behaviorally descriptive personality factors listed earlier.

Thompson (1966) investigated students in a college of agriculture through administration of a survey form including information on educational expectations, family background, reasons for attending college and post-college plans. A "commitment index" was also obtained indicating how strongly the student felt about his career field of choice. Committed students were compared to uncommitted students. The committed student was found to be more persistent in his interest in his chosen field, fewer of this group changed majors and fewer

of the committed withdrew from college. Committed students had slightly lower (one-tenth to two tenths of a point) grade point averages than those who were uncommitted. Uncommitted students proved to have more superior verbal and mathematical aptitude. Thompson suggests that the "measure of commitment may tend to identify a certain kind of student, and this student follows a certain behavior pattern -- he appears to be a traditionally oriented, dedicated, hard-working task-centered student.

Dickason (1969) reported on a study of awareness of and commitment to engineering and its relationship to academic success. Although Dickason states that past research indicated a negligible relationship between academic success and admissions interview ratings, he hypothesized that a student's relative accuracy of knowledge of what is involved in engineering education and engineering as a career field would be related to academic success. Cornell University engineering freshmen served as subjects. A rating of awareness/commitment was obtained and the interview circumstance of the student (staff, alumnus, no interview or staff and alumnus). The awareness/commitment ratings were assigned by the admissions committee and independent assessment was made by each reader of the admissions folder. Ratings were made on a zero (total lack of awareness and total lack of expressed commitment) to 10 scale (clear evidence of having investigated field, conscious deliberation of differences between engineering and

other math-science curricula, thorough investigation of Cornell curriculum, and work habits adequate for engineering curriculum). Dickason concluded that it would have been better to use awareness and commitment as separate criteria. The awareness/commitment rating did not relate practically to first term grade point averages although the results were statistically significant. One finding, however, was of special note. The prediction of academic success in the engineering curriculum was best when the factors of awareness and commitment were identified by staff, those most knowledgeable about the curriculum being considered by the student and those knowledgeable about the characteristics of people in the field. Dickason proposed that the awareness and commitment factor may be even more useful as a predictor of retention or persistence in an engineering curriculum.

Abel (1966) found that college students having a low certainty of their vocational-academic plans also had a higher attrition rate. Watley (1965a.) also sought engineering students' expression of confidence in completing their educational program. Those with the least confidence did well academically in their first quarter of college work but were more likely to drop out of their programs and had scores on a personality inventory suggesting they were overly sensitive, compulsive and tend to withdraw from social contacts. In another study Watley (1965b) found that the later in their

pre-college period students elected to enter engineering the greater the likelihood these students would obtain poorer first quarter grade point averages, the greater would be the likelihood of withdrawal and to be in scholastic difficulties at the time of withdrawal. The later decision group (high school senior year) also had lower ability test scores and had measured interest less appropriate for engineering.

The Engineering Type

Before leaving this introductory section reference will be made to the general personality description of the engineer/engineering student as it has been presented in the literature. The references presented in this section represent only a sampling of some of the evidence available on personality factors associated with engineering.

Redlo's (1951) Master's thesis presented the assumption that personality patterns can differentiate students choosing certain majors in college. Redlo reviewed findings of earlier studies. The engineer (when compared to a metallurgist) was found to be the one who sees his work as a whole and who takes a more general approach to problems. In another study engineers showed less interest in people than other occupational groups. Rodlo's own study compared college students in various majors on the Minnesota Multiphasic Personality Inventory. The engineering group tended toward lower

scales on the L and F scales than did a number of other groups, lower on the MF scale, and lower on Ma than the social science and arts groups. The engineers were described as less psychopathic and less manic than the combined total group of college students (p. 51). Interestingly also, in every major grouping, except engineering and anthropology, the students who reported they would have selected a different major if given the chance deviated more from their own group than did those reporting they would select the same major.

Danielson (1960) developed a description of the engineer based upon the perceptions of engineers and supervisors of engineers. Danielson concludes that the engineer is anxious to prove himself through his work, is self-confident, individualistic, self directed, competent, expresses skepticism and objectivity, and is insensitive to human relations aspects.

Korn (1962), using personality and interest inventories, compared engineering and physical science students. On the California Psychological Inventory, engineering majors scored higher on the Socialization, Social Presence and Communality scales. High scorers fit the pattern of very deliberate, organized, efficient and conscientious individuals with a practical orientation and a responsible outlook. Further interpretation seems rather conflicting with suggestions of caution and formality in dealing with others contrasted

with adaptability, a relaxed approach. Conflicting interpretive suggestions may be due to the instrument.

Beall & Bordin (1964) found that engineers concentrate upon material products and practical outcomes; prefer the planful, orderly and objective and have a need for "clean cut" certainty; exhibit a strong identification with authority and act in a manner characteristic of the male role. The writers further report that engineers seek travel and adventure and display daring as another way of displaying masculinity. Fathers of engineers typically were seen as powerful masculine figures. Furthermore, parents of engineers typically presented a firm, demanding quality and placed emphasis upon self-reliance and achievement for their sons. Through parental example, then, the engineer apparently learns to react to things with little display of emotion.

A 1966 report by Smith presented a description of the engineer as given by engineers and their supervisors. Engineers are described as individuals who put considerable effort and ability into problems assigned to them; take pride in the work they do and are easily stimulated to work on a problem. They are also described in the article as very work oriented in that they look for work to do when they have free time, often do something extra and even take work to do at home.

Taylor & Roth (1972) reported a study of University of

Minnesota engineering freshmen. As interests in the physical sciences (SVIB, group II) increased, students expressed more problems with social relationship and leadership roles, and also expressed a preference for being seen as responsible and conforming. Several of the technical - skilled occupations of Group IV occupations on the Strong VIB, showed similar patterns. As students expressed more interest in the technical-managerial occupations (military service officers) they also expressed more self-confidence, enjoyment of leadership roles and more positive social relationships.

The Center for Policy Alternatives of MIT recently released a report (1973) in which was included a summary of other writings describing engineers. The M.I.T. report described engineers on the basis of these studies as (a) having a "strong career orientation as well as a basically pragmatic style" (p. 24); (b) "modest in his aspirations, narrowly trained, active rather than contemplative, intolerant of ambiguity and approaching engineering as a job rather than as a calling" (p. 24); (c) valuing "task completion more than task initiation" (p. 24); (d) "noted for authoritatian behavior, that is, a tendency toward ordering others and being the dominant individual in an activity" (p. 24); (e) having "lower than average aesthetic interests" (p. 25); and (f) "less interested in other people than most students" (p. 25).

Purpose of the Study

The various studies reported upon herein reflect that

there are differences between persisting college students and those who leave. Furthermore, it seems clear that prediction is probably improved by considering past performance, ability, interests, personality and biographical factors as well as by paying attention to the degree of vocational maturity and career awareness of the student. The evidence is also suggestive of a particular personality pattern or style which seems more characteristic of engineering students than other college students.

The expense of a college education and operation of a college program, particularly in a technological/scientific institution, attrition of students and declining enrollments, are all factors which would lead to the view that it would be beneficial for engineering colleges as well as the students and their families to reduce the drop-out rate as much as possible.

The present study is an exploratory study designed to look at the attrition problem at one urban engineering college, Stevens Institute of Technology. The study plan is to look at various ability, achievement, personality interest and biographical factors available at a student's entry into the college to determine if any of these factors predict whether or not a student would persist, withdraw or do unacceptable academic work and therefore not be permitted to continue.

CHAPTER II

METHODS

Subjects

The subjects for this study were drawn from the freshmen entering class (Class of 1973) of Stevens Institute of Technology, Hoboken, New Jersey. The group which entered in September 1969 consisted of 381 male students. Of the students who enrolled in 1969, 259 graduated and received their Bachelor of Science degree. The group which persisted to graduation will be called the "Stay" group, or group S, for identification purposes.

Among the student group which entered Stevens Institute in 1969 were 122 students who subsequently dropped out sometime during the four year period. Astin (1972) has suggested that labelling students who leave an institution of higher learning as "drop-outs" is inaccurate in that substantial numbers do not permanently drop-out; rather they transfer elsewhere or perhaps return to schooling at a later date. For the present study, the students who left Stevens were classified as "Fails" (Group F) and "Transfers" (Group T). "Fails" were students who were unable to maintain the required minimum grade point average even if they repeated work. These students left for academic reasons. The "fail"

group consisted of 82 students. Another group of 40 students voluntarily left for non-academic reasons and transferred elsewhere according to records in the Registrar's office.

On several occasions, in the treatment of data, the "Fail" and "Transfer" groups were combined into a total "Leave" group.

Academic Ability Data

All entering freshmen were required to complete the College Entrance Board's Scholastic Aptitude Tests. The data on the SAT Verbal and SAT Mathematics tests were included in the data analysis.

The academic Grade Point Average (GPA) of the students at Stevens Institute was available from the Dean's office records and was included as part of the data analysis. The investigator would have regarded the GPA of students in four years of high school as potentially more meaningful but time and resources did not permit computation of such an average from the high school transcripts of the students contained in their files at Stevens.

Inventory Data

Each entering freshman was required to complete several

instruments of inventory nature during the orientation week. The inventories were administered and scored by staff of the Laboratory of Psychological Studies located on the Stevens Institute campus. The instruments included the Brown-Holtzman Survey of Study Habits and Attitudes (SSHA), the Strong Vocational Interest Blank for Men (SVIB), and the Minnesota Multiphasic Personality Inventory (MMPI).

Biographical Data

In addition to the previously mentioned sources of data, all students also completed a biographical information blank of self-descriptive nature. The blank (Appendix A) was one designed by staff of the Laboratory of Psychological Studies. In some cases, a few students did not complete all the tests, hence the sample size differed (but negligibly) for different tests.

Data Analysis

For each of the three groups of students, means and standard deviations were computed for each subscale of the SVIB, MMPI, SSHA, and also the College Board's SAT tests.

The t-ratio was used to test if there were significant differences in the aforementioned measures for each of the three study groups. Other statistics were employed according to the unique characteristics of the specific measures themselves.

For the MMPI, profiles based upon the mean scores on each of the regular validity and clinical scales were drawn. (Means

and standard deviations were also computed for several of the additional scales.) The frequencies and percentages of the two highest clinical scales (high point code) were computed for each group.

In addition to the individual scales, the SVIB scales were grouped into the eleven main interest clusters usually found on the scored profile. For each student, each cluster was catergorized as "Primary", "Secondary", "Reject" or "Indeterminate" patterns. The first three patterns were determined according to the criteria suggested by Darley & Hagenah (1955). The "Indeterminate" category was used for patterns not fitting the preceding categories. For each of the four patterns for the eleven interest clusters, frequencies and percentages were computed for the student groups under investigation. The Chi-Square test was performed to test the significance of any differences between the three groups in the patterning of the interest scores.

The biographical data were treated by calculating the frequency and percentages of responses of the three groups on each of the data blank items. For those items for which the distribution of percentages were large and seemed likely to provide differences, the Chi-Square Test was performed.

For all data which proved to be significant in differentiating the three study groups, standard regression analysis was attempted for purposes of developing equations which might serve for prediction purposes.

All data analysis was performed on the PDP-10 of the Stevens Institute of Technology Computer Center. Computer time was made possible through the generosity of Stevens Institute.

CHAPTER III

RESULTS

Results of the statistical analyses of the data are presented below in sections for each of the different areas investigated.

Scholastic Aptitude and Performance

As has been stated earlier, it was not possible to develop adequate data on the high school grade point averages of the students although various studies have rather consistently suggested that high school grade point average is a good predictor of college performance.

Analysis was, however, made to determine if the grade point average (GPA) of students who continued at Stevens did or did not differ from that of students who transferred or failed. No attempt was made to weight the data on the basis of length of stay of the college. Some weighting occurs, of course, through the method by which the GPA is computed.

Logically one would anticipate that the "Fail" group would have the lowest grade point average of all the students and this was found. The mean GPA for the "Fail" group was not, however, significantly different (Table 1) from the other two study groups. Further, no statistically significant differences were found between the "Transfer" and the "Stay" group. Combining the "Fail" and "Transfer" groups into a total "Leave" group also did not result in significant differences from the "Stay" sample.

TABLE 1

Mean Grade Point Averages of Three Study Groups

Group	Mean GPA	SD	t
Stay	2.772	0.52	
			.0192
Transfer	2.631	0.50	
			.1450
Fail	1.414	0.62	
			.2469
Stay	2.772		
			.2004
"Leave"	1.816		

Although the high school grade average was not available, there is an association between academic performance and the College Entrance Examination Board's Scholastic Aptitude Test (SAT). When the mean SAT scores of the three study groups and the combined "Leave" group were analyzed, some significant differences were found. (Table 2)

The average SAT scores on the Verbal and Mathematics tests were lowest, as anticipated, for the "fail" group. Scores on the same tests were highest of all groups for the students who left Stevens and presumably transferred elsewhere. If "brightness" from an academic standpoint is in any way measured by the CEEB SAT, then it would appear that the brighter undergraduates who enroll at Stevens are more likely to be numbered among those who leave to continue their education elsewhere. As expected, it is the poorest student who is most likely to be among the group which fails at Stevens Institute and leaves college.

Table 2

Mean Scores, SD's and t-tests for the Scholastic Ability Test

Group	SAT-Verbal	SD	t	SAT-Math	SD	t
Stay	551.10	86.03		656.53	78.91	
			.4148			2.7676**
Fail	548.89	92.17		641.75	78.68	
			4.1891*			3.2398*
Transfer	583.59	66.54		668.59	45.59	
			-4.4165*			1.6394
Stay	551.10			656.53		
			-1.8496			1.3583
Leave	559.77			650.17		

*p= .001 **p=.01

As will be noted by reference to Table 2, the difference between the "Stay" and the "Transfer" group was statistically significant at the .001 level on the SAT-Verbal test. The "Stay", or persisting group, differed significantly from the "Fail" group at the one percent level on the SAT-Mathematics test. The mean score differences between the "Transfer" and "Fail" group were significant at the .001 level for both the Verbal and Mathematics test.

The "Transfer" students differed from both of the other groups in the superiority of their verbal skills. The Transfer Students also had a higher mean Mathematics score but differed statistically at an acceptable level of significance only from the "Fail" group. The failing group was also significantly lower on the Mathematics test than was the group of persisting students. In spite of the statistically significant differences found it should also be noted that in all three study groups, the mean SAT scores were above the national averages of entering college students.

Study Skills and Attitudes

The Brown-Holtzman Survey of Study Habits and Attitudes (SSHA) had also been administered to the subjects as entering freshmen. Four years later when their test scores were analyzed to determine possible differences between the three groups under study, no significant differences were found. The mean scores of the "Stay" group, however, were consistently higher on all four of the survey scales.

Table 3

Mean Scores and t-tests for four major scales of the SSHA

	Delay Avoidance			Work Methods			Teacher Approval			Education Acceptance		
oup	Mean	SD	t	Mean	SD	t	Mean	SD	t	Mean	SD	t
ay	22.59	9.06		25.06	8.69		27.68	9.75		29.39	7.29	
			.9142			.2756			.4029			.7865
il	17.70	8.56		23.59	8.31		25.53	8.45		25.18	7.20	
			.0031			-.0943			-.0608			-.0550
ansfer	17.73	7.81		22.81	7.61		25.03	8.02		24.73	5.68	
			.6601			.3063			.3610			.6329
ay	22.59			25.06			27.68			29.39		
			1.0403			.3664			.4930			.9269
ave	17.71			23.35			25.37			25.04		

Occupational Interests

The pattern of likes and dislikes of the students was evaluated with the use of the Strong Vocational Interest Blank for Men which compared these likes and dislikes to those of men in various professional and business occupations.

The student from the class of 1973 who persisted until graduation differed statistically on twenty-two of the occupational scales from those who went elsewhere. The majority of these

differences (14) were significant beyond the .01 level of confidence. The "Stay" group achieved significantly lower scores, compared to Transfer students, on the Physician, Psychiatrist and Psychologist Scales. A fourth scale within the same biomedical science cluster, that of Biologist, approached but did not achieve significance at the 5% level. The "Stay" students obtained lower mean scores on the Architect, Librarian, Artist, Performing Musician, Music Teacher, and the Author-Journalist scales. Two other scales, while not reaching the 5% level of significance, were in the same direction of lower mean scores for the persisting group -- the Advertising Man and Lawyer Scales. Several of the "Social Service - Welfare" cluster occupations also showed significant differences again in the direction of lower mean scores for the group which graduated. The differences on the Rehabilitation Counselor and Social Worker scales was significant statistically beyond the five percent level. Two others were again in the same direction but did not achieve significance at the .05 level; these were the YMCA Executive and Minister scales.

By contrast, the persisting students obtained higher scores on the Production Manager, Air Force Officer, Carpenter, Policeman, Senior Certified Public Accountant, Accountant, Office Worker, Purchasing Agent, Banker, Pharmacist and Credit Manager scales. All of these scales achieved statistical significance at the .05 or beyond levels. The Business Education Teacher scale mean difference was not significant at the five percent level but was in the same direction as the preceding scales and

the scale itself had similar implications to many of those already mentioned immediately above.

When the "Stay" groups' Strong Vocational Interest Blank scores were compared to those of the students who failed and apparently did not continue their education, eleven significant differences were found while several others approached significance at the 5% level. All of the differences were in the same direction as those found when the Transfer group was analyzed. The persisting group again had the higher scores on the Production Manager and Air Force Officer scales, the Senior Certified Public Accountant, Purchasing Agent, Banker and Pharmacist scales. The graduating Stevens' students had lower mean scores on the Minister, Librarian, Artist, Performing Musician and Music Teacher scales.

Only five scale differences were found between the "Transfer" and "Fail" groups. Transferring students had higher scores on the Psychiatrist, Psychologist, Rehabilitation Counselor and Librarian scales. The Social Worker and Performing Musician scales were in the same direction although not statistically significant. The Office Worker scale was the only instance of the "Fail" group having a significantly higher mean score than the transferring student. The Accountant scale was in the same direction though not significant.

Table 4

Mean SVIB Scale Scores and t-tests for the "Stay" vs "Transfer" "Stay" vs "Fail" and "Transfer" vs "Fail" Groups

Scale	Stay Mean	Stay SD	t	Transfer Mean	Transfer SD
Dentist	35.17	9.85	-.5607	36.19	8.34
Veterinarian	28.91	8.11	1.4984	26.17	8.20
Physician	35.84	10.86	-2.7582**	40.88	11.26
Psychiatrist	26.23	10.43	-4.4721*	34.42	9.99
Psychologist	30.60	9.75	-3.6773*	37.33	11.37
Biologist	35.56	11.19	-1.8494	38.94	12.04
Architect	35.28	10.61	-1.9722+	38.89	13.35
Mathematician	29.57	10.65	-1.0505	31.50	8.95
Chemist	34.15	11.75	-0.6325	35.31	11.28
Physicist	43.17	11.78	0.5044	42.25	11.13
Engineer	39.69	10.36	0.7269	38.36	14.01
Production Manager	34.93	8.21	2.3489+	30.64	11.35
Air Force Officer	39.06	8.53	2.8595**	33.83	8.48
Carpenter	30.98	11.05	2.1469+	27.06	12.48
Forest Service Man	20.98	10.52	1.6617	17.82	10.20
Farmer	37.25	9.43	1.7935	33.97	11.79
Math-Science Teacher	38.56	8.73	0.3659	37.89	11.69
Policeman	20.85	9.24	2.1457+	16.82	9.47
Personnel Director	17.60	11.03	0.0321	17.54	15.25
Public Administrator	25.00	12.04	-0.0933	25.17	13.90
Rehabilitation Counselor	21.62	9.78	-2.7096**	26.36	13.50
YMCA Executive	19.67	10.42	-1.7520	22.83	13.55
Social Worker	18.87	11.28	-3.1863**	24.54	10.84
Social Science Teacher	16.33	9.34	-0.0296	16.38	8.72
School Superintendent	12.03	8.91	-0.4021	12.78	8.39
Minister	12.80	10.41	-1.5920	15.90	10.86
Librarian	25.61	10.63	-4.1959*	32.94	13.24
Artist	33.55	9.93	-3.1321**	39.03	9.23
Musician Performer	37.08	8.92	-3.9885*	44.05	11.70
Music Teacher	19.76	9.05	-3.3086**	25.56	8.81
CPA Owner	25.45	9.05	-0.8716	26.97	9.62
Senior CPA	32.73	9.72	2.2870**	28.69	14.85
Accountant	25.77	10.03	3.3636*	19.74	10.82
Office Worker	26.19	10.00	3.4009*	20.25	10.57
Purchasing Agent	32.42	9.98	4.1008*	25.25	10.17
Banker	23.03	8.21	3.3944*	17.51	9.14
Pharmacist	30.29	7.76	2.4500**	26.36	7.64
Sales Manager	23.01	8.44	0.5787	22.08	9.10
Real Estate Salesman	30.23	7.14	0.9907	28.64	6.96
Life Insurance Salesman	20.88	7.20	-0.6956	22.00	8.23
Advertising Man	26.36	7.08	-1.9235	29.44	7.58
Lawyer	28.83	7.72	-1.6826	31.53	8.66
Author-Journalist	31.14	8.30	-2.5259+	35.19	7.26
President, Manuf. Co.	22.04	8.66	0.1956	21.72	8.74
Credit Manager	24.07	11.07	2.6372**	19.83	10.75
Cham. of Commerce Exec.	26.31	9.21	-0.3414	26.86	8.28
Physical Therapist	33.37	10.83	0.4404	32.67	10.43
Computer Programmer	48.08	9.90	1.1083	46.31	7.12
Business Educ. Teacher	22.45	9.82	1.8873	19.41	9.64
Community Recreat. Admin.	19.78	11.27	-0.2225	20.15	10.00
Specialization Level	40.31	9.70	-0.9471	41.83	9.19
Academic Achievement	47.41	10.75	-1.6461	50.06	9.78

p = .001* p = .01** p = .05+

Table 4

t	Fail Mean	Fail SD	t
-0.3776	35.69	8.95	0.2365
0.6295	28.03	8.04	-0.8829
-1.5348	37.99	10.56	1.3765
-1.6177	28.49	11.80	2.8085**
-1.4034	32.57	11.21	2.2606
-0.0968	35.69	11.57	1.5403
-1.0861	36.80	9.58	0.9917
-1.0913	31.10	12.28	0.1890
-0.1947	34.42	12.60	0.4197
0.3314	42.71	12.15	-0.2181
1.0037	38.29	10.85	0.0338
3.0794**	30.64	9.44	0.0006
2.1851*	36.01	9.14	-1.0341
0.7215	29.97	12.32	-1.3785
0.6640	20.03	11.66	-1.0090
0.5759	36.45	9.33	-1.1744
0.4830	37.88	9.00	0.0023
1.0777	19.32	10.50	-1.1519
0.6242	16.71	10.67	0.3873
1.2433	23.25	10.25	0.9064
-0.3264	22.06	9.53	2.1340*
-0.9669	21.00	11.57	0.8868
-1.3221	20.70	13.06	1.8622
-0.0503	16.40	9.58	-0.0071
-0.5518	12.85	9.92	-0.0336
-2.3599*	16.57	11.92	-0.2953
-2.2174*	28.56	10.49	2.1717*
-2.1292*	36.39	9.40	1.3074
-2.4705*	40.37	8.92	1.8243
-2.2217*	22.75	10.50	1.3878
-0.7721	26.48	8.01	0.2450
2.6470**	29.20	10.39	-0.2541
1.5958	23.64	10.15	-1.8989
1.3842	24.33	10.49	-2.0122*
3.3898+	27.89	9.80	-1.3134
2.9708**	19.39	7.97	-1.0049
2.1567*	27.65	7.51	-0.6977
1.0158	21.77	8.10	0.1703
-0.1444	30.41	7.19	-0.9548
-0.6277	21.65	8.13	0.1880
-0.9035	27.46	8.07	1.0703
-1.2535	30.36	8.73	0.6298
-1.5895	33.08	9.04	1.1388
0.3491	21.61	7.23	0.0613
1.5467	22.16	11.43	-1.2551
0.1138	26.17	9.04	0.3713
1.1926	31.91	9.63	0.4072
0.9328	46.94	10.04	-0.3439
1.1688	21.01	9.45	-0.8634
-0.0876	19.89	11.71	0.1342
0.4452	39.77	9.99	1.1160
-0.1593	47.61	10.96	1.3222

Additional analysis of the data on the Strong Vocational Interest Blank was performed by classifying profiles on the basis of cluster patterns. The method employed was an adaptation of one suggested by Darley & Hageneh(1955). In addition to "primary" (predominantly A and B+ scores), "secondary" (predominantly B+ and B scores) and "reject" patterns (C scores), the classification of "indeterminate" for scores not falling into the above patterns was used: The percentages of students in the study groups falling into each pattern was calculated and compared.

Table 5

Percent of Students Obtaining Various SVIB Cluster Patterns (Stay, Transfer & Fail Groups)

Group	Primary			Secondary			Indeterminate			Reject		
	S	T	F	S	T	F	S	T	F	S	T	F
I	4.4	22.2	7.2	27.7	41.6	36.2	55.0	25.0	44.9	12.0	8.3	11.5
II	24.4	33.3	39.1	24.4	25.0	13.0	38.1	25.0	26.0	12.8	16.6	21.7
III	15.6	16.6	8.6	34.1	16.6	31.8	40.1	27.7	30.4	10.0	38.8	28.9
IV	.8	2.7	1.4	15.6	16.6	28.9	76.7	52.7	53.6	6.8	27.7	15.9
V	.0	.0	1.4	2.8	2.7	2.8	24.0	36.1	26.0	73.0	61.1	69.5
VI	1.6	13.8	10.1	12.0	27.7	26.0	63.4	55.5	55.0	22.8	2.7	8.6
VII	1.6	2.7	.0	5.2	5.5	1.4	25.3	16.6	36.2	67.8	75.0	62.3
III	4.8	2.7	2.8	8.0	2.7	4.3	58.2	36.1	50.7	28.9	58.3	42.0
IX	2.0	2.7	2.8	2.0	5.5	4.3	24.8	22.2	30.4	71.0	69.4	62.3
X	2.8	11.1	7.2	14.0	25.0	24.6	32.9	33.3	26.0	50.2	30.5	42.0
XI	.8	.0	1.4	3.2	5.5	.0	16.4	16.6	8.6	79.5	77.7	89.8

A review of Table 5 indicates that the Transfer group has a greater likelihood of obtaining a "primary" pattern of Group I scales (the biological-medical science cluster). The Group II occupations (the physical science-math cluster) was somewhat more likely to be rejected by the "Fail" group of students. Group III occupations comprise what have been labelled the technical-managerial or technical-supervisory occupations. There was a somewhat greater incidence of the "stay" student to be oriented towards these interests and for "transfer" students to more characteristically reject such occupations. The occupations comprising Group IV are essentially technical - skilled level occupations many of which also include some outdoor interests. Very few of the students who entered Stevens had any significant interests similar to these occupations. Transfer students more clearly rejected this area than did the other two groups. The social service and welfare types of occupations, those involving more direct helping relationships with others, are represented in Group V. The largest percentage of all the students rejected interests represented by the occupations in this group. Group VI consists of occupations classified as the aesthetic - cultural grouping. Very few of the persisting students seem to favor interests represented by this group and more directly reject these occupations. One occupation, the Senior Certified Public Accountant, constitutes Group VI. For all groups there is a greater likelihood that this occupation will be rejected, and especially so by the transfer group. Other business-detail occupations are found in Group VIII and in this cluster the Transfer student

more clearly rejects the types of interests represented whereas almost three times as many of the Stay group show some positive feelings. The business-contact, sales, persuasive occupations are clustered in the Group IX but no clearly defined differences between the student groups shows. Group X is made up of the verbal-linguistic and expressive occupations which perhaps place greatest emphasis upon the written work. Transfer students show more "primary" patterns and the least likelihood of a "reject" pattern. Of all the students, the "stay" group has the greatest probability of rejecting these types of interests. Finally Group XI is again a single occupation reflecting perhaps some entrepreneurial tendencies -- Presidents of Manufacturing Concerns. The most typical response for most students seems to be to reject interests represented by this occupation.

Personality Factors

The Minnesota Multiphasic Personality Inventory results were analyzed in two ways. First, mean scores for all scales were computed and compared for the three different groups of students. (Table 6). Second, the frequency distributions for the three study groups were tabulated for "high point"codes. (Appendix B)

When the scores of students who subsequently graudated were compared to those of students who left and went elsewhere, significant differences were found on the F scale (.05 level) and the MF and SC scales (p=.01). The transferring students obtained higher mean scores on the cited scales.

Comparison of the persisting group and those whose academic performance qualified them for membership in the "Fail" group, generated statistically significant differences on five of the MMPI scales. Specifically, differences were found on the Control (Cn) scale at the five per cent level and the Ma, Pd, Sc and F scales at the one per cent level. In all instances the "Fail" group obtained higher mean scores on the scales noted above.

The only difference between the "Transfer" and "Fail" groups was on the Pd scale with the higher mean score obtained by the failure student.

Analysis of the "high point" code frequencies indicated that the primary factor which describes the "Fail" group is the Pd scale where some three to four times as many of the group had the Pd scale as a "high point" scale. The student who experiences academic failure at Stevens Institute differs from students who graduate in a larger percentage having high point codes on the Sc scale and a difference also in a greater proportion who obtain a "high point" classification on the Ma scale. The three groups do not, however, show large differences on the Ma scale frequencies.

Table 6

Mean Scores per MMPI scales and t-tests for the Stay, Failure and Transfer Groups

MMPI Scale	Stay Mean	Stay SD	t	Transfer Mean	Transfer SD	t	Fail Mean	Fail SD	t-i
L	49.25	7.39	-0.1631	49.65	7.30	0.4047	48.54	6.34	0.3994
F	55.44	8.63	-2.2369**	61.00	7.06	0.3637	60.00	9.37	-2.5747**
K	52.85	8.93	0.9906	50.38	9.13	-0.9094	52.89	8.83	-0.0215
Hs	52.90	10.00	0.1627	52.50	10.47	-0.7303	54.50	7.71	-0.9054
D	57.57	12.29	0.3389	56.73	13.02	-0.7478	58.79	10.53	-0.6852
Hy	55.60	8.96	-0.9041	57.85	11.07	-0.0858	58.08	7.15	-1.4019
Pd	56.05	9.61	-0.8279	58.11	10.96	-2.0805*	63.84	11.49	-4.3916**
MF	59.15	10.34	-2.5869**	65.58	8.57	1.1578	62.39	10.63	-1.8331
Pa	55.91	9.17	-1.1499	58.77	8.75	0.1128	58.46	10.97	-1.4386
Pt	58.54	12.18	-1.0226	61.08	12.28	-0.0138	61.11	11.52	-1.4564
Sc	59.55	12.44	-2.8097**	66.54	12.18	-0.0069	66.56	13.87	-3.9538**
Ma	58.82	11.06	-1.9310	63.62	11.21	-1.2011	66.92	9.69	-4.5745**
Si	53.41	10.43	-0.3002	54.15	10.07	0.5031	52.77	8.68	0.3597
Pr	47.95	9.23	-1.1345	50.77	8.66	0.6017	49.11	9.45	-0.6581
A	50.04	10.48	-1.9187	54.81	10.31	1.0986	51.79	11.09	-0.9872
Cn	57.22	11.85	-1.1971	60.19	8.95	-0.2043	60.75	12.66	-1.9972*
Es	57.95	9.56	1.8043	53.46	8.18	-1.3048	57.05	9.15	0.5074

p = .05* p = .01**
i - Fail vs Stay comparison

Biographical Data

As part of the freshmen orientation testing program for students' entering Stevens Institute in 1969, a locally designed questionnaire was also administered.

a. The first set of comparisons to be reported are between the "Stay" and the "Fail" groups. Three items were different at the ten percent level while eleven others were significantly different at the .025 level or well beyond (4 at .025, 3 at .01, 4 at .005). The results reported below are confined to the eleven most significant factors.

The largest majority of the entrants into the class of 1973 reported coming from intact homes. There was, however, a greater likelihood that students who experience academic failure would come from homes in which the parents were widowed, divorced, separated or both deceased (p=.01). Students who continue until graduation are also differentiated from the failing group by having fathers who were helpful to them in learning the use of tools (p=.025). The "stay" group also reported more frequently having had the father's assistance and involvement in the selection of a job (p=.025). One finding is a bit unusual in that the two groups of students are differentiated on one item in almost two opposite ways. With regard to the number of siblings which the student reports having, the failing student has a much greater likelihood of being an only child or coming from a family of five or more siblings (p=.01). Being an only child may be the most contributory since some differentiation (at the 10% level of significance only) occurred on the item exploring the student's position in his family. The "fail" group had over a 2 to 1 probability of being an only child than did the "stay" group.

Another differentiating item is the one asking about

membership in the high school honor society. Interestingly, the majority of students in all three of the groups under study report not being members of the honor society but the "Fail" group reports the least likelihood of having held such membership (p=.005). Still another very highly significant item differentiating the two groups is their manner of responding to the question of how often they regarded themselves as more consistent and harder workers in their classroom assignments than their peers. On this last item the "stay" group reported such feelings more frequently and more regularly whereas those who failed rarely or ever experienced this feeling (p=.005). The "fail" group also had a greater tendency to let themselves be distracted from school work by other interests (p=.005); almost 1/2 experienced this distraction "sometimes" or with greater frequency. A closely related item which differentiated the groups at the .025 level of significance, was the students' view as to their experiencing a strong desire to excel academically. As expected, it is the student who eventually graduates who has more positive and more frequent feelings about wanting to excel in academic work.

Students had been asked to indicate the frequency with which they had engaged in certain activities before coming to college. Only one activity area showed a difference between groups and this only between the "stays" and "fails." The students who fail have had more experiences before coming to college in which they have been involved with activities producing money either for business (income) or even welfare purposes (p=.01).

Differences were also found in the area of reading habits and more particularly in the kinds of material read. Those who continue on to graduation at Stevens report a much greater probability that, if reading fiction is among the activities of the individual, such fiction will be concentrated in science fiction, mysteries or detective stories, humor and historical fiction ($p=.025$).

Finally, the "stay" group is revealed as different from the "fail" group by failing students having worked in part-time employment more frequently and for more hours than did the persisting group ($p=.005$). It is interesting also to note that more of the "stay" group anticipate having to or wanting to obtain summer employment after the freshmen year of college ($p=.10$). Another stem, also only significant at the ten per cent level, was one indicating that failing students have a higher probability of having selected their occupational goals on the basis of salary, parental pressure or the opportunities in the labor market.

b. The second set of comparisons for the biographical data are the "Stay" versus the "transfer" group. Six of the Chi-Square tests were statistically significant at the .05 level or beyond and one reached only the 10 per cent level of significance. Two of the differences were the same as found when persisting students were compared to those who failed (#21, regarding self as more consistent and harder worker than peers; #22, other interests interfering with school work). The remaining items are discussed below.

Although no socio-economic factors in general were found to differentiate the student groups, the transferring student differed from the "stay" group in the greater proportion of these students whose fathers belong to a professional association (p=.05).

A finding rather consistent with the interest patterns were the reading, television viewing and radio listening habits of the students. Transfer students reported reading a significantly larger number of fiction books (p=.025) and also read more in the area of non-fiction dealing with social corns or problems (p=.05). Whereas the persisting student prefers sports program, the transferring student is decidedly more interested in opera, drama and documentaries (p=.025).

c. The final comparisons are between the academic failure group and the group of students who decided to transfer elsewhere. Only five of the biographical data blank questions produced differences at or beyond the five per cent level. All the differentiating items were already found to differentiate the "stay" group from one or the other of the two remaining groups.

As with the persisting versus transfer comparison, the transfers were again different in the greater proportion whose fathers held membership in some professional association (p=.05). The question on position in the family also showed a significant difference (p=.05) with the failing student being

more frequently an only child or the oldest child in the family.

The item on honor society membership also differentiated the two samples (p=.01) as had the "fail" versus "stay" comparison in the greater proportion of failing students reporting in the negative. Another item with similar findings was the one asking about the desire to excel academically. The "transfer" group more frequently experienced the feeling than did the "fail" group (p=.005).

Perhaps more crucial are several of the other differences found. The student who eventually fails at Stevens Institute reports having engaged in part-time work for more hours during high school than either the "Transfer" or "Stay" groups. (p=.05) Also significant at the five percent level was the greater likelihood that a failing student has selected his career goal on the basis of the pay, parental influence or labor market conditions than does the student who transfers. The latter has the greatest likelihood of all the students of having made the decision on the basis of self-estimated abilities and interests (p=05).

Regression Analysis

The various test and biographical data elements which were found to be statistically significant for differentiating the student groups were subjected to regression analysis in order to establish predictor equations.

a. Stay versus Fail

The initial intercorrelations included were the Scholastic Aptitude Test - Mathematics test, the Minnesota Multiphasic Personality Inventory (F, Pd, Sc, Ma and Cn scales). Step-wise multiple regression analysis was used to construct a prediction equation. The first variable entered was the Ma scale of the MMPI. The resulting multiple correlation coefficient was .318. The second variable was the Pd scale of the MMPI which increased the multiple correlation coefficient to .396. Subsequent variables did not contribute significantly to improving the prediction value of the regression equation.

The resultant prediction equation is:

$$\bar{Y} = -.845 + .02003\ Ma + .02054\ Pd$$

Although it was possible to construct the above equation, its value is markedly limited since so little reliable variance is accounted for (about 16%).

A similar approach was taken with the Strong Vocational Interest Blank scales which had been shown to differentiate the persisting from the failing student. The Production Manager scale was the first variable entered. The multiple correlation coefficient was .206. The second variable entered was the Banker scale which

increased the multiple correlation coefficient to .217. The F value on this scale, however, was not significant thus suggesting that regression analysis be terminated after the first variable. The two variables, if used, accounted for only 4-5% of reliable variance; thus, the development of a regression equation using the interest variables has little practical value.

The biographical data was also treated the same way. The regression analysis of the biographical data proved to be much more profitable. The first variable entered was item #21 dealing with the student's concept of himself as a more consistent and harder worker in the classroom than his classmates. This variable produced a multiple correlation coefficient of .244. The second variable, #22, related to how easily the student permitted other interests to distract them from school work. The multiple correlation coefficient was increased to .299. The third variable was #39, the student's report of number of hours of part-time work while in high school. The last variable which it proved appropriate to enter into the regression analysis was item #9 on which students reported correlation coefficient increased to .354 (accounting for 12% of reliable variance). The following prediction equation results although its practical value is clearly very limited.

$$Y = 2.7915 - .1812\ (\text{Item } 21) - .1508\ (\text{Item } 22) + .1208\ (\text{Item } 39) - .2748\ (\text{Item } \#9).$$

b. Stay versus Transfer

The first set of variables considered were the Scholastic Aptitude Test - Verbal test, and the F, MF and Sc scales of the Minnesota Multiphasic Personality Inventory. Again, based upon size of intercorrelation of the variable, each was entered in order of decreasing size into a step-wise multiple regression calculation. When the SAT-Verbal was entered the resulting multiple correlation was .224 (adjusted for degrees of freedom). The second variable was the Mf scale of the MMPI, thus increasing the multiple correlation to .257. Subsequent variables again did not add significantly to the improvement of the regression equation.

The resultant prediction equation may be written as follows:

$$Y = .4167 + .0077 \text{ SAT-V} + .0049 \text{ Mf}$$

As with the comparison of persisting students with failing students, the Strong Vocational Interest Blank scales were also treated by multiple regression analysis. Twenty-two of the scales with scores which differentiated the two groups of students were treated by intercorrelation of scale scores. The Psychiatrist scale was the first dependent variable entered. The resultant multiple correlation coefficient was .255 and when the second variable, the score on the Air Force Officer scale was added, the correlation increased to .325. Again, subsequent additional variables produced

non-significant F values and further regression analysis was not regarded as useful or productive.

The following prediction equation results:

Y=1.2202 + .0080 (Psychiatrist) - .0081 (Air Force Officer).

Finally, the biographical factors which differentiated the groups were also treated in the same fashion. The first variable was having a father who held membership in professional associations. (Item #11) The multiple correlation coefficient was a meagre .157. Adding a second variable, the student viewing himself as having been a consistent and hard working student in high school (Item #21), increased the correlation to .202 with an F value significant at the .025 level or beyond. From thereon out no significant improvements were made in the multiple correlation by adding more variables.

The resultant equation, then, would read as follows:

Y=1.2680 + .1722 (Item #11) - .0462 (Item #21).

When one looks at the multiple correlations found, the largest accounts for only 10% of the reliable variance. Thus, the calculation of the prediction equation to determine which student will graduate, which will fail or transfer appears to be a useless exercise based upon present data.

No attempt was made to perform a regression analysis of data differentiating the "Fail" from the "Transfer" group.

CHAPTER IV

SUMMARY AND CONCLUSIONS

The present report describes a study of factors associated with attrition at one private institute of technology. The "dropout" problem for colleges has been described as costly to business and industry. The recent decline in college enrollments, and costly investment in laboratory and computer equipment of the technological college probably makes attrition at such colleges even more costly. Thus, it has been proposed, that a reduction of student attrition at engineering-science colleges is both a necessary and important activity from a purely economic viewpoint. It is also important to recognize that college attrition is costly in human welfare. The student who fails in a college effort may generalize and personalize the experience as representing a personal failure. The student who transfers may lose time (as well as money) and may have to accept that he or she made a poor (or incorrect) initial college choice. Although such events can also be positive learning experiences for the individual, they produce negative self-evaluations, anxieties and other non-constructive feelings for some adolescent.

Factors which contribute to college persistence and attrition have been investigated from several viewpoints. One of the earliest approaches was to consider the relationship of ability to staying in or leaving college. The evidence has tended to suggest that academic performance in high school

school and performance on scholastic ability tests are the better predictors of college grades. The mathematics and science achievement tests have tended to be the best predictors of engineering college grades, although not consistently in all cases There also has been a tendency for studies to find "drop-outs" as lower on test scores and high school performance than were persistors. When the noted relationships have been found they have generally accounted for a small percentage of reliable variance and therefore have not offered much promise for prediction purposes.

The limited success of predicting engineering college persistence from ability measures led to looking at other factors. The interests of students presented another focus for study. Most of the studies have shown that students who persist in engineering-science colleges have early developed and defined interests which do not change significantly during their college years whereas drop-outs and transfers show shifts. The persisting student seems to consistently reject social service interests and prefer physical scientific and technical interests as well as often technical supervisory interests.

Another factor investigated has been that of personality traits. The initial thrust of investigation in this area concentrated more upon academic achievement and personality congruences. Generally, lower achieving students have tended to show less favorable personality traits. Non-persisting students have been found to show traits such as impulsivity,

rigidity, a lack of goals and values, rebelliousness and non-conformity. When the non-persisters were separated into sub-groups of successful withdrawals (those who were doing well academically and typically transferred elsewhere) and unsuccessful withdrawals (those who left because of poor academic performance), the transfers were seen as more intellectually oriented, more tolerant of ambiguity, appreciative of freedom of thought, and also more nature and socially oriented. The persisting engineering student, characteristically has been described as dependent upon authority, unable to rebel and unlikely to protest, inflexible, intolerant, immature, conventional, rigid, emotionally suppressed, close-minded, and limited in social interactions.

Biographical factors have been found to be the focus of some investigations. Students who planned to marry before graduation, who were concerned about financing their college education and worked during the school year were found to have a greater probability of not persisting in college. Students with engineering interests have been found to have a history of limited social dating and have not felt free to express their views to associates. Graduate engineering have been reported to have a history of unsuccessful or painful personal contacts, a history of long career-planning and a liking for work with things and ideas.

Additional areas of study have suggested that the student who persists has a greater likelihood of longer interest in his goals, is better informed about educational expectations and the career field and thus is more "committed" to his objectives.

Findings of the Study

The present study found that students who terminated their education at one eastern institute of technolo were less able than their peers who persisted or transferred elsewhere. It proved to be the transfer student who had the highest average ability test scores and achieved grades almost equal to those of the persisters. This finding is similar to other studies in that the more able student is often numbered among those who leave the college of first enrollment. Perhaps, it is also the more able student who has the greatest opportunity for successful transfer. Interestingly, the total group of students had ability test scores above the national average and thus there is a restriction in the range of ability of the students which is probably why attempts to obtain a prediction formula using the ability indicators was not successful.

Examination of the different student groups of the present study did not reveal statistically significant differences in their responses to a study habits inventory although the persisters or "stay" group did show more positive scores on scales indicating good work methods and usage of time,

positive attitudes towards teachers and towards education in general. The investigation of study habits in relationship to persistence in engineering-science colleges apparently hasn't been done previously or a more exhaustive search of the literature may have been required to discover this type of research.

The measured interests of the groups in the present study showed definite differences. The persisting students were found to have interests most like men employed in technical-supervisory occupations, those involved in business record-keeping and men in technical-skilled level occupations. This same group had little resemblance to the interests of men employed in the biological-medical science occupations, the aesthetic-cultural occupations, social service-welfare occupations and the verbal-linguistic occupations. Thus, the persisting student has very practically directed interests emphasizing applied knowledge particularly in business-managerial areas and he does not appear to be very theoretical or scientific in orientation and certainly not creative, expressive or concerned with helping others.

Students who were known to have transferred to other colleges had interests most like men in the biological-medical sciences, and least like those of technical-managerial or technical skilled occupations. Further, the transferring student shows a greater likelihood of verbal expressive

interests and somewhat higher interest in social service activities.

The failing student seemed to be best characterized by non-professional, non-college oriented interests which tended also to be relatively undifferentiated. Most clearly, however, failing students rejected physical science and mathematically related occupations.

Personality variables were also found to differentiate the students who were part of the present investigation. Most notable, perhaps, was the finding that failing students were revealed as prone to hyperactive or impulsive behavior, non-conforming, resistant to authority, and as someone who may feel socially isolated, alienated or misunderstood. Transferring students were suggested as showing a more intellectual orientation, broader interests of more creative and/or fantasy outlet and which could make them feel "different" from their peers at Stevens.

Various biographical factors were among the items investigated. The persisting student was most likely to report the type of relationship with his father in which the father assisted him in the selection of a job. The persisting student considered himself to have been a more consistent and harder worker than their peers in high school. Furthermore, the "stay" student has more frequently had feelings of a desire to excel in academic work. The student who eventually completes his degree at Stevens Institute is not

a very avid reader but when he does read non-technical materials he tends most characteristically to select science fiction detective mysteries, humor or historical fiction. When viewing television or listening to radio, the "stay" student most consistently prefers sports programs.

The same set of questions suggested that the "transfer" student had a greater likelihood of having a father who held membership in some professional association. The implication of this finding is not clear but it may be that these students have parents who are more accepting (possibly even more encouraging) of changes in college. Perhaps, it is more simply a matter of these students having more opportunity to transfer by virtue of family finances or maybe even contacts at other colleges. Such implications must, however, be seen as only speculative at this point. The transferring student also experienced a desire to excel academically while in high school and did not permit other interests to interfere with school work. Two other notable findings were, first, the transferring student's greater reading of fictional books and non-fiction dealing with social concerns or problems, and second, his greater interest in opera, drama and TV documentaries. Finally, it was notable that the "transfer" student was most likely of all the students to have made the decision about eventual career goal on the basis of self-estimated abilities and interests.

On the questionnaire, the students who eventually left

because of inadequate academic performance had the greatest likelihood of being members of families in which parents were divorced, separated, widowed or both parents were deceased. Additionally, these students were typically "only" children or came from large families of five or more siblings. Failing students r rely had regarded themselves as consistent, hard workers in classroom assignments in high school; they also let themselves be more easily distracted from their school work by other interests. The finding that the student who eventually fails had been more frequently involved in money generating activities before college and had worked in part-time employment more frequently and for more hours than other students suggests that these students may have more financial pressures. Such a possibility receives support also from the finding that the"fail" student also reports having selected his initial occupational goal on the basis of salary, labor market opportunities, or parental pressure.

Composite of the Stevens Graduate

The student who entered Stevens Institute of Technology in 1969 and successfully completed his degree program four years later is an able student who obtains scholastic ability test scores above the national average for entering college freshmen. He is also a student who seems to have adequate knowledge of appropriate study methods and tends to apply them with limited procrastination of distractibility.

Additionally, this student reflects rather accepting and positive views with regard to education, its values and practices, and towards teachers and their methods. Since these views are reflections of how the student felt in these areas before beginning college it seems safe to conclude that, as a group, these students have probably had satisfactory high school experiences. One possible implication is that these students are also quite task-oriented when it comes to academic achievement. The measured interests of the graduating student also seem to reflect the same implication. The Stevens graduate, as an entering freshman, has rather pragmatic interests. He is most like men employed in technical-skilled occupations, technical-supervisory and business-detail occupations. Thus, he seems interested in working with numbers, is conscious of and concerned about details; he likes things more than people and theory, and he seeks power by preferance for managing or manipulating others; he also prefers applying his knowledge and skills quite directly to practical problems. The graduating student is one who has had a relationshhp with his own father which may be judged as positive if we can assume this from his father having assisted him in learning the masculine role through learning how to use tools, and having assisted him in the selection of a job. Unfortunately, the data do not permit a clearer definition of the term 'assisted" or how students interpreted the term when responding. If we may extrapolate from other information about engineers and

engineering students, the present data may also be interpreted as reflecting a strong masculine identification, and an authoritarian outlook perhaps growing out of this identification.

The graduating Stevens student entered college with an apparent positive approach to studies and academic work which included a history of regarding himself as a hard working and consistent student in high school. The desire to achieve is apparently also strong, as this student reports having had a desire to excel in his academic work.

The data, then, would tend to suggest that the graduating Stevens student, when he enters college, is a rather narrow-minded individual who sets his eyes on some goal, works hard and consistently to achieve the goal, and in the process has little time for or interest in other things. He wants to involve himself in very practical things which he can manage and direct, including the management and direction of others to achieve the goals. If the evidence from other studies is correct we might anticipate that the student who graduates will still fit the description offered above but the present study only achieved the description of the student as he enters college, and one particular college at that.

Implications-Admission

The fact that failing and transferring students are

individuals who differ in some respects from the student who stays at Stevens to complete his degree suggests that early screening prior to admission could reduce the student attrition. In order to do so, administration of tests and questionnaires would need to occur before the decision to admit is made.

The SAT would undoubtedly be useful for identification of the potential academic failure if the proportion of students who fail were calculated for the various test score points, thus, in effect determining cut-off points for selection purposes.

Another helpful approach would be a careful interview of all applicants by a member of the admissions staff who is thoroughly conversant with the curriculum and the career requirements of engineers, scientists and mathematicians. The purpose of the interview would be to explore the applicant's knowledge in these same areas of information, the length of time he has been interested in engineering or science, and the potential student's commitment to the choice. Although such a procedure would be costly in terms of staff time and would require subjective judgment, the improvement in "hit" rate in selection may be worth the cost and risk. Certainly, an experimental year in which the interviews are conducted and a record of judgments made without effecting the decision on admission might be appropriate. Subsequently, the accuracy

of the predictions could be checked against experience. It would also be possible to obtain the information about applicant awareness and commitment from a carefully worded questionnaire or weighted application blank.

The early identification of the applicants' interest patterns is another useful procedure for identification of students with interests which are not compatible with the curricula offerings at Stevens Institute. The establishment of a third curriculum, the Technology and Society curriculum, plus the enrollment of female students may be complicating factors in such an approach because the implications of the present study are derived from male students exclusively and from a period in which the curriculum was more restricted. The picture of a student's interest can be expanded by some of the biographical questionnaire data which reflect past and present manifestations of interest through reading, hobbies, television viewing habits, school subjects, and related information.

The data on personality characteristics also indicated that there were differences in patterns for the different groups of students. In spite of this finding, the primary value of personality evaluation is still seen as being the collection of information which is useful in counseling students. Additionally, of course, the data are useful in obtaining a composite description of a group of people who

represent an occupational or academic major category and thus permits comparison to comparable data from other sources.

Implications - Research

The implications of the present study are limited to one particular group at one college. Replication of the study would provide a clearer picture of the most important factors in differentiation of students who eventually graduate, transfer or leave due to academic failure. Furthermore, it would be important to differentiate the engineering from the science students.

Since the implications about and also the description of the graduating student is based upon information collected at the start of the college period, and since some changes might occur in the four years of schooling, there is potential value in re-evaluation of such factors as interests, personality and study habits of seniors with comparison to the entrant data.

The review of research at other engineering colleges over a period of years shows some consistency in the implications but also some inconsistencies. Thus, the present investigator views as of much potential value a longitudinal study of engineering college entrants to a point at least five to six years beyond graduation. Furthermore, such a longitudinal study would be even broader in t he implications of its

findings if a number of engineering schools were involved as the source of the students. Dependent upon funding, such a study could be geographically limited or at best be a cross-section of engineering schools of different size, geographical location and type of school (private vs public specialized college vs engineering school in a university).

On a markedly less grandiose scale would be the development of a weighted application blank for use in the screening of applicants to Stevens Institute of Technology.

One last point with reference to future research. In the planning for the present study, various methods of approaching the configural analysis of the Minnesota Multiphasic Personality Inventory and Strong Vocational Interest Blank were investigated. (In personal correspondence with David Campbell there was indication of someone else having used a satisfactory configural approach but this study could not be obtained).

APPENDIX A

STUDENT PERSONAL DATA RECORD

The purpose of this record is to aid us in helping you during your years at Stevens. Please be frank. Answer every question to the best of your ability in order that we may help you to get the most out of college life.

Name _____ _____ _____ Date _____
(last) (first) (middle)

Date of birth _____ Height _____ Weight _____

Single _____ Married _____ Number of children _____

Home town and state _____

Description of home town (check one)

_____ A village or farm

_____ An independent town of less than 2,000 population

_____ An independent town of 2,000 to 5,000 population

_____ A city of 25,000 to 250,000 population

_____ A city larger than 250,000 population

_____ A suburban community near a city larger than 250,000 population

_____ Other; specify _____

Town and state in which you have spent most of your life _____

_____

Description of this town (check one)

_____ A village or farm

_____ An independent town of less than 2,000 population

_____ An independent town of 2,000 to 5,000 population

_____ A city of 25,000 to 250,000 population

_____ A suburban city larger than 250,000 population

_____ A suburban community near a city larger than 250,000 population

_____ Other; specify_____

Veteran: Yes_____ No_____ Branch of service_____

Dates of military service_____

Type of discharge_____ Rank at discharge_____

Physical Condition: Poor_____ Average_____ Good_____

Excellent_____

Physical Disabilities_____

Serious illnesses and operations and age of occurrence_____

_____

Family Data

Father's age_____ If deceased, indicate year of death_____

Father's education_____

Father's occupation (engineer, lawyer, plumber, etc.)

_____

Description of father's job (chief engineer in a manufacturing plant; partner in a law firm; self employed plumbing contractor,etc.)

_____

_____

Mother's age_____ If deceased, indicate year of death_____

Mother's education_____

Mother's occupation_____

Description of mother's job_____

_____

Parents: married_____ separated_____ divorced_____

widowed_____ remarried_____ other(specify)_____

Activities in which mother and/or father have helped you in (check all that apply)

	mother	father
a. learning to use tools		
b. learning domestic skills		
c. learning sports		
d. school work		
e. selecting school subjects		
f. selecting college		
g. selecting a job		
h. selecting a vocation		
i. learning to drive		
j. developing cultural interests		
k. other; specify and check		

The organizations to which my mother and/or father have belonged to are (check all that apply)

	mother	father
a. church group		
b. athletic club		
c. cultural society		
d. political club		
e. parent-teacher's association		
f. card club		
g. college alumni club		
h. veterans' organization		
i. service club		
j. country club		
k. labor union		
l. hunting or fishing club		
m. professional association		
n. chamber of commerce		
o. Junior League		
p. farmer's association or grange		
q. Other; specify and check		

Number of: Brothers_____ Sisters_____

Your position in family: Youngest____ Oldest ____ Middle ____

only child_____

Brother	Sister	Age	Educational Level	Occupation

Education

Name and address of high school _____

_____

Co-educational: Yes _____ No _____

Description of school

_____ Public
_____ Parochial
_____ Private non-Parochial
_____ Parochial Boarding school
_____ Private (non-Parochial) Boarding school
_____ Other: specify _____

Number of Students in graduating class _____ Class rank _____

Year graduated _____ Age at graduation _____

Honors, prizes, distinctions _____

_____

_____

Organizations and activities in high school

Name	Offices held	Length of time
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

How many hours per week did you devote to extracurricular activities _____

What organization or activities do you plan to take part in while in college: _____

_____

Indicate the number of times you changed schools (other than by graduation): _____

Reason(s) for having changed schools _____

_____

Three most liked subjects in high school (in order of preference)

1. _____ 2. _____ 3. _____

Three least liked subjects in high school (in order of least preferred)

1. _____ 2. _____ 3. _____

Three most difficult subjects in high school (in order of difficulty)

1. _____ 2. _____ 3. _____

Three easiest subjects in high school (in order of ease)

1. _____ 2. _____ 3. _____

How many hours per week did you study during high school

_____

Which subject(s) do you think will offer the most difficulty in your freshman year _____

Do you think you might go on to graduate professional school?
Yes _____ No _____

Check the one answer in each question which most applies to yourself while in high school:

When you knew there were going to be one or two questions on an exam from outside reading assignments, did you always read all the material?

Never____ Rarely____ Sometimes____ Often____ Always_____

Did you regard yourself as a more consistent and harder worker in your classroom assignments than the typical high school student in your class?

Never____ Rarely____ Sometimes____ Often____ Always_____

Had others (not your good friends) thought of you as one who "missed some of the fun" because you were so serious?

Never _____ Rarely_____ Sometimes_____ Often_____ Always_____

Do you think your fellow students in high school thought of you as a hard worker?

Never _____ Rarely_____ Sometimes_____ Often_____ Always_____

Did most of your teachers probably think of you as one of their hardest workers even though not necessarily one of the brightest?

Never _____ Rarely_____ Sometimes _____ Often_____ Always_____

Did other interests (sports, extracurricular activities, or hobbies) prevent you from obtaining an excellent rating or mark for effort in school?

Never_____ Rarely_____Sometimes_____Often_____ Always_____

Did you have a very strong desire to excel academically?

Never_____ Rarely_____Sometimes_____Often_____ Always_____

Did you try harder than the average student in your class to get on the school honor roll or merit list?

Never_____ Rarely_____Sometimes_____Often _____ Always_____

Did you try to do most assignments at least a little better than what you thought was expected?

Never_____ Rarely_____Sometimes_____Often _____ Always_____

Did you tend to give up or delay on uninteresting assignments?

Never_____Rarely_____Sometimes_____Often_____Always_____

Social and Recreational Activities

Outside organizations and activities (Boy Scouts, YMCA, Church groups, etc.)

Organization	Office held	Length of time

Check all activities in which you have participated, and double check all those which you have enjoyed the most:

Sports

_____ baseball
_____ basketball
_____ bowling
_____ golf
_____ handball
_____ softball
_____ tennis
_____ volley ball
_____ boating
_____ camping
_____ fishing
_____ hiking
_____ hunting
_____ skating
_____ skiing
_____ sledding
_____ swimming
_____ other: specify

_____
_____

Mechanical

_____ home repairs
_____ auto repair
_____ science project
_____ electrical repair
_____ assembled electronics equipment
_____ built a tree house
_____ built models
_____ built furniture
_____ invented a machine or gadget
_____ built a boat or raft
_____ other; specify

_____

Artistic

_____ played a musical instrument
_____ magazine or newspaper reporter
_____ written a short story
_____ worked in sculpture or ceramics
_____ painted a picture
_____ sang in a choral group
_____ written or arranged music
_____ written a funny skit
_____ acted in a play
_____ visiting museums
_____ attending concerts
_____ attending the theatre
_____ managed a show or play
_____ other; specify

_____

Commercial

_____ earning money in part time job
_____ sold or promoted something
_____ started a new business
_____ sold house to house
_____ ran a contest or raffle
_____ purchased stocks
_____ raised money for a charity
_____ Junior Achievement
_____ other; specify

_____
_____

What hobbies do you now have or have had? _____

_____

_____

What magazines do you read regularly? _____

_____

The number of books (other than textbooks) I have read during the past year: fiction _____ nonfiction: _____

The kind of fiction book I most enjoy reading is (check one only)

_____romances
_____science fiction
_____historical
_____mysteries or detective stories
_____westerns
_____humor
_____other; specify_____

The kind of non-fiction book I most enjoy reading is (check one only)

_____biographies
_____historical
_____scientific and technical
_____political and current events
_____social and psychological
_____religious
_____philosophy
_____other; specify_____

The type of radio and television program that I like best is:

_____sports events
_____operas, symphonies or concerts
_____comedy or variety
_____westerns
_____mysteries
_____documentaries
_____dramas
_____other; specify_____

During high school, how many hours per week did you devote
radio listening_____ television_____ sports_____ hobbies____
reading for enjoyment_____ social life_____ part-time work_____

Frequency of dating during senior year in high school:

_____never
_____less than once a month
_____about once a month
_____twice a month
_____once a week
_____more than once a week

The activities in which I had been away from home and on my own were:

_____military service
_____summer camp
_____youth hostels
_____overnight camping and hiking
_____cross country tours
_____overseas travel
_____skiing trips
_____working in a resort or summer camp
_____out of town youth conferences
_____religious retreats
_____other specify_____

Vocational Objectives

Indicate your present vocational goal _____

Indicate the (5) most important factors you considered in making your vocational choice (in order of importance):

1. _____
2. _____
3. _____
4. _____
5. _____

If you had complete freedom of choice, would you still choose your present vocational goal? Yes _____ No _____

If no, what would be your vocational goal? _____
And what prevents you from pursuing it? _____

Financial Support

Source of financial support (State % of the total support each source contributes.)

Tuition		Expenses	
self	_____ %	self	_____ %
scholarships	_____ %	scholarships	_____ %
parents	_____ %	parents	_____ %
other; specify	_____ %	other; specify	_____ %
_____		_____	

Employment History

List employment experience during high school including part-time and summer jobs

From	To	Hrs./ Wk.	Nature of Employment	How obtained (Check one) Family	On my Own	Other; Specify

What kind of work do you expect to do next summer? _____

Appendix B

High Point Code Frequencies on MMPI Scales for Stay, Fail and Transfer Groups

Code		Stay		Transfer		Fail	
			%		%		%
02		2	(1.2)	1	(3.8)		
07		1	(.6)	–			
	Total 0	3	(1.8)	1	(3.8)		
12		1	(.6)				
13		1	(.6)			1	(1.6)
14							
15		1	(.6)				
16		1	(.6)				
17							
18						1	(1.6)
19		–		1	(3.8)	–	
	Total 1	4	(2.4)	1	(3.8)	2	(3.2)
20		2	(1.2)				
21							
23		2	(1.2)				
24		1	(.6)				
25							
26							
27		6	(3.8)	1	(3.8)		
28		7	(4.4)				
29		3	(1.9)	–		–	
	Total 2	21	(13.1)	1	(3.8)	0	(0)
31		1	(.6)		(3.8)		
32		2	(1.2)				
34		3	(1.9)				
35		4	(2.5)	1	(3.8)	1	(1.6)
36		1	(.6)				
37							
38		1	(.6)				
39		2	(1.2)	1	(3.8)	–	
	Total 3	14	(8.6)	3	(11.4)	1	(1.6)

Appendix B (cont'd)

41		1	(.6)				
42		1	(.6)			2	(3.2)
43		1	(.6)	1	(3.8)	1	(1.6)
45		1	(.6)	1	(3.8)	1	(1.6)
46						1	(1.6)
47							
48		1	(.6)			4	(6.5)
49		4	(2.5)	-	-	3	(4.9)
	Total 4	9	(5.5)	2	(7.6)	12	(19.4)
50		4	(2.4)				
51							
52		2	(1.2)	1	(3.8)		
53		5	(3.1)	1	(3.8)		
54		3	(1.9)			1	(1.6)
56		3	(1.9)			1	(1.6)
57				1	(3.8)		
58		2	(1.2)	2	(7.6)	3	(4.9)
59		7	(4.4)	-	-	1	(1.6)
	Total 5	26		5	(19.0)	6	(9.7)
60				1	(3.8)		
61							
62							
63		1	(.6)			1	(1.6)
64		2	(1.2)				
65						1	(1.6)
67		1	(.6)				
68		1	(.6)				
69		-	-	-	-	1	(1.6)
	Total 6	5	(3.0)	1	(3.8)	3	(4.8)
70		1	(.6)				
71		1	(.6)				
72		3	(1.9)				
73						1	(1.6)
74						1	(1.6)
75		2	(1.2)			1	(1.6)
76							
78		4	(2.5)			2	(3.2)
79		1	(.6)	-	-	-	-
	Total 7	12	(7.4)	0	(0)	5	(8.0)

Appendix B (cont'd)

80	1	(.6)				
81	1	(.6)				
82	3	(1.9)	1	(3.8)		
83						
84	1	(.6)			3	(4.9)
85	1	(.6)		(3.8)	2	(3.2)
86	2	(1.2)			1	(1.6)
87	4	(2.5)	2	(7.6)	5	(8.1)
89	4	(2.5)	1	(3.8)	3	(4.9)
Total 8	17	(10.5)	5	(19.0)	14	(22.7)
90					1	(1.6)
91	1	(.6)	1	(3.8)	1	(1.6)
92	3	(1.9)			3	(4.9)
93	3	(1.9)			1	(1.6)
94	7	(4.4)			2	(3.2)
95	11	(7.0)	2	(7.6)	4	(6.5)
96	5	(3.1)	1	(3.8)		
97	2	(1.2)			1	(1.6)
98	7	(4.4)	3	(11.5)	5	(8.1)
Total 9	39	(24.5)	7	(26.7)	18	(29.1)

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