

INTELLECTUAL AND NONINTELLECTUAL PREDICTORS
OF PERFORMANCE IN MEDICAL SCHOOL

A Thesis

Presented to

The Faculty of the Department of Psychology

The University of Houston

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

Dwayne C. Piercy

January 1967

391676

ACKNOWLEDGMENTS

The writer is indebted to numerous persons who contributed in diverse ways to the completion of this thesis. He wishes to express his sincere gratitude to Drs. James L. McCary, Shalom Vineberg and Genevieve Arnold who, as committee members, provided both constructive criticism and food for thought. Special appreciation is given to Dr. Lawrence McGaughran for his patience, suggestions and guidance as committee chairman.

The writer is grateful for many of the early ideas behind this study, and for aid in its implementation, to Dr. Harold Goolishian.

The time and counsel of Dr. John Overall of the University of Texas Medical Branch, Research Computation Center, is especially appreciated. Sincere thanks are given to him and to his staff for their assistance in the statistical treatment of the data.

Special appreciation is expressed to Betty M. Compton for her cooperation and assistance in the collection of the data.

Dwayne C. Piercy

January 1967

INTELLECTUAL AND NONINTELLECTUAL PREDICTORS
OF PERFORMANCE IN MEDICAL SCHOOL

An Abstract of a Thesis

Presented to

The Faculty of the Department of Psychology

The University of Houston

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

Dwayne C. Piercy

January 1967

ABSTRACT

It was the purpose of this study to investigate the assumption that personality descriptions as measured by an objective personality test, the California Psychological Inventory (CPI), would be efficacious in predicting performance in medical school when differential criteria, such as performance during the academic and clinical years of medical school, and scores obtained on a relatively objective achievement test, as exemplified by the National Board examinations in medicine, were used. In addition, a comparison was made between the predictive powers of this nonintellectual test and a more traditional measure of intellectual ability, the Medical College Admissions Tests (MCAT).

The subjects for this study were those individuals enrolled in the medical school at the University of Texas Medical Branch in Galveston in the academic years 1958-59 and 1959-60. The total number of students thus enrolled was 196. Of this number, 162 completed their medical training, and constituted the final sample.

With multiple correlation techniques, it was possible to develop five multiple regression equations predictive of performance in medical school. It was also concluded that the best single predictor of grade-point average in the first two, or academic, years in medical school was the Science Achievement section of the MCAT. Only one factor, the

Well-being scale of the CPI, was found predictive of performance during the clinical years. The MCAT was also found to be a fairly effective predictor of performance on the National Board examinations, while the CPI was less successful in this respect.

It was possible to use the results of the present study to picture the ideal medical student as a person with scientific knowledge and skill who is confident of his own abilities, but who is properly submissive to authority, while giving the impression of being an enterprising, hard worker.

TABLE OF CONTENTS

CHAPTER	PAGE
I	THE PROBLEM 1 Criticisms of Traditional Methods of Selecting Medical Students 3 Research with Selection Techniques 6 Statement of the Hypotheses. 8
II	REVIEW OF THE LITERATURE 12 Intellectual Predictors. 12 Nonintellectual Predictors 30 Research with Projective Tests. 30 Research with Structured Tests. 34 Research with Personality Types 42 Points of Interest in the Literature 47
III	METHODS AND PROCEDURES 49 Predictors 49 Criteria 50 Subjects 52
IV	RESULTS. 53
V	DISCUSSION 67 Conclusions. 73 Goals for Future Research. 74
VI	SUMMARY. 77

LIST OF TABLES

TABLE	PAGE
I. CORRELATIONS BETWEEN MCAT SUBTEST SCORES AND NATIONAL BOARD PART I AND PART II AVERAGES FOR 1956 SENIOR MEDICAL STUDENTS.	25
II. MEANS AND STANDARD DEVIATIONS OF PREDICTOR AND CRITERION VARIABLES	54
III. INTERCORRELATION MATRIX OF PREDICTOR AND PERFORMANCE VARIABLES FOR ALL UTMB MEDICAL STUDENTS ENTERING IN 1958-59 AND 1959-60 (PEARSON'S r)	58
IV. SUMMARY OF SIGNIFICANT CORRELATIONS FOR BOTH PREDICTOR AND PERFORMANCE VARIABLES FOR ALL UTMB MEDICAL STUDENTS ENTERING IN 1958-59 AND 1959-60 (PEARSON'S r)	59

CHAPTER I

THE PROBLEM

One of the most difficult, and at the same time, one of the most essential problems in the general field of education today is the proper selection of students for higher education. It is certainly of the greatest possible interest to institutions of higher learning and to potential students since a mistake in selection can mean a tremendous loss in terms of finances and time invested by both parties.

This problem is probably more acute in the field of medical education than any other area of higher learning. Not only is the number of openings in medical schools very small, but it is a well-known fact that almost every area in the country has a continuous, largely unmet demand for more physicians of every type. The current increase in population, which shows no sign of abatement, presages an ever-increasing shortage of trained medical personnel.

In contrast, at least under present traditions and policies, there seems to be little likelihood for any marked increase in the number of enrolled students, or in the number of new medical schools. For example, the Study of Applicants (to medical schools) for the academic year 1964-65 (Johnson, 1965) lists a total of 88 medical schools in the United States. There is only one new medical school scheduled to open in 1966-67, and only four others tentatively expected to open in 1967-68.

It is not even remotely possible for such a small increase in medical facilities to provide the number of medical practitioners necessary for a country with a population that at the present time exceeds 190 million.

Until more medical schools can be made available, it is essential that admission procedures be made as accurately predictive as possible. Buehler and Trainer (1962) estimate a total cost of approximately \$12,000 to the school, should the student drop out before completion of his training. (This cost would be for the entire four-year period, since it would not be possible to fill the vacancy left by the departing student.) The monetary expense to the student would probably be comparable, depending upon how long he pursued the study of medicine. The student's loss of time--time which could have been dedicated to some more successful pursuit--is, perhaps, an even more important consideration.

The problem is obvious. There is a need for the best possible selection of medical students. This goal includes the necessity for evolving methods for identifying both those candidates who may be expected to fail and those who may be expected to withdraw for reasons other than failure. In addition, it is a matter of great concern that selection procedures not reject potential students who could succeed if admitted, but who might not be accepted under current criteria.

Criticisms of Traditional Methods
of Selecting Medical Students

Efforts to accomplish these goals have been in existence for many years. Ingersoll and Graves (1965) cite 1925 as the year of the first published attempt to predict completion of medical school. At this time, Bott (1925) examined the efficacy of college grades in making such a prognostication. Since that time, many other predictive criteria have been employed, and such criteria have taken many forms. However, as Gough and Hall (1964) have pointed out, efforts to forecast the performance of applicants to medical school have long relied on three types of evidence: measures of intellectual aptitude, usually by means of the Medical College Admissions Test (MCAT); pre-medical grades, especially in science; and various types of interview ratings.

Traditionally, these have been the three sources of information most often used in assessing the medical school applicant, with each factor being given a different weighting, according to the biases of the members of different selection committees. Indeed, such methods seem to have worked fairly well for a long period of time. More recently, however, the medical schools have come under more and more pressure to improve their selection processes, largely because of the demands noted above.

Criticism of the validity of the traditional selection

methods has become more widespread. Many have challenged the MCAT as an as-yet-unproven test (e.g., Gough, Hall & Harris, 1963; Gough & Hall, 1964; Wantman, 1953; Wesman, 1959). Some have denied this contention (Sanazaro & Hutchins, 1963); others have defended the MCAT on the grounds that what it should measure has not been adequately defined (Ebel, 1965), and still others seem resigned to its shortcomings (Dubois, 1965). However, several recent studies (e.g., Gough & Hall, 1964; Hoffman, Wing & Lief, 1963) have suggested that, at the very least, the predictive value of the MCAT declines as completion of training approaches.

Similarly, while some researchers have found that the interview rating of the applicant is of somewhat more value in the clinical years than the MCAT (e.g., Hoffman, Wing & Lief, 1963), it, too, has had its share of criticism and opprobrium. In fact, Gough and Hall (1964) have concluded from a review of the literature that the use of the MCAT and the admissions interview combined would produce a mean correlation of no higher than .20 with such criteria as over-all grades and evaluations by the faculty.

Finally, fault has also been found with pre-medical scholastic achievement as a predictor of medical school performance. Sanazaro and Hutchins (1963), among others, have noted the great variation among different undergraduate schools in their grading systems. (Also, see Funkenstein, 1957, Hill & Heck, 1960).

They also have pointed out the failure of many selection committees to take such differences into account. Funkenstein (1966a), among others, has pointed out that some undergraduate schools have many different levels at which a course may be taught. In addition, it has been found that students may take many courses in an area in which they are weak. Many admission committees, however, may note only that this student had a great deal of work in this area, and conclude that he therefore must be very good in it.

The sometimes contradictory evidence gained from these traditional forms of evaluation is well illustrated by the work of Buehler and Trainer (1962). They found that strict application of all of the usual predictive criteria would eliminate all but five students in a sample of 120 students, most of whom had successfully completed medical school.

Such discouraging findings have led many to conclude that perhaps, after all, there is more to selecting a satisfactory medical student than mere assessment of his intellectual ability. Disenchanted with purely intellectual measures and subjective interview ratings, many investigators have begun to advocate more complete consideration of the individual's personality characteristics (Kole & Matarazzo, 1965). The question really being asked by them is: Assuming that we can accurately (or at least fairly accurately) assess an individual's intellectual ability for medical school, why do students still fail?

The answer, according to many (e.g., Funkenstein, 1957, 1962; Gough, Harris & Hall, 1963), lies in better understanding of the personality of the potential medical student. Lief, Young, Spruiell, Lancaster and Lief (1960) have gone so far as to say that

. . . medical students rarely flunk out of medical school because of intellectual deficits. Almost always it is on the basis of psychological and emotional problems which affect their thought processes, their organization of their work, and the learning process itself (Lief, Young, Spruiell, Lancaster & Lief, 1960, p. 704).

A similar conclusion has been drawn by Schwartzman, Hunter and Prince (1961). These authors compared 45 students who had been referred for counseling because of academic difficulties, with a random sample of 34 control subjects, who had not received psychiatric treatment, nor failed courses during their premedical or medical school careers. These subjects were compared on the basis of their academic rank at the end of their freshman year in medical school, and of scores obtained on the MCAT and the Wechsler-Bellevue Adult Intelligence Scale. The results of this study indicated that both groups of subjects, while statistically significantly different in academic rank, were essentially almost identical on the measures of aptitude and intelligence. The discrepancy in academic attainment, then, seemed to be due to nonintellectual factors.

Research with Selection Techniques

Thus, the problem is formulated: How are these nonintel-

lectual factors to be taken into account in the selection of medical students? The solution to the problem is less clear. Early efforts centered around examining the usefulness of projective tests, such as the Rorschach, in assessing personality characteristics (e.g., Harrower-Erickson, 1944; Waggoner & Ziegler, 1946; Brosin, 1948; Eron, 1954). Discouraging results led then to an interest in so-called "objective" (structured) tests of personality (this distinction is explained by Schofield, 1957). Those objective tests used have included the Minnesota Multiphasic Personality Inventory (Glaser, 1951; Goldstein & Salzman, 1962; Knehr & Kohl, 1959), the Strong Vocational Interest Blank (Stuit, 1941) and many others. Concomitant with this tactic has been the employment of batteries of such tests (e.g., Kole & Matarazzo, 1965), and of various intermixtures of test results and demographic variables (e.g., Johnson, 1962).

Another current line of investigation involves an attempt to develop some type of global, composite description of the different types of medical students. Several different descriptions are now in the literature (e.g., Frankel & Motto, 1963; Funkenstein, 1962; Coker, Greenberg & Kosa, 1965; Schlageter & Rosenthal, 1962; Buehler & Trainer, 1962), and may eventually be useful in selection procedures.

It has more recently become apparent that all of the difficulty in the selection of medical students does not lie in the predictive instrument used. Much of the problem apparently

is at least partially a function of the particular criterion or criteria selected to represent desired performance in medical school. Many early studies, and even some recent ones, have relied on the first year grade-point average as the criterion of successful medical school performance (e.g., Gottheil & Michael, 1957). This practice has recently been thoroughly criticized (Gough, Hall & Harris, 1963), and more than one study has shown performance in later years in medical school to be less well correlated with, for example, the MCAT, than achievement in the earlier years (e.g., Hoffman, Wing & Lief, 1963). As Kole and Matarazzo (1965) have noted, there has also long been too much reliance upon descriptions of medical students based only upon their grades. This has been despite the fact that more representative and perhaps more objective criteria are available. One example is the National Board examinations in medicine, a fact suggested by Sanazaro and Hutchins (1963), who have reported one of the few studies utilizing this criterion.

Statement of the Hypotheses

It would seem that one should make more use of such relatively more objective criteria, as well as criteria which take into account the changes in the medical school program that occur when the student begins to shift his study interests from the academic to the clinical, or practical, side of his training. Some efforts have been made in this direction.

There is a need for more. Undoubtedly, new research will establish even more firmly the importance of nonintellectual factors in medical school performance. However, there will be many problems.

For instance, Hoffman, Wing and Lief (1963) have pointed out that, since work in the basic science areas can be assessed more reliably and objectively than work in the clinical areas, statistically significant correlations with pre-admission data are more likely in the first and second (or basic science) years than in the clinical years. Yet, who could argue that the work in these latter years is less important for later professional success and competence?

Since grading in these years is often quite subjective, it seems only logical that personality characteristics of the medical student may well be considered as important in any consideration of his success in these years as his intellectual characteristics, and hence equally worthy of consideration in assessing the applicant. Viewed in this light, better delineation of the applicant's potentially important personality characteristics is highly desirable at the time of his application for acceptance. (Hoffman, et al., have developed a similar line of reasoning.)

It is the purpose of the present study to attempt an examination of some of the implications inherent in the argument that nonintellectual factors may be at least as useful as

intellectual ones in differential prediction of achievement during medical school. More explicitly, it is the purpose of this study to investigate the assumption that personality descriptions as measured by an objective personality test, the California Psychological Inventory (CPI), are efficacious in predicting performance in medical school when differential criteria, such as performance during the academic and clinical years of medical school, and scores obtained on a relatively objective achievement test, as exemplified by the National Board examinations in medicine, are used. In addition, a comparison will be made between the predictive powers of this nonintellectual test and a more traditional measure of intellectual ability, the Medical College Admissions Tests (MCAT).

Specific hypotheses include the following:

1. Results of the MCAT are more closely related to the grade-point average (GPA) obtained in the first two (or academic) years of medical training than to the second two (or clinical) years.
2. A lesser relationship exists between the results of the MCAT and the National Board examinations, and this relationship is attenuated in Part II of the examinations.
3. A close relationship exists between the results of the National Board examinations and GPA at both stages, but especially between academic years and Part I. (Part II and the clinical years relate to more clinical material, and the grading,

therefore, is more subjective, while both grading and assessment in the academic years are probably more uniform, because of the formal nature of the material covered in these years).

4. The CPI is more useful as a predictor of grades in the clinical years, because personality (nonintellectual) characteristics become more important as the grading becomes less objective.

CHAPTER II

REVIEW OF THE LITERATURE

Some idea of the interest in predicting medical student success is gained from the fact that Gottheil and Michael (1957), in a summary of such research to that time, listed some 95 references. Many more studies have appeared since. As has been noted in the preceding chapter, traditional methods of investigation have involved assessment of intellectual factors believed to be related to such performance. Only more recently has attention been paid to nonintellectual factors. While many recent studies have involved both kinds of assessment, it is possible to divide most of the literature roughly into these two categories.

Intellectual Predictors

The most usual evaluation of the intellectual ability of applicants to medical school has been with the MCAT. As has been noted by Gough, Hall and Harris (1963), studies of its predictive validity have been surprisingly few. In an early summary of such studies, Gottheil and Michael (1957) concluded that the MCAT was a fairly good predictor of first year medical school grades. However, they, and most of the experimenters whose studies they reported, failed to consider later medical school performance.

Watson (1955), finding the results of such measures as

Thorndike's CAVD, a Cooperative Zoology test, a Cooperative General Chemistry test and the Minnesota Reading examination for college students to show relatively little relation to medical school grades, surmised that the MCAT predicted first year grades fairly well. However, he also concluded that after the first year of medical school, the best predictor of medical school success was first year grades.

More recently, Garfield and Wolpin (1961) employed the MCAT to study students who withdrew from medical school. They obtained MCAT scores on 51 of 53 students who withdrew from medical school over an eight year period. They found that it was possible to distinguish the 27 academic failures in their sample from the rest of the withdrawal group; the failure group scored significantly lower on the Verbal, Quantitative and Science subtests, but not on the Modern Society section. The Science score seemed to be the most reliable predictor. Those subjects with emotional and family problems scored higher than the failure group on all tests but the Quantitative section. It is interesting to note that those withdrawing for emotional reasons were virtually indistinguishable on the basis of MCAT scores from their fellow students who remained in school.

In 1962, Schwartzman, Hunter and Lohrenz concluded that ". . . the relation between the MCAT and medical school performance is not strong" (Schwartzman, Hunter & Lohrenz, 1962a, p. 758). In a later study (Schwartzman, Hunter &

Lohrenz, 1962b), the same authors compared a group of 138 students who withdrew from medical school over a ten-year period with a group of 422 currently registered students. They found some significant differences on the MCAT and other variables between 82 students who withdrew because of academic failure and the current sample. However, like Garfield and Wolpin, these authors found that the 56 students in their sample who withdrew for reasons other than failure were much like their current sample, and in fact showed some nonsignificant tendencies to have slightly higher MCAT scores.

Buehler and Trainer (1962) studied a group of male students admitted to the University of Oregon Medical School between 1949 and 1954. They isolated a "Top Selection" group of students, whom they predicted would do well in medical school, and a "Bottom Selection" group, predicted to do poorly. This was accomplished by taking those students with the ten highest and ten poorest premedical science grade-point averages in each class, since the premedical science grade-point average was considered to be the best predictor in their school. This method yielded a total of sixty students in each group.

Their next step was to select another sample of students consisting of a "High Achiever" group of 22 individuals who had graduated in the top ten per cent of their medical school class, and a "Low Achiever" group, nine of whom were failures

and 16 of whom fell in the bottom twenty per cent of their class.

In evaluating their samples, these writers discovered that the Bottom Selection and Low Achiever groups were likely to contain students that were more likely to be married, to have attended more schools and to have better overall grades than the other two groups. In addition, the Low Achiever group members were more likely to be older than the members of the other groups. Findings specifically related to the MCAT results included the fact that Modern Society scores were poorly related to success, while high Science Achievement scores were closely related to success.

Utilizing these findings, Buehler and Trainer were able to develop a composite picture of the successful medical student. However, they discovered that if all of their criteria were applied to their sample, only five of 120 students were left. From this experience they concluded that

It appears that we have very little difficulty in knowing which are the best students and the best risks. We have considerable difficulty in identifying which of the poorer candidates are most likely to succeed (Buehler & Trainer, 1962, p. 17).

Moore (1962), in discussing the manner in which the MCAT is utilized at his medical school in the selection of students, asserted that ". . . there is a significant correlation between the MCAT scores and the grade on Part II examination of the National Board of Medical Examiners covering the principal

clinical subjects" (Moore, 1962, p. 457). He also stated that a study sponsored by the Association of American Medical Colleges (for which he gives no reference) had been studying the problem of personal characteristics and their influence in the performance of medical students. The results suggested that scholarship was approximately twice as important as personal qualities and motivation. He added that, at his school, objective tests have been used to measure general and specific knowledge, skills, interests, social awareness and emotional stability. However, tests other than the MCAT were used only to answer specific questions. Examples of tests so used would be the Strong Vocational Interest Pattern Test, a reading test, or a "concept mastery test".

Hoffman, Wing and Lief (1963) studied twelve classes composed of 1278 students from the Tulane School of Medicine. They considered eight predictor and four criterion variables for this group. Three of the eight predictors showed statistically significant relative weightings in the equations derived from their data. The science "quality point ratio" (premedical) showed a consistent decline from the first to the fourth medical school years. A similar decrease was found for the MCAT Science Aptitude section. However, there was a significant increase noted in prediction equation weights for the Interview Rating Variable compared with the last two years of medical school as opposed to the first two years.

Additionally, some nonsignificant, but suggestive, trends emerged. These included:

. . . a tendency for the overall premedical grade average to be a relatively more important indicator after the first year, while the score on the Quantitative Aptitude section of the MCAT makes almost no contribution to prediction of grades after the first year. There is a slight, but consistently positive relationship between the score on the Verbal Aptitude section of the MCAT and each of the four grade averages. There is a slight, but consistently negative relationship between age at admission and each of the four grade averages. The remaining predictor variable, MCAT-Modern Society score, exhibits a very slight, and generally negative, relationship with grade averages (Hoffman, Wing & Lief, 1963, p. 855).

Hoffman, et al., went on to interpret their data as clear evidence that there was only a slight relationship between both pre-admissions data and medical school grades in the first two years, and grades during the clinical years. They suggested that their finding that the interview rating was increasingly important as the student progresses in medical school pointed to a need for refinement and clarification of these rating procedures.

It should be added at this point that Gough, Hall and Harris (1963) found a similar relationship between admissions ratings and the grade-point average during the clinical years. The difficulty was, as Gough, et al., noted, that there was a great deal of contamination and overlap possible in such ratings, since quite often both clinical grades and ratings came from the same persons. This alone would have made such ratings

difficult to study, even if reliable techniques for doing so had been available.

In any consideration of studies using various intellectual measures on a group as highly selected as medical students, one comes across many different explanations for lack of predictive validity for the instruments used. Those explanations most often encountered for the MCAT and similar tests have been presented by Hunka, Gilbert & Cameron (1966). They have listed several factors which they view as being related to the loss of predictability encountered in dealing with a group of applicants possessing fairly homogeneous traits, such as is apparently the case with medical students. These factors, which are found when applicants must meet, for example, minimum academic requirements, include:

. . . (a) restriction of heterogeneity of the available measures such that these measures have little relationship with the performance criterion; (b) instability of prediction equations when applied to a new group of applicants; (c) predictor measures which have low criterial validity; and (d) low reliability in the measures available (Hunka, Gilbert & Cameron, 1966, p. 368).

Hunka, et al., claimed that their own research with Canadian medical students has contradicted most American findings that the MCAT has little predictive usefulness. They suggested as a possible explanation for this discrepancy that the MCAT practice exercises which are available to American students may greatly affect the validity of the MCAT for that group.

Gough, Hall and Harris (1963) have taken exception to this usual explanation of lack of validity for such instruments of intellectual assessment. A review of the literature on the MCAT led them to contend that there was little in the way of validation studies on the MCAT, and that it had been widely used even before attempts at such studies were made. Particularly worthy of note was their finding that the original formulation of goals for the MCAT stressed the importance of the "intrinsic validity" of the MCAT, to the exclusion of demonstrations of actual predictive ability. To put it another way, those responsible for developing this particular instrument seem to have done so more by trying to measure certain types of intellectual skills, knowledge, and attitudes which they felt, a priori, to be important for a prospective medical practitioner, than by empirically seeking to prove a correlation between the predictive powers of the instrument and actual performance.

On the basis of their review of the literature, these authors further concluded that

The general picture that emerges from these studies is somewhat discouraging. The MCAT appears to have at best a low validity for forecasting performance in school and for completion of training. With respect to later criteria of performance in internship and professional practice the validity is essentially zero. One can hardly escape the thought that the test is in need of improvement in the predictive realm (Gough, Hall & Harris, 1963, p. 987).

As for a comparison of all three of the usual selection methods--evaluation of premedical scholastic record, consideration of achievement and aptitude test scores from the MCAT, and appraisal by means of personal interview--these authors admitted that there is such a paucity of evidence that it was quite a problem to reach a definitive conclusion about the predictive validity of any of these methods. Nevertheless, on the basis of present evidence, they concluded that

Premedical grades show some promise, particularly in forecasting achievement in the first two years of medicine, but the MCAT and the admissions interview reveal less value as predictors of later performance (Gough, Hall & Harris, 1963, pp. 987-988).

In order to determine for themselves the effectiveness of admission procedures, Gough, Hall and Harris studied 1088 medical students, members of fourteen classes (1951 to 1964) at the University of California School of Medicine in San Francisco. They obtained the grade-point average of each student for each of the four years of medical school, plus the overall grade-point average. These grade-point averages were compared with the following variables: MCAT scores, premedical grade-point average, premedical science grade-point averages, premedical grade-point averages in the last two school terms, and admissions committee interview ratings.

The authors' conclusion was that the quantitative methods

did quite poorly in making differential predictions. This applied whether the methods for evaluation were simple correlations or multiple regression solutions.

These authors also considered some of the usual hypotheses as to why such procedures so often give unsatisfactory results--such hypotheses as those advanced by Hunka, et al.

For one thing, they investigated the frequent contention that tight selection procedures result in a reduction of variance and a consequent restriction of range, which tends to lower correlations between predictors and criteria. For their sample, they found that the Verbal, Quantitative and Modern Society sections of the MCAT had essentially normal distributions, although the Science Achievement scores did ". . . show a slight disproportionality of subjects with high scores" (Gough, et al., 1963, p. 994). However, while there was some reduction of range apparent in the slightly decreased standard deviations, the authors contended that "The changes here are small, indicating that restriction of range, of the magnitude actually encountered in admissions practice, is not consequential" (Gough, et al., 1963, p. 995).

In similar fashion, an examination was made of the so-called "ceiling" problem--that is, that an otherwise good predictor loses its effectiveness at its upper ranges. It was concluded that the degree of elevation found was not really high enough to preclude effective prediction by an otherwise

valid test.

Such conclusions led these authors to suggest that it would be more profitable to improve the testing procedures rather than seek to excuse their shortcomings. As a start they offered several hypotheses as to reasons for the deficiencies in current procedures.

For one thing, they suggested that, while such tests as the MCAT ". . . tend to have their highest validities for undergraduate achievement, (they) do not involve fully enough the independence, self-initiation, and critical judgment demanded of the professional" (Gough, Hall & Harris, 1963, p. 996). Another criticism was that emphasis is placed on convergent rather than on more creative or divergent thinking, with the result being a considerable cost in creative professional work on the part of those selected by current procedures.

Finally, it was noted that only a minimal number of factors are being considered in selection procedures. These authors suggested several other tests which might be employed. One of these was the California Psychological Inventory, which had shown promise in making differential predictions about scholastic achievement among National Merit Scholarship Corporation finalists (Holland, 1959).

A defense of the MCAT against the foregoing criticisms of Gough, Hall and Harris has been offered by Sanazaro and

Hutchins (1963). They made some telling points about difficulties with validation of such a test. For example, a student may be selected primarily on the basis of any one high score, whether it be high Science score or high pre-medical grade-point average. If one factor is very low and the other very high, this fact will impair the predictive ability of one factor and enhance that of the other. Such decisions will necessarily affect any correlational study.

These authors also mentioned two other factors that may influence validity studies on the MCAT. One is the fact that students with very high MCAT scores, but with little motivation for studying medicine may be admitted. In this regard, they added:

Analysis of the Annual Medical School Questionnaire of the AMA-AAMC Liaison Committee on Medical Education for the years 1954-62 reveals that thirty-eight per cent of students who dropped out during this period were in satisfactory academic standing. Among the remaining sixty-two per cent of dropouts ascribed to poor academic standing, many students suffered primarily from problems of motivation or emotional stability rather than lack of abilities measured by the MCAT (Sanazaro & Hutchins, 1963, p. 1047).

These authors then pointed out that in validation studies, there was often the problem of having an adequate criterion with which the MCAT might be compared. They also noted that the only ". . . nationally available reliable measure of knowledge in the medical sciences is the National Board examination, Part I and Part II" (Sanazaro & Hutchins, 1963, p. 1048).

They then presented one of the few published comparisons between the MCAT and the National Board examinations, based upon the scores of 1956 senior medical students in thirteen schools. (The results of this study have been reproduced in Table I.)

According to the authors, the total correlations were statistically significant beyond the .001 level of confidence. However, when the results from individual schools were considered, it was readily apparent that there is a very large variation in correlation from school to school. This led to a statement by the writers that

In the final analysis it is the responsibility of each school to determine the validity of its entire admissions process in the context of all variables unique to that school. Finding high or low correlations between MCAT scores and later performance in medical school does not constitute complete evidence per se that the MCAT is or is not serving its intended function in the selection process (Sanazaro & Hutchins, 1963, p. 1049).

Sanazaro and Hutchins also took issue with the contention of Gough, Hall and Harris that more long-range criteria than medical school grades should be used in correlational studies of the MCAT. The authors argued, reasonably, that the basic purpose of the MCAT was only to aid selection committees in ascertaining that their students would possess adequate academic skills, intellect and formal preparation for the study of medicine, not to guarantee that they would be competent professionals once the formal medical study was completed.

TABLE I

CORRELATIONS BETWEEN MCAT SUBTEST SCORES AND NATIONAL BOARD PART I
AND PART II AVERAGES FOR 1956 SENIOR MEDICAL STUDENTS

Part I*			
<u>MCAT Subtest</u>	<u>Reliability of MCAT Based on KR-20</u>	<u>Correlations with Part I Average for All Stu- dents in 13 Schools (N= 1098)</u>	<u>Range of Individual School Correlations Obtained in 13 Schools (N's range from 35 to 135)</u>
Verbal Ability	(.91)	.33	.12 to .46
Quantitative Ability	(.86)	.31	.10 to .51
Modern Society	(.94)	.34	.14 to .46
Science Achievement	(.93)	.51	.30 to .69
Part II†			
<u>MCAT Subtest</u>	<u>Reliability of MCAT Based on KR-20</u>	<u>Correlations with Part II Average for All Stu- dents in 17 Schools (N= 1427)</u>	<u>Range of Individual School Correlations Obtained in 17 Schools (N's range from 35 to 163)</u>
Verbal Ability	(.91)	.43	.14 to .49
Quantitative Ability	(.86)	.32	.03 to .46
Modern Society	(.94)	.42	.15 to .53
Science Achievement	(.93)	.47	.02 to .59

TABLE I (CONTINUED)

CORRELATIONS BETWEEN MCAT SUBTEST SCORES AND NATIONAL BOARD PART I
AND PART II AVERAGES FOR 1956 SENIOR MEDICAL STUDENTS

*Part I average reliability estimate based on Kuder-Richardson Formula 20 for this examination was .90.

Part II average reliability estimate based on Kuder-Richardson Formula 20 for this examination was .75.

†(Table reproduced from Sanazaro and Hutchins, 1963, p. 1048)

Finally, these authors questioned the validity of the criticism by Gough, Hall and Harris concerning the lack of "broadened scope of inquiry" with the MCAT. The argument was that Gough, et al., could not be expected to be aware of the "extensive research" carried out by those connected with MCAT administration. This was certainly a valid point, since such research has apparently not been made available through publication of the findings, as a research of the literature readily reveals. The real question is: Why not? Until such research is available, many issues remain in doubt, and those responsible for the MCAT can expect more criticism of an as-yet unproven test.

With such dissatisfaction with the most common intellectual predictor becoming more widespread, some investigators have begun to experiment with multi-factor approaches to selection procedures. Johnson is one such writer. Starting with a preliminary attempt to isolate by means of an "actuarial" approach those factors related to success in medical school (Johnson, 1960), he progressively developed a multi-factor method of evaluating some 927 applicants to medical school (Johnson, 1962). Using as criteria both a pass-fail category, and a division of performance into top twenty per cent, middle sixty per cent and bottom twenty per cent of the classes, Johnson was able to establish cut-offs for ten predictive factors:

. . . (a) age, (b) college grades (adjusted according to the average MCAT of the undergraduate college), (c) science index (based on both the quantity and quality of college science study), (d) MCAT quantitative score, (e) MCAT science score, (f) MCAT average score, (g) Otis I.Q., (h) predicted first-year average, (i) college recommendations, and (j) interviewer rating score (Johnson, 1962, p. 664).

Johnson found his cut-offs to be more effective than simple, or even multiple, correlations. He also found them effective not only at his medical school, but at other medical schools, though to a lesser degree. These findings led him to conclude that each medical school could develop its own cut-off points, taking care only to revise them from time to time to make adjustment for changes in faculty, grading systems, etc.

Concluding that correlational approaches to predicting medical school performance are often less than satisfactory because many of the selection procedures employed do not possess a linear relationship to the criteria, Conger and Fitz (1963) attempted to develop a "sign-approach," similar to that of Johnson. In a pilot study, six "predictor variables" were isolated which related to cumulative grade-point average: adjusted undergraduate grade-point average, MCAT-science score, MCAT-modern society score, mean interview rating by two selection interviewers, premedical adviser rating and age. The authors were able to isolate "danger ranges" for these pre-

dictors in comparisons with each of four criteria: ". . . dropout rate and cumulative class standings (above or below the median), for the preclinical and clinical years separately" (Conger & Fitz, 1963, p. 944).

Several of their findings were of particular interest.

One was their conclusion that

Generally, it would appear that to do above average work over the four years, as opposed to simply avoiding failure, the student needs to be younger; his undergraduate grades need to be higher; and he needs to show more of the kinds of personal qualities judged important by admission committee interviewers (Conger & Fitz, 1963, p. 946).

Another finding was that there was a stronger correlation between adjusted grade-point averages and performance than when uncorrected grade averages were used.

Yet another result of their study concerned the performance of the student as he moved from the academic to the clinical years in medical school. It was found that, as the student made this shift, there was also a shift downward in the danger range for the adjusted premedical grade-point average, and an accompanying decrease in relationship between class standing and undergraduate grades. There was also a weakening of the relationship between the MCAT subtests and class standing, and, within broader limits, the factor of older age was less of a handicap. At the same time, interview ratings maintained their constancy.

Such findings led the authors to conclude that, as the student passed from the academic into the clinical years, his academic abilities became less crucial in attaining success, while his personal qualities gained in relative importance.

Nonintellectual Predictors

The search for nonintellectual factors predictive of performance in medical school has usually involved consideration of various tests of personality. More recently, there has been considerable interest in evolving descriptions of personality types. Thus, the study into such factors can be divided into three major categories: research involving projective tests; research utilizing objective, or structured, tests; and attempts to describe personality types.

Research with Projective Tests

One of the earliest studies of medical students in which projective tests were employed was that of Harrower-Erickson (1944). She administered the group Rorschach test to 108 new medical students at McGill University, and found that personality ratings based on the Rorschach corresponded fairly well to later work in medical school. Apparently, however, it worked best with the extreme groups, since the reported results suggested that those students rated as below average, though not poor, did as well as those rated above average. The fact that those rated as "poor personalities" did, indeed, do very poorly may be related to the Rorschach's success as an indicator of pathology.

Reported in this same paper were the results of the administration of a multiple-choice Rorschach to medical students at Illinois in 1942. It is interesting to note that many more freshmen than seniors were rated as having a "poor adjustment," suggesting either that "poor personalities" were eliminated along the way, or, perhaps, became better adjusted.

Waggoner and Ziegler (1946) reported a consistent relationship between Rorschach findings and psychiatric interview data in a study of 148 freshmen medical students at the University of Michigan. While they reported no actual quantitative data, they believed that the two methods employed enabled them to predict fairly well the likelihood that an individual would succeed in medical school.

Brosin (1948) reported a study in which both group Rorschachs and group Thematic Apperception Tests were given to 130 medical students. He found only a slight degree of relationship between the findings from these methods and an overall prediction of success; he concluded that such group tests, either individually or in conjunction with other tests, were not significantly useful in predicting success or failure, but that, when combined with individual psychiatric interviews, the combination was one of the best methods yet available (at that time) for selection purposes.

Most later studies have been less optimistic, as has been

pointed out in a review by Strother (1957). However, Strother, in discussing the Brosin study, quoted Joel Handler's observation in an unpublished paper that individual Rorschachs on this same group of subjects did aid a great deal in describing personality patterns, especially in relation to psychopathological processes. Handler was apparently impressed with the fact that so much psychopathology was found among these students. But he also noted that there was little or no relationship between success in medical school and psychopathology, and that even frankly psychotic students (as shown by the tests) were able to place in the upper third of their class.

Still commenting on the Brosin study, Strother also cited a personal communication by L. W. Earley to the effect that projective tests were so time-consuming as to be profitably employed only in special cases.

A similar conclusion to that of Brosin was reached by Shoemaker and Rohrer (1948). These investigators used the Rorschach to study those freshman students at the University of Oklahoma Medical School who fell into the upper and lower fifteen per cent on the basis of grade-point averages. They employed a sign analysis and found no group difference with a number of scoring categories. (Again, no statistical analysis was offered). Their conclusion was that the Rorschach was useful only in conjunction with psychiatric screening, and not as a predictor in its own right.

Eron (1954) used as subjects 35 male third-year medical students and 35 third-year divinity students, and found only slight ability to discriminate between the two groups. In addition, he compared the ten best and ten poorest medical students, only to find no statistical or clinical differences.

Faterson (1956) administered the Draw-a-Person Test to medical school applicants at the State University of New York College of Medicine. It was found to have some utility as an adjunct to a psychiatric interview, but was not felt to be a reliable predictor on its own. However, no comparisons with actual performance were cited.

In the review mentioned above of the usage of projective tests to that time, Strother (1957) was forced to conclude that there was not enough evidence available to regard projective tests as effective predictors of medical student performance. He felt the Rorschach and Thematic Apperception tests to be too time consuming, and to have too little predictive ability, for consideration for extended usage. While he admitted the Draw-a-Person Test to be potentially useful, mostly because of its brevity, this test also suffered from lack of demonstrated validity. But so, too, did the psychiatric interview.

A somewhat different application of projective tests was made by Schlageter and Rosenthal (1962). They were not concerned

with predicting a student's success or failure, or with analyzing his performance on psychological tests or in interviews. Rather, they wanted to work out a "global picture of the student."

They selected 20 first-year medical students at random. These were interviewed by one of two psychiatrists, and given a Rorschach test. Each student was then rated on each of 23 variables designed to evaluate "behavioral and psychic traits, defenses, and characteristics." These authors found that their students characteristically employed such techniques as repression, isolation, productivity and achievement, and that their personality type could therefore be described as basically obsessive-compulsive--findings confirmed by Lief, Young, Spruiell, Lancaster and Lief (1960). It was concluded that this personality type was probably the most adaptable for the task which confronted them in the study of medicine.

As is obvious from these studies, projective tests have added little to consistent predictions about future medical school performance. For this reason, in more recent studies the attempt has been to make use of structured tests.

Research with structured tests

In one of the earliest studies, Stuit (1941) administered the Strong Vocational Interest Blank (SVIB) to 131 students. He found that the physician's key correlated only .16 with

first-year medical school grades.

Glaser (1951) gave the Minnesota Multiphasic Personality Inventory to 150 medical students. He attempted to use a "sign" approach, but this failed to isolate any MMPI signs with a significant relationship to scholastic achievement.

On the other hand, Schofield (1953) compared the top versus bottom quarter of a group of medical students by giving them the MMPI during their freshman and junior years, and found some patterns of change which were promising. These subjects were also matched on the basis of scores on the American Council on Education Psychological Examinations. The results of the MMPI indicated that the top quarter students showed decreased scores at second testing on the Mf and Ma scales, and increased scores on the Sc scale, while the bottom quarter students exhibited only a decrease in Ma scores. Schofield attributed the increased Sc scores of the top quarter students to an increased tendency for self-analysis. As for the decreased Ma scores, he felt that the top quarter students reduced their scores in the course of their medical school careers because of increasingly realistic attitudes, while the scores of the bottom quarter students dropped because of a mild deterioration of morale. This investigator also found significant differences between the two groups studied on the Hy, Pd and Sc scales, and concluded that chief deviations of these three scales were indicative of a lowering

of the general level of scholarship in the class.

On the basis of his findings, Schofield hypothesized that

. . . students who show both a restricted scholastic promise and marked deviation of the Hy, Pd, or Sc scales would be particularly poor academic risks. In the absence of any limitation of academic aptitude, the admission to medical training of students showing chief deviations (even though within the "normal" limits) on the Hy, Pd, and Sc variables would appear to make for a lowering of the general level of scholarship of the medical school class. (Schofield, 1953, p. 52).

Holt and Luborsky (1958) found that the Strong Vocational Interest Blank differentiated accepted from rejected candidates for psychiatric residency, but did not forecast differential attainment to a significant degree during the residency.

Knehr and Kohl (1959) examined the utility of the MMPI as a screening device, using as subjects 249 medical students in three classes who later graduated. They found only slight, nonsignificant correlations between MMPI scales and cumulative class standings. They also followed 63 students in this group whose MMPI profiles indicated psychiatric instability. By the time of graduation only 18 of them had received any psychiatric treatment while in school, whereas 19 other students, whose profiles had not been so suggestive of psychiatric instability, had also sought psychiatric help.

In an attempt to find factors which might be predictive of differential performance in medical school, Gough and Hall (1964) obtained MCAT and California Psychological Inventory scores, and premedical grade-point averages on 100 applicants to the University of California School of Medicine. Medical school grade-point averages and faculty ratings were also gathered on the 34 applicants later admitted to medical school. CPI scores and grade-point averages were also obtained for a cross-validation sample of 63 students at the University of Colorado School of Medicine.

Only one CPI scale, Socialization, and one MCAT scale, Quantitative, differentiated those in the original sample of 100 who were admitted from those who were not. Gough and Hall felt that such criteria as premedical grade-point averages and interview ratings were more heavily weighted as admission factors than, for example, MCAT scores, and this, they pointed out, would tend to restrict the ranges of scores on the CPI. Among the admitted group of students, the CPI scales of Sociability, Tolerance, and Intellectual Efficiency were significantly (positively) correlated with over-all grade-point averages; the Sociability scale also correlated $+0.48$ with admissions-committee ratings.

Noting that third- and fourth-year grade-point averages seemed to correlate highly with faculty ratings, though not with, for example, MCAT scores, the authors questioned the

advisability of relying only on first-year grades as a criterion in validation studies. On the other hand, they emphasized, the CPI seemed to gain in correlation with each succeeding year in medical school or, in their interpretation, ". . . as the criterion moves closer to the circumstances of professional practice. . ." (Gough & Hall, 1964, p. 223). This was especially apparent, in their study, when multiple correlations were considered. Parenthetically, it is interesting to note that the faculty tended to give higher ratings to students with lower verbal scores (MCAT).

Having concluded that faculty rating was the most important of the criteria at hand, Gough and Hall then considered in detail the equation derived to predict this criterion:

"Medical promise = $+.794 S_y + 1.144 C_m - .696 C_s$ "
(Gough & Hall, 1964, p. 223).

They then devised a study to examine the psychological meaning behind this equation. To avoid the pitfalls inherent in self-report questionnaires, they used as subjects 41 fraternity members. The subjects were first given the CPI. Later, they were asked to use Gough's Adjective Check List to describe five of their peers in the study. Then, the results of the "medical promise" equation for each subject was correlated with the ". . . social-psychological descriptions of the everyday social and interactional behavior of each

subject" (Gough & Hall, 1964, p. 224). They found positive correlations with unselfish, considerate, informal, forgiving, reasonable and self-confident.

The authors interpreted this equation as describing ". . . a pattern of personal resourcefulness coupled with sensitivity to the needs and demands of others" (Gough & Hall, 1964, p. 225). They believed that it ". . . screens out a kind of petulance, self-centeredness, and intolerance which most would see as undesirable characteristics in a prospective medical practitioner" (Gough & Hall, 1964, p. 225). Their conclusion was as follows:

Perhaps of greatest immediate interest is the psychological nature of the personality syndrome defined by the CPI equation. This syndrome appears to embody a high degree of personal maturity, concern for others, and self-confidence, and to be free of any sort of narcissistic achievement drive or compulsive striving. In a functional sense, the equation may be said to identify persons likely to do well in training, as shown by evaluations near the end of such training, and at the same time to emphasize a constructive, desirable, and beneficent constellation of personal attributes (Gough & Hall, 1964, p. 225).

Kole and Matarazzo (1965), in a study designed to take note of an increasing dissatisfaction in recent years with evaluations of medical students entirely on the basis of grades, compared 40 ~~medical~~ students, 40 police applicants and 40 fireman applicants, matched on the basis of age and marital status.

The subjects were administered the Wechsler Adult Intelligence Scale (WAIS), Cornell Medical Index (CMI), Taylor Manifest Anxiety Scale (TAS), Saslow Psychosomatic Screening Inventory (SPI), Edwards Personal Preference Schedule (EPPS), and Strong Vocational Interest Blank for men (SVIB). Using these various measures of intelligence (WAIS), emotional adjustment (TAS, CMI, SPI), reported physical health (CMI), personality needs (EPPS) and interests (SVIB), the authors came to several conclusions about the average medical student. He was found to be

. . .intellectually superior, physically healthy, and emotionally stable. . ., has reported strong personal needs. . .for Achievement and Endurance, with a relative lack of need to depend on others for emotional support. . ., is largely self-inspired. . ., has a high drive to do his best. . ., and. . .has the personal capacity to persevere with prolonged professional training without constant emotional assistance and prodding from others. . .(He has) interests like those of successful practicing physicians (Kole & Matarazzo, 1965, p. 1143).

Not surprisingly, Kole and Matarazzo found their medical students to be ". . .a relatively homogeneous group in terms of intelligence, emotional adjustment, personality needs, and interests" (Kole & Matarazzo, 1965, p. 1144). However, their study also revealed considerable evidence of individual differences among the medical students, and many suggestions of clearcut differences in personality.

Coker, Greenberg and Kosa studied the responses of 2,548

white male medical students from eight medical schools on two research instruments. One was the California authoritarian (F) scale. The other was Christie's Machiavellian scale (Mach IV),

. . .which asks about the respondent's agreement with statements taken from the writings of Niccolo Machiavelli and refers to the evaluation of commonly accepted moral standards such as sincerity, deceptiveness, and the means used in 'getting ahead'. The Machiavellian personality (who scores high on the scale) tends to endorse the statements implying the manipulation of such moral standards (Coker, Greenberg & Kosa, 1965, p. 1075).

They found that their subjects tended to select fields of medical practice in accordance with several factors. Those students who were more authoritarian (had high F-scores) tended to reject psychiatry and internal medicine, while selecting general practice. "Machiavellian" students, on the other hand, were prone to reject general practice and adhere to psychiatry. The authors found this general pattern of selection of field more prevalent among senior than freshman students, and more common in schools with a nonauthoritarian value climate. They also observed that authoritarian students made such career choices earlier, and that nonauthoritarian schools seemed to have more students who selected specialities.

In discussing their findings, the authors contended that individual personality characteristics largely counteracted

the influence of such factors as fellow students' opinions and type of medical school. They also suggested

. . .that the authoritarian personality, in his attempt to avoid ambiguous situations, tends to select general practice as a field of practice promising a certainty of knowledge and routine, and tends to reject internal medical and psychiatry as fields where he cannot expect such conditions. On the other hand, the Machiavellian personality may tend to select psychiatry in the expectation of a relatively easy work load and challenging problems in practice, and tends to reject general practice as a field contrary to such expectations (Coker, Greenberg & Kosa, 1965, p. 1084).

Research with Personality Types

In actuality, several of the studies already reviewed here under other headings had as their eventual aim some sort of evolution of a description of different types of personality. Thus, for example, the study of Buehler and Trainer (1962) utilized the MCAT and other traditional measures to develop some composite picture of the ideal medical student. Schlageter and Rosenthal (1962) employed a projective test, among other measures, to gain some idea of the personality of the medical student. Coker, Greenberg and Kosa (1965) used two structured tests to divide medical students into two personality types.

Other investigators have conducted studies that are not as easily cast into one of the three categories considered thus far. Because of the complexity--and paucity--of such

investigations, only two of the most representative are presented here.

The first is that of Frankel and Motto (1963), who interviewed 25 senior medical students in an attempt to understand the importance of structure in the performance of medical students. They were able to identify six patterns of academic performance by considering the class standings of their subjects. These could be summarized as follows:

"Steady performers" were those students who showed little shifting in class standing. These individuals could be subdivided into "high," "medium" and "low" performers.

Variable performers was that group of subjects who shifted an average of 45 places in class standings. They could be subdivided into "rising," "falling" and "irregular" performers.

The authors also felt that the students could be described according to learning patterns, such as structure-dependent, or self-structuring or flexible, depending upon how they learned best. A somewhat analogous distinction had been advanced earlier by Wispe (1951). He had noted that, if students were divided into "extrapunitive" and "intrapunitive" groups, the extrapunitive students seemed to need a relatively low degree of structure for course work, while the intrapunitive group needed a relatively high degree of structure.

Another classification made by Frankel and Motto identified

students who were either "accepting" or "non-accepting" of the medical school structure. The non-accepting students could be viewed also as being "indifferent," "rejecting" or "overwhelmed" by the school structure.

Through lengthy interviews, the authors discovered that

. . .the (four) steady high performers were... flexible and accepting. The two steady low students were structure-dependent and rejecting. The (five) variable risers tended to be self-structurers and shifted from non-accepting to accepting in their attitude while the (nine) variable fallers were structure-dependent and shifted from accepting to non-accepting. The (three) steady middle students seemed to be structure-dependent and accepting, but they may have a need for conformity and be covertly rejecting. The variable irregular category is inconclusive (Frankel & Motto, 1963, p. 167).

Frankel and Motto suggested that such learning sets may actually be the basis of many emotional and study problems often noted in medical students. They stressed the importance of selection committee members being aware of the type of demands made by their school, and of keeping this in mind during selection procedures.

Finally, Funkenstein (1962) felt that one of the major problems facing medical schools today is the rising attrition rate of medical students. He cited the finding of Hutchins and Gee (1961) that the attrition rate of medical students had increased by almost two-thirds in the six academic years between 1954-55 and 1959-60. However, Funkenstein had compiled

tables which indicated that, while this attrition rate had increased, there had been no significant change in MCAT scores or college grade-point averages. This lack of change seemed to suggest that the difference in attrition was largely due to the increased demands of the medical schools upon their students, with a corresponding failure of the students to meet the new demands.

Funkenstein also pointed out that at least part of the problem involved seemed to be that medical students have difficulties in psychosocial development. If such were the case, he felt that it would be useful to attempt to isolate some of those components of personality in the perspective medical student which tend to have a detrimental effect upon his performance.

In an effort to deal with this problem, Funkenstein studied two classes of medical students in the Harvard Medical School, as well as failing students in a number of other medical schools. In organizing his findings, Funkenstein attempted to distinguish three types of medical students: the Student Scientist, the Psychologically-Minded Student and the Student Practitioner. He described these types in the following manner:

1. The Student Scientist: These students majored in science and have as their goal research and teaching. They have high quantitative aptitudes relative to their verbal aptitudes, have studied mathematics to a high

level, and have high Medical College Admission Test science achievement scores. On the Strong Vocational Interest Blank, they show the measured interests of natural scientists. They are too often not experienced in working with people or in the humanities.

2. The Psychologically-Minded Student: These students usually majored in the humanities and have as their goal psychiatry in which they will principally function as a psychotherapist. Their verbal aptitudes are highest of any in this group but their quantitative aptitudes are apt to be relatively low. In secondary school they had difficulties with mathematics and usually took only three years of mathematics. Often they have worked with people and have considerable skill in this area. Their science grades in college are often high but represent a tremendous amount of work, and were achieved not because of interest in the subject but in order to enter medical school. On the Strong Vocational interest Blank they show measured interests in the verbal-linguistics group.

3. The Student Practitioner: These students majored in extracurricular activities and have as their goal the practice of medicine, usually a specialty, in which they will primarily work with people. Their quantitative aptitudes are apt not to be as high as those of the Student Scientist and their verbal aptitudes not as high as the Psychologically-Minded Student. They may or may not have studied mathematics to a high level, have science achievement scores lower than the Student Scientist, have some knowledge of the humanities, but have few intellectual interests. Their Strong Vocational Interest Blanks show measured interests in the science occupations (Funkenstein, 1962, p. 591).

Funkenstein also pointed out certain differences in academic performance in medical school among the members of the different groups. For instance, the Student Scientist

did quite well in the first two, or basic science, years of medical school because of his interest in, and aptitude for, science. However, he was apt to have problems when he reached the second two, or clinical years because of his lack of experience in working with people. He was also likely to have some difficulties in learning psychiatry.

The Psychologically-Minded Student achieved success in the first two years only after an intense internal struggle. He frequently had a problem learning science, but he often made higher grades in the clinical years than any other students, because he had learned enough science in the first two years for clinical practice, and because he had the ability to understand behavior and to work with people.

The Student Practitioner had a great deal of difficulty in the first two years because of the absence of patients, and his primary interest in people, as well as the fact that his preparation and basic intellectual interests were not so profound as those of other students. However, he was likely to do quite well in the clinical years, although he might find it difficult to learn psychiatry because he was not very introspective.

Points of Interest in the Literature

In concluding this review of the literature, several facts seem to stand out which are worthy of further consideration. One is the fact that there is some doubt as to the

efficacy of traditional methods of assessing the entering medical student's ability to complete his training. In particular, there is some doubt as to the predictive validity of the MCAT.

Another point which seems important is the conclusion reached by several authors, and most strongly stated by Lief, Young, Spruiell, Lancaster and Lief (1960), to the effect that the personality of the medical student may be at least as influential with respect to his medical school tenure as his intellectual attributes.

There are also indications that there may be different factors of importance for the clinical years of medical school, as opposed to the academic years (e.g., Conger & Fitz, 1963).

Finally, there seems to be a need to consider more fully the predictive validity of various selection instruments against more objective criteria (e.g., Sanazaro & Hutchins, 1963).

It will be the purpose of this study to give more thorough consideration to these points, at least for one medical school population, than has been the case so far.

CHAPTER III

METHODS AND PROCEDURES

In an effort to examine some of the implications of the studies reviewed in the previous chapter, the investigator decided to follow the performance of a sample of medical students at the University of Texas Medical Branch in Galveston. An attempt was made to identify those personal and intellectual attributes necessary for adequate performance.

Predictors

The instrument chosen as a predictor of intellectual abilities, the MCAT, because it is a widely used and accepted instrument for selecting medical students. In addition, as Watson (1955) and Moore (1962), among others, have pointed out, it supposedly has scales which measure both aptitude (Verbal and Quantitative) and achievement (Modern Society and Science Achievement) for medical school performance. Some of the controversy involving usage of this test as a selection device and predictor of medical school performance has already been presented. More thorough criticisms of the specific subtests of the MCAT, as well as suggestions for beneficial changes in the instrument have been offered by Funkenstein (1965, 1966b). Since the interest in this study is in the instrument as presently constituted, no further discussion of these points will be offered here.

Selection of a test of personality was more difficult but, for several reasons, Gough's California Psychological Inventory (Gough, 1957) was finally selected. For one thing, the CPI has norms available for medical students. For another, it is relatively simple to convert raw scores on this instrument to standard scores, thus facilitating treatment of the data.

However, the most important reason for the selection of this test was that many of the scales seemed to be potentially meaningful ones for assessing and describing personality factors in nonpsychiatric terms. In the more glowing terms of Gough and Hall, the CPI

. . . was originally constructed in the hope of providing measurement of those interpersonal factors of character and temperament which are involved in everyday social living and constructive achievement; i.e., the CPI is addressed to variations within the positive sphere of ego functioning (which it should be stressed, is not merely equivalent to an absence of psychopathology and malfunctioning) (Gough & Hall, 1964, p. 220).

Criteria

Review of the literature suggested the need to relate the predictors to more meaningful and objective criteria than merely, e.g., first-year grade-point averages. Because of the findings of differences between performance in the first two, or academic, years and the second two, or clinical years

by such investigators as Hoffman, Wing and Lief (1963) and Conger and Fitz (1963), it was decided to include averages for each of these periods of medical education as criteria of performance.

Finally, in response to the plea by Sanazaro and Hutchins (1963) to relate predictors to more objective tests of medical knowledge, it was decided to use the National Board examinations in medicine as the second set of criteria.

This set of examinations, as described by Cowles and Hubbard (1954), was originally composed of essay-type questions, but was gradually changed to an objective-type format. It is divided into two parts, with one part being administered at the end of each two years of medical school. Part I assesses knowledge in the areas of anatomy, physiology, biochemistry, pathology, bacteriology and pharmacology; it is given at the conclusion of the academic years. Part II covers medicine, surgery, obstetrics and gynecology, public health, pediatrics, and psychiatry; it is administered at the end of the clinical years.

Testees are questioned, according to Miller (1962), chiefly on their ability to recall or recognize relatively isolated fragments of information or to exhibit relatively simple levels of understanding. However, this same author considers the National Board examinations to possess a ". . . remarkably high level of internal consistency, reliability,

and statistical validity. . ." (Miller, 1962, p. 86).

Subjects

The members of two incoming freshman classes at the University of Texas Medical Branch--those entering in 1958-59 (N=108) and 1959-60 (N=88)--were administered the CPI during their orientation periods. The medical school careers of these medical students have now been completed, favorably or otherwise, and the desired measures of their achievement are available for study. The results of such a study are presented in the next chapter.

CHAPTER IV

RESULTS

Preliminary inspection of the data indicated that the grade-point averages for the two classes of medical students showed essentially the same distribution. Therefore, it was felt feasible to consider all subjects as a unitary sample.

The means and standard deviations for each of the measures under consideration are presented in Table II. It is immediately apparent that mean grade-point averages are much higher in the clinical years than the academic years. This is not an unexpected finding, since the first two years in medical school are traditionally a period for "weeding out" the poorer students. Also, since the grades assessed in the clinical years are more subjective, there is probably a tendency not to give exceptionally low ratings. The smaller standard deviation for the clinical years is additional confirmation of this conclusion.

It is obvious, from an observation of changes in sample size, that the academic years are very effective, if their function is to serve as an elimination process. Of the 34 students who did not continue in medical school, 33 (or approximately 16 per cent of the original sample of 196) had departed by the end of the first two years. (The one additional student dropping out was a female who, after passing Part I of the National Board examinations, married and transferred

TABLE II

MEANS AND STANDARD DEVIATIONS OF PREDICTOR AND CRITERION VARIABLES

<u>Variable</u>	<u>Mean</u>	<u>S.D.</u>	<u>N*</u>
1. 1st 2 yr. GPA	1.55	.25	163
2. 2nd 2 yr. GPA	1.96	.14	162
3. Dominance	61.82†	7.94	196
4. Capacity for Status	58.73	4.94	196
5. Sociability	59.33	5.06	196
6. Social Presence	57.57	8.71	196
7. Self-Acceptance	61.99	7.48	196
8. Sense of Well-Being	56.02	5.80	196
9. Responsibility	57.13	4.77	196
10. Socialization	56.56	5.02	196
11. Self-Control	50.93	7.68	196
12. Tolerance	56.03	5.59	196
13. Good Impression	51.84	1.01	196
14. Communality	55.72	4.25	196
15. Achievement via Conformance	58.31	5.71	196
16. Achievement via Independence	55.95	5.91	196
17. Intellectual Efficiency	58.99	5.23	196
18. Psychological-Mindedness	57.63	6.53	196
19. Flexibility	52.59	1.26	196
20. Femininity	49.81	7.69	196
21. Verbal Ability	497.55	4.32	196
22. Quantitative Ability	498.11	5.53	196
23. Modern Society	512.76	4.58	196
24. Science Achievement	502.23	5.70	196

TABLE II, (CONTINUED)
MEANS AND STANDARD DEVIATIONS OF PREDICTOR AND CRITERION VARIABLES

<u>Variable</u>	<u>Mean</u>	<u>S.D.</u>	<u>N*</u>
25. Anatomy	81.19	2.68	163
26. Physiology	78.22	3.49	163
27. Biochemistry	75.63	3.10	163
28. Pathology	80.24	3.59	163
29. Bacteriology	78.35	3.24	163
30. Pharmacology	77.91	3.97	163
31. Medicine	81.62	2.02	162
32. Surgery	81.99	2.26	162
33. Ob-Gyn	82.96	1.98	162
34. Preventive Medicine	79.88	2.22	162
35. Pediatrics	81.28	2.38	162
36. Psychiatry	79.68	2.01	162

*

One student withdrew at the end of the second two years, after completing Part I of the National Board examinations. CPI and MCAT scores obtained are for all 196 entering students.

†

CPI scores are given in standard score form.

to an academic degree program). Closer examination of the data, however, yields the interesting finding that only about half of these 33 students (16) actually failed. The remainder (15) withdrew in good standing. Some of these, admittedly, may have withdrawn before failing, but others were in no such danger. Unfortunately, the small size of this particular portion of the sample makes any conclusions rather difficult.

It will be noted that, on all CPI scales except femininity, these students tend to score above Gough's forced baseline of 50, and to show less variance than expected in terms of his standard deviation of ten. These scores, however, are in line with Gough's norms for medical school applicants (Gough, 1957).

Comparison of the means of the various MCAT scores with national means for the years in which these applicants took the examination (Association of American Medical Colleges, 1963) indicates that the applicants at UTMB, at least for those particular years, score slightly above the national means on the Modern Society and Science Achievement sections, slightly below the national means on the Verbal section, and right at the mean on the Quantitative portion. Discrepancies, however, are quite small.

Two observations are in order concerning the National Board examination scores. The first is the fairly low spread of scores, as indicated by the small standard deviations.

For Part I (the first six topics in the table), the standard deviation for the Anatomy section is especially low; this probably reflects the effects of amount of emphasis on this topic at UTMB, as indicated by the relatively large number of class hours devoted to teaching it.

A second observation, more difficult to explain, is that the spread of scores is reduced even more on Part II. This finding may be the result of several factors. One possible explanation is that, having successfully passed Part I, these students were more confident of their abilities, and hence, experienced less anxiety in taking this section. Another is the related possibility that they knew how better to prepare for Part II because of this previous success. Finally, it is generally recognized that it is relatively difficult to adequately assess knowledge in the clinical areas represented in Part II by means of objective, multiple choice questions, and this may make Part II a somewhat less demanding series of examinations.

Correlations (Pearson's r) among all 36 predictor and performance variables are presented in Table III. (Refer to Table II for variable names and N values). Table IV summarizes several of the significant correlations found.

An examination of Table IV suggests several things. For one thing, the best predictor of performance in the first two years of medical school is the MCAT Science Achievement

TABLE III

Intercorrelation Matrix of Predictor and Performance Variables for All
UTMB Medical Students Entering in 1958-59 and 1959-60 (Pearson's r)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36				
1																																								
2	.65																																							
3	.00	.10																																						
4	.13	.13	.13																																					
5	-.06	-.01	.59	.52																																				
6	-.02	-.02	.21	.48	.54																																			
7	.01	.03	.42	.30	.46	.40																																		
8	.15	.22	.19	.28	.29	.25	-.12																																	
9	.16	.05	.23	.08	.08	-.21	-.12	.37																																
10	.11	.08	.02	-.12	.05	-.25	-.12	.36	.41																															
11	.00	.10	-.03	.02	-.11	-.23	-.38	.57	.52	.40																														
12	.09	.13	.12	.27	.16	.23	-.07	.61	.42	.22	.54																													
13	.03	.04	.20	.24	.15	-.05	-.14	.58	.49	.32	.75	.45																												
14	.12	.03	.10	-.03	.06	-.00	.22	-.07	.13	.20	-.09	.05	-.11																											
15	.04	.03	.36	.24	.28	.04	.03	.56	.56	.39	.58	.47	.62	.09																										
16	-.01	-.01	-.04	.25	-.01	.20	.03	.32	.25	-.02	.28	.65	.17	-.06	.29																									
17	-.04	.04	.33	.43	.42	.42	.14	.50	.30	.08	.24	.55	.26	-.03	.44	.49																								
18	-.00	.10	.11	.11	.03	.19	.03	.30	.21	.00	.35	.44	.27	-.11	.25	.35	.31																							
19	-.02	.01	-.11	.24	-.00	.38	.03	.07	-.08	-.26	-.03	.26	-.00	-.09	-.11	.52	.27	.28																						
20	-.05	-.04	-.04	-.11	-.15	-.29	-.02	.06	.42	.00	.22	.07	.17	.10	.22	.14	-.06	.10	-.03																					
21	.24	.02	.09	.26	.11	.20	.14	.10	.07	-.17	-.10	.17	-.02	-.09	.03	.25	.28	.05	.12	.02																				
22	.16	-.00	.04	.11	.01	.06	.03	.09	.09	-.09	-.01	.10	.00	-.12	.06	.24	.15	-.05	.01	.00	.41																			
23	.16	.07	.02	.09	-.06	.08	.08	-.05	.04	-.22	-.14	.06	-.11	.02	-.03	.17	.18	.03	.11	.04	.55	.27																		
24	.42	.10	-.01	.15	-.05	-.03	.04	.06	.04	-.18	-.01	.02	.00	-.13	-.06	.12	-.03	.09	.02	.05	.34	.43	.29																	
25	.66	.55	-.01	.10	-.04	-.07	-.03	.18	.08	.08	.18	.11	.19	.02	.10	.07	-.01	-.02	-.02	-.03	.10	.20	.01	.36																
26	.64	.45	.01	.23	-.09	.04	.03	.08	.04	-.02	.07	.13	.09	-.01	.08	.16	.01	.10	.04	-.10	.20	.22	.08	.37	.61															
27	.66	.59	.01	.11	-.04	-.01	-.07	.13	.01	-.02	.12	.04	.13	.10	.01	-.04	-.08	.02	.04	-.04	.02	.05	-.09	.28	.64	.64														
28	.71	.59	.06	.10	-.03	-.04	.10	.06	-.01	-.04	-.02	.03	.02	.08	-.10	.02	-.02	-.02	.04	-.07	.20	.04	.06	.28	.59	.67	.69													
29	.67	.52	-.03	.05	-.09	-.02	-.03	.09	.08	-.04	.08	.11	.03	.04	.02	.13	.04	.08	.01	-.06	.21	.13	.11	.31	.52	.62	.61	.72												
30	.61	.59	-.03	.08	-.10	-.00	-.06	.09	.01	-.01	.08	.10	-.00	.15	.00	.01	-.02	-.05	-.04	-.09	.03	.00	-.06	.22	.56	.62	.71	.66	.68											
31	.61	.68	.06	.13	-.03	.01	.00	.11	.01	-.05	.08	.06	.03	-.00	-.02	.02	.04	.05	-.02	-.11	.08	.11	-.00	.17	.55	.57	.65	.64	.57	.63										
32	.62	.65	.06	.10	.10	-.12	.00	.10	.06	.08	.12	.10	.06	.03	.03	-.03	.01	-.00	-.08	-.08	.07	.11	-.04	.22	.52	.56	.56	.56	.52	.58	.68									
33	.61	.61	.02	.11	.08	-.06	.04	.10	.03	-.01	.00	.10	.02	.05	-.06	.05	-.03	-.00	.07	-.10	.08	.16	.06	.25	.52	.60	.58	.59	.55	.51	.68	.66								
34	.55	.45	.00	.06	-.08	-.07	-.03	.06	.02	-.04	.04	.10	.08	-.09	-.02	.09	.09	.14	-.01	-.11	.32	.29	.22	.39	.51	.54	.48	.55	.66	.52	.61	.52	.58							
35	.57	.58	-.05	.13	-.11	-.04	-.05	.12	.08	.08	.18	.11	.06	.07	.06	.05	.08	.04	-.05	-.01	.07	.03	-.02	.10	.50	.48	.58	.56	.59	.61	.73	.63	.63	.63						
36	.27	.30	.15	.15	.06	.02	.04	.16	.06	-.07	.06	.21	.12	-.11	.09	.28	.16	.15	.16	.04	.36	.20	.18	.22	.26	.27	.20	.53	.30	.24	.28	.27	.31	.46	.35					

TABLE IV

SUMMARY OF SIGNIFICANT CORRELATIONS FOR BOTH PREDICTOR AND
 PERFORMANCE VARIABLES FOR ALL UTMB MEDICAL STUDENTS
 ENTERING IN 1958-59 AND 1959-60 (PEARSON'S r)

<u>MCAT Variables</u>	<u>r</u>	<u>Sig. Level*</u>
Verbal Ability and 1st 2 yr. GPA	.24	.005
Verbal Ability and Socialization	-.17	.025
Verbal Ability and Tolerance	.17	.025
Verbal Ability and Self-Control	.26	.005
Verbal Ability and Achievement via Independence	.25	.005
Verbal Ability and Intellectual Efficiency	.28	.0005
Verbal Ability and Social Presence	.20	.01
Verbal Ability and Physiology	.20	.01
Verbal Ability and Pathology	.20	.01
Verbal Ability and Bacteriology	.21	.005
Verbal Ability and Preventive Medicine	.32	.0005
Verbal Ability and Psychiatry	.36	.0005
Quantitative Ability and 1st 2 yr. GPA	.16	.025
Quantitative Ability and Achievement via Independence	.24	.005
Quantitative Ability and Anatomy	.20	.01
Quantitative Ability and Physiology	.22	.005
Quantitative Ability and Obstetrics-Gynecology	.16	.025
Quantitative Ability and Preventive Medicine	.29	.0005
Quantitative Ability and Psychiatry	.20	.01
Modern Society and 1st 2 yr. GPA	.16	.025
Modern Society and Achievement via Independence	.17	.025
Modern Society and Intellectual Efficiency	.18	.025

TABLE IV, (CONTINUED)

SUMMARY OF SIGNIFICANT CORRELATIONS FOR BOTH PREDICTOR AND
 PERFORMANCE VARIABLES FOR ALL UTMB MEDICAL STUDENTS
 ENTERING IN 1958-59 AND 1959-60 (PEARSON'S r)

<u>MCAT Variables</u>	<u>r</u>	<u>Sig. Level*</u>
Modern Society and Socialization	-.22	.005
Modern Society and Preventive Medicine	.22	.005
Modern Society and Psychiatry	.18	.025
Science Achievement and 1st 2 yr. GPA	.42	.0005
Science Achievement and Socialization	-.18	.025
Science Achievement and Anatomy	.36	.0005
Science Achievement and Physiology	.37	.0005
Science Achievement and Biochemistry	.28	.0005
Science Achievement and Pathology	.28	.0005
Science Achievement and Bacteriology	.31	.0005
Science Achievement and Pharmacology	.22	.005
Science Achievement and Medicine	.17	.025
Science Achievement and Surgery	.22	.005
Science Achievement and Obstrectics-Gynecology	.25	.005
Science Achievement and Preventive Medicine	.39	.0005
Science Achievement and Psychiatry	.22	.005
<u>CPI Variables</u>		
Cs and Physiology	.23	.005
Wb and 2nd 2 yr. GPA	.22	.005
Wb and Anatomy	.18	.025
Wb and Psychiatry	.16	.025
Sc and Anatomy	.18	.025

TABLE IV, (CONTINUED)

SUMMARY OF SIGNIFICANT CORRELATIONS FOR BOTH PREDICTOR AND
 PERFORMANCE VARIABLES FOR ALL UTMB MEDICAL STUDENTS
 ENTERING IN 1958-59 AND 1959-60 (PEARSON'S r)

<u>CPI Variables</u>	<u>r</u>	<u>Sig. Level*</u>
Sc and Pediatrics	.18	.025
To and Psychiatry	.21	.005
Gi and Anatomy	.19	.01
Ai and Physiology	.16	.025
Ai and Psychiatry	.28	.0005
Ie and Psychiatry	.16	.025
Fx and Psychiatry	.16	.025

*Based on two-tail test of significance.

score, with a correlation of $+0.42$, which is significant beyond the $.0005$ level. Next comes the MCAT Verbal Ability score; the correlation of $+0.24$ with this criterion exceeds the $+0.025$ level of confidence. Correlation values for other predictors indicate lesser degrees of association with this particular performance item; this is especially true of the CPI measures for which there is not one significant correlation.

However, the CPI fares somewhat better in reference to the grade-point average in the second two years. As had been suggested earlier by Watson (1955), the best predictor of performance at later levels in graduate school is performance at earlier levels; thus, the first and second two years performance measures correlate $+0.65$. Aside from this, only one predictor variable correlates significantly with performance during the second two years of medical school: the CPI scale for sense of well-being, which with an r of $+0.22$, is significant beyond the $.001$ level of confidence. The MCAT scales all show very low correlations with this criterion.

With respect to the last set of criteria, the National Board examinations, the MCAT subtests are clearly superior to the CPI in predicting performance. This is especially true of the Science Achievement section, which shows the highest correlations. However, it seems to predict best achievement on Part I, and to have varying degrees of success on Part II. Most noticeable here is its complete lack of success in pre-

dicting scores on the section concerned with Pediatrics.

The Verbal section seems to be most effective in predicting such predominantly verbal activities as Psychiatry and Preventive Medicine; the latter, however, shows higher correlation with the Science Achievement portion.

The one really notable finding involving the relation between the various CPI sections and the board tests is the correlation ($r=+.28$) between Achievement by means of Independence and Psychiatry, which is significant at beyond the .0005 level of confidence.

One more point of interest which should be commented upon here is the large number of intercorrelations between predictors. This is true of both the CPI and the MCAT variables. Cronbach (1960) has noted this tendency for the CPI, and suggests that such correlations have been too high for efficient measurement. Such a criticism seems equally valid for the MCAT. However, because of the relative lack of standardization and validation, the CPI is probably even more open to such criticism.

The simple correlations considered here appeared to give no really definitive answers to the questions raised by the literature, although several suggestive leads were evident. In order to maximize the predictive efficiency of the various predictors in relation to the different criteria, several step-wise multiple regression analyses were undertaken.

The purpose was to seek optimum combinations of predictor variables which would forecast performance on the various criteria. Thus, each step of such a multiple regression solution would yield a multiple correlation coefficient (R) between the observed and estimated scores of the variable under consideration. At the same time, R^2 could be considered, according to Walker and Lev (1953), as the proportion of the sum of squares in the multiple regression solution which could be ascribed to variation in the prognosticator.

At each step, the partition of the sum of squares would lead to an F-test of significance for the multiple correlation coefficient. That is, there would be an F-ratio consisting of the sum of squares of the regressed values over the sum of squares of the residual errors. The particular distribution of F, then, would constitute a test of the significance of the multiple correlation coefficient so derived at each stage.

Proceeding in this manner, a t-test of the relationship between each individual variable and the particular criterion under consideration would lead to the elimination of the least predictive variable at each stage until the maximum weightings at one particular stage would yield the most predictive multiple regression solution. At this stage, the F-ratio would attain its maximum value, which would suggest that this stage represented the most significant multiple regression solution for the

criterion under consideration. The multiple weights attained at this stage could then be stated in a multiple regression equation predictive of performance on a particular criterion measure.

This procedure led to the development of five multiple regression equations.

The first criterion employed was the grade-point average for the first two years. For comparison purposes, it was possible to develop two equations for this criterion.

First, using only those variables showing the greatest correlation with the criterion when simple linear regression methods were used, seven CPI scores (capacity for status, sociability, social presence, sense of well-being, self control, good impression, communality) and all four MCAT scores yielded the following equation:

$$(1) \text{ First 2 yr. GPA} = 1.0894 \text{ Wb} + 1.5117 \text{ Cm} + .2921 \text{ Sci. Ach.} - 138.3713 \text{ (Significant beyond the .0005 level)}$$

Secondly, using the same criterion, but this time considering only the 18 CPI variables:

$$(2) \text{ First 2 yr. GPA} = 2.1075 \text{ Cs} - 1.5004 \text{ Sy} - 1.5596 \text{ Sp} + 2.4226 \text{ Wb} - 1.7493 \text{ Sc} - 163.9131 \text{ (Significant beyond the .001 level)}$$

Next, the grade-point average for the second two years was employed as the criterion. Using both the most significant CPI variables and all the MCAT variables, and employing only the CPI variables, only one equation was possible:

$$(3) \text{ Second 2 yr. GPA} = 1.0871 \text{ Wb} + 135.7715$$

(Significant beyond the .01 level)

Finally, it was decided to use as the criterion the sum of the National Board examinations scores. This, too, produced two separate equations.

Initially, only the two most significant CPI scores (Cs, Sy) and the four MCAT scores were utilized:

$$(4) \text{ Sum of National Boards} = .2256 \text{ Sci. Ach.} + 844.3212$$

(Significant beyond the .0005 level)

The final equation was developed with the 18 CPI variables:

$$(5) \text{ Sum of National Boards} = 1.9186 \text{ Cs} - 1.5541 \text{ Sy} + 938.3402$$

(Significant beyond the .01 level)

(All weighting factors are presented in raw score form).

CHAPTER V

DISCUSSION

While the results of this study provide no definitive answers to any of the questions which led to its formulation and execution, several promising leads have emerged from this investigation. In addition, at least some confirmation has been found for many of the conclusions reached in earlier studies.

It has become apparent that the best single prediction of medical school performance in the academic years is the Science Achievement section of the MCAT. The value of this predictor is apparent in linear and multiple regression analysis. However, certain CPI variables seem able to enhance the predictive ability of this MCAT variable, at least in a multiple regression solution. One of these CPI variables is a positive weighting for the sense of well-being (Wb) scale, which has been described in several different ways by Gough (1957). Although interpretation of all CPI scales is at this time extremely arbitrary (Cronbach, 1960), one may attempt to relate a priori assumptions about medical students to the reputedly "psychosocial," adjectival descriptions used by Gough to describe what his scales measure. Doing so, one might develop the point that the Wb measure which seems to be related to academic work actually refers to such traits as being a hard worker, being confident, and possessing ambition.

In similar fashion, one might develop the argument that

somewhat the same personality traits are measured by the communality (Cm) scale. This scale, too, can be seen as referring to a person who is steady, dependable, and, in addition, patient and conscientious.

Can the fact that the MCAT variable in the equation is able to achieve a fairly acceptable level of correlation on its own lead one to the conclusion that there is no utility in employing other measures? If so, then one must ignore the fact that, when this variable is used alone, it accounts for only about 18 per cent of the total variance, whereas the proportion accounted for rises to about 23 per cent if the total equation is used.

The next question which arises is whether or not the CPI alone can be of use in predicting the performance of a particular student during his first two years in medical school. The answer could be a highly qualified "yes," at least at UTMB. However, there would be several drawbacks to such a decision. One is the fact that relying exclusively on the CPI would call for an unnecessarily laborious operation, since more predictors would be necessary--five CPI scores to be exact, as against two CPI scores and one MCAT score. Another problem is apparent when one considers that the equation utilizing CPI scores alone accounts for only some 13 per cent of the total variance, suggesting the possibility that there are many other variables in the situation which are

not being measured under current conditions. Certainly, this is less than an optimal situation.

Nevertheless, before leaving this topic, it might be useful to consider those CPI factors which make up the second equation. Since the sense of well-being factor has already been presented above, attention should be given to those elements in the other variables that are not redundant with this factor. For instance, the negative value for sociability (Sa) called for by the second equation suggests that the medical student who would be successful in his academic years should not be too original or fluent in his thinking. He should also be submissive to authority, detached and suggestible. Somewhat the same description can be applied to the negative value of social-presence (Sp), with the added implication that he be rather formal in manner, or reserved, and that he not be particularly talkative. The negative value of the self-control (Sc) variable could be considered initially as being impulsive and lacking in control, but, since this is not too true of most medical students (it is hoped, at any rate), then it seems more probable that it refers to what might be termed an "adaptive self-centeredness," and thus is really a concern with self-gain, something perhaps which could be more simply termed as "broadly ambitious."

As concerns the results obtained with the criterion of the clinical years grade-point average, one question might be--

why does sense of well-being suddenly become more important? The answer may be that it has been there all along, but has only now come into its own, with some relaxation of the relative social isolation imposed during the academic years. There is an initial tendency to conclude that confidence in oneself in these years (or the ability to project such an image) is all that is really important. However, leaping to such a conclusion might cause the observer to overlook the fact that, despite the unique ability of this factor to predict success during the clinical years, it accounts for only about five per cent of the variance. The implication here is not really clear. On one hand, this study could have failed to identify many other variables that might be important in such a prediction problem. On the other hand, the qualities needed for success in these years may be so complex--perhaps even so arbitrary--as to defy simple; or even more complex, analysis. Another way of making this point may be to say that the whole may be so much more than the sum of its parts that the contribution of most of its parts may be unrecognizable.

In considering the final criterion, the sum of the Board tests, one might make somewhat the same point made before about the equation utilizing only the MCAT Science Achievement score. It is perhaps more important here, since the proportion of the variance accounted for is only about twelve per cent. The CPI-only equation has an even smaller portion accounted for--only

six per cent. It is probably not surprising to find that the CPI equation (number five) here contains two of the same variables (Cs and Sy) as the equations for predicting the grade-point average for the first two years. This undoubtedly emphasizes the fact that the Board examinations are unable to assess many of the factors important to success in the clinical years through objective types of questions. It appears at this point that such assessment will tend to remain a highly subjective affair.

The next question to be considered is that of how the hypotheses formulated at the beginning of this study have fared. They will be covered in the same order as originally stated in the first chapter of this report.

In the first place, the MCAT has been shown to be definitely more predictive of performance in the academic than the clinical years, and to a highly meaningful level. It would seem that, whatever else this test may measure, it is not what those who grade students in the clinical years seem to value most highly.

The second hypothesis seems to have been only partially substantiated. While the MCAT has been less predictive of performance on the National Board examinations than of grade-point averages in the academic years, its predictiveness has shown no clear and consistent difference in its relationship to Part I in preference to Part II, even though there are

discernible trends in this direction.

The third hypothesis is rejected, because both Part I and Part II seem to relate well to grade-point averages at both stages of medical training. This finding may suggest that, while personality may influence grading in the clinical years, it may do so only after it is ascertained that the student has some basic knowledge or skill important to doing well on objective tests of medical knowledge.

The fourth and final hypothesis is unqualifiedly accepted, because the CPI variable, Wb, was the only predictor in the study found predictive of grades in the clinical years. In these years, then, at least one aspect of personality seems important.

Perhaps it is advisable at this point to take cognizance of the unexpectedly high correlations which the MCAT has with the grade-point averages in the academic years. Cronbach (1960), in discussing the Moss Aptitude Test (a forerunner of the MCAT), noted that this test showed initially good results when used to predict grades. However, after it had been employed for some time in the selection of students, the correlations began to drop. This led to the discarding of this test. When the test was no longer used to select students, the correlations were again found to rise in value. It would seem possible that the same principle might be in operation at some medical schools that are now relying heavily on the

MCAT; researchers (e.g., Gough & Hall, 1963), studying the effectiveness of the MCAT as a predictor in these settings, have cited similar drops in degree of association between the results obtained with this instrument and those reflected in differences in school achievement. Applying this logic in reverse, MCAT scores at UTMB may correlate well with first two year grade-point averages precisely because the MCAT is not so heavily weighted as a selection factor, or perhaps such low cutoffs are employed as to allow a large range of scores. Such an hypothesis is admittedly difficult to study, but certainly worthy of consideration.

Conclusions

From the present results, it would seem that a composite picture of the successful medical student at UTMB can be tentatively sketched. For success in his academic years, he should possess a great deal of scientific knowledge, and know how to use it. He should be confident of his own abilities and, perhaps more importantly, exude that confidence to others in a controlled manner implying, perhaps, a kind of scientific detachment. He should also be submissive to authority, and accepting of its dictates, without giving the impression of wishing to add his own ideas. He should, however, be adaptive to new demands, even if he disagrees with them. He should also be aggressive enough to appear enterprising. He should be able to look out for his own inter-

ests, and have a desire to do so, but in a realistic manner.

For the clinical years, he should maintain this impression, but perhaps in a more active manner, in order to appear to be a hard worker.

Goals for Future Research

Much room remains for additional research related to the type of study undertaken here. For instance, more consideration might be given to the students in medical training who drop out without failing. While the number of students in the current sample who left medical school was deemed too small for reliable and meaningful study, some informal study along this line was carried out. The results suggest that, as in other studies, there was a difference between those who left for academic reasons and those who simply withdrew. In addition, the subjects of this study included a subsample of students selected on the basis of performance in the first year for an accelerated program of study. While there was a very limited number of such students, a comparison of their scores on the variables in this study yielded a provocative finding: the "accelerated" group appeared to be much more like those who withdrew from the program of study than like those who successfully completed the full four year course. A more complete examination of such trends would seem in order.

Finally, while research in the area just studied has not yielded spectacular results thus far, it is ideally possible

that, granted sufficient knowledge, we may one day be able to predict not only the success of a particular applicant to medical school, but also the course of his career after he finishes medical school. Such goals do not seem too far beyond the realm of possibility. Some efforts along this line have already been made. For example, Schumacher (1963) asked a total of 1,649 individuals nearing the end of their internship to state their plans for future careers. These subjects had been administered the Allport-Vernon-Lindzey Study of Values, the Edwards Personal Preference Schedule and the Strong Vocational Interest Blank at the time that they had entered medical school. Combinations of 35 characteristics measured by these tests were predictive of several aspects of future career choice. For example, it was possible to distinguish between individuals interested in either whole or partial pursuit of academic careers and individuals planning to engage in full-time private practice. While those in different types of private practice could not be distinguished, some individuals planning academic affiliations could be distinguished by interest areas, for example, psychiatry from surgery or medicine.

More knowledge in such areas could have tremendous importance at the time of admission to medical school. It would theoretically be possible, through judicious selection of medical students (assuming only enough applicants for selectivity), to control the proportion of students who would eventually

enter particular specialities. Although at present, shortages of applicants in all areas do not make such knowledge really necessary, circumstances may someday be quite different, and the ability to make such predictions may be vital.

CHAPTER VI

SUMMARY

It was the purpose of this study to investigate the assumption that personality descriptions as measured by an objective personality test, the California Psychological Inventory (CPI) would be efficacious in predicting performance in medical school when differential criteria, such as performance during the academic and clinical years of medical school, and scores obtained on a relatively objective achievement test, as exemplified by the National Board examinations in medicine, were used. In addition, a comparison was made between the predictive powers of this nonintellectual test and a more traditional measure of intellectual ability, the Medical College Admissions Tests (MCAT).

The subjects for this study were those individuals enrolled in the medical school at the University of Texas Medical Branch in Galveston in the academic years 1958-59 and 1959-60. The total number of students thus enrolled was 196. Of this number, 162 completed their medical training, and constituted the final sample.

With multiple correlation techniques, it was possible to develop five multiple regression equations predictive of performance in medical school. It was also concluded that the best single predictor of grade-point average in the first two, or academic, years in medical school was the Science Achievement

section of the MCAT. Only one factor, the sense of well-being scale of the CPI, was found predictive of performance during the clinical years. The MCAT was also found to be finally predictive of performance on the National Board examinations, while the CPI was less successful in this respect.

It was possible to use the results of the present study to picture the ideal medical student as a person with scientific knowledge and skill who is confident of his own abilities, but who is properly submissive to authority, while giving the impression of being an enterprising, hard worker.

References

- Association of American Medical Colleges. Application activity and MCAT data of applicants to the class of 1962-63. J. med. Educ., 1963, 38, 774-778. (Datagrams)
- Bott, E. A. The predictive value of college marks in medical subjects. J. educ. Research, 1925, 12, 214-227.
- Brosin, H. W. Psychiatry experiments with selection. Soc. Serv. Rev., 1948, 22, 461-468.
- Buehler, J. A. & Trainer, J. B. Prediction of medical school performance and its relationship to achievement. J. med. Educ., 1962, 37, 10-18.
- Coker, R. E., Greenberg, B. G. & Kosa, J. Authoritarianism and Machiavellianism among medical students. J. med. Educ., 1965, 40, 1074-1084.
- Conger, J. J. & Fitz, R. H. Prediction of success in medical school. J. med. Educ., 1963, 38, 943-948.
- Cowles, J. T. and Hubbard, J. P. Validity and reliability of the new objective tests. J. med. Educ., 1954, 29, 30-34.
- Cronback, L. J. Essentials of psychological testing. New York: Harper & Row, 1960. (Second edition).
- Dubois, P. H. Review of the MCAT. In Buros, O. K. (Ed.), The sixth mental measurements yearbook. Highland Park, N. J.: Gryphon Press, 1965, pp. 1347-1348.
- Ebel, R. L. Review of the MCAT. In Buros, O. K. (Ed.), The sixth mental measurements yearbook, Highland Park, N. J.: Gryphon Press, 1965, pp. 1344-1347.
- Eron, L. D. Use of the Rorschach Method in medical student selection. J. med. Educ., 1954, 29, 35-39.
- Faterson, Hanna. The Figure Drawing Test as an adjunct in the selection of medical students. J. med. Educ., 1956, 31, 323-327.
- Frankel, B. & Motto, J. A. The role of structure in the academic performance of medical students. J. med. Educ., 1963, 38, 164-168.
- Funkenstein, D. H. Possible contributions of psychological testing of the nonintellectual characteristics of applicants to medical school. J. med. Educ., 1957, 32, 88-112.

- Funkenstein, D. H. Failure to graduate from medical school. J. med. Educ., 1962, 37, 588-603.
- Funkenstein, D. H. Current problems in the Verbal and Quantitative Ability subtests of the Medical College Admission Test. J. med. Educ., 1965, 40, 1031-1048.
- Funkenstein, D. H. Current changes in education affecting medical school admissions and curriculum planning. J. med. Educ., 1966a, 41, 401-423.
- Funkenstein, D. H. Testing the scientific achievement and ability of applicants to medical school: The problem and a proposal. J. med. Educ., 1966b, 41, 120-134.
- Garfield, S. L., and Wolpin, M. MCAT scores and continuation in medical school. J. med. Educ., 1961, 36, 888-891.
- Glaser, R. Predicting achievement in medical school. J. appl. Psychol., 1951, 35, 272-274.
- Goldstein, R. H. & Salzman, L. F. Correlates of clinical judgment in psychiatry. J. med. Educ., 1962, 37, 1101-1104.
- Gottheil, E. & Michael, C. M. Predictor variables employed in research on the selection of medical students. J. med. Educ., 1957, 32, 131-147.
- Gough, H. G. Manual for the California Psychological Inventory. Palo Alto, California; Consulting Psychologists Press, 1957.
- Gough, H. G. & Hall, W. B. Prediction of performance in medical school from the California Psychological Inventory. J. appl. Psychol., 1964, 48, 218-226.
- Gough, H. G., Hall, W. B. & Harris, R. E. Admissions procedures as forecasters of performance in medical training. J. med. Educ., 1963, 38, 983-998.
- Harrower-Erickson, M. R. The Rorschach Test. J. Ass. Amer. med. coll., 1944, 19, 193-201.
- Hill, J. K. & Heck, Arlene. Variations in college grading standards and performance in medical school. J. med. Educ., 1960, 35, 993-998.
- Hoffman, E. L., Wing, Jr., C. W., & Lief, H. I. Short and long-term predictions about medical students. J. med. Educ., 1963, 38, 852-857.

- Holland, J. L. The prediction of college grades from the California Psychological Inventory & the Scholastic Aptitude Test. J. educ. Psychol., 1959, 50, 135-142.
- Holt, R. R. & Luborsky, L. Personality patterns of psychiatrists. New York: Basic Books, 1958.
- Hunka, S., Gilbert, J. A. L., & Cameron, D. F. The prediction of success in medical school. J. med. Educ., 1966, 41, 368-376.
- Hutchins, E. C., and Gee, H. H. The study of applicants. 1959-60. J. med. Educ., 36, 1961, p. 289.
- Ingersoll, R. W. & Graves, G. O. Predictability of success in the first year of medical school. J. med. Educ., 1965, 40, 351-363.
- Johnson, D. G. An "actuarial" approach to medical student selection. J. med. Educ., 1960, 35, 158-163.
- Johnson, D. G. A multifactor method of evaluating medical school applicants. J. med. Educ., 1962, 37, 656-665.
- Johnson, D. G. The study of applicants, 1964-65. J. med. Educ., 1965, 40, 1017-1030.
- Knehr, C. A. & Kohl, R. N. MMPI screening of entering medical students. J. Psychol., 1959, 47, 297-304.
- Kole, D. M., & Matarazzo, J. D. Intellectual and personality characteristics of two classes of medical students. J. med. Educ., 1965, 40, 1130-1144.
- Lief, H. I.; Young, Kathleen; Spruiell, V.; Lancaster, R.; and Lief, V. F. A psychodynamic study of medical students and their adaptational problems: Preliminary report. J. med. Educ., 1960, 35, 696-704.
- Miller, G. E. Research emphasis and the evaluation of learning. J. med. Educ., 1962, 37, 82-86.
- Moore, R. A. The use of objective tests in the selection of medical students. J. med. Educ., 1962, 37, 453-462.
- Sanazaro, P. J. & Hutchins, E. B. The origin and rationale of the Medical College Admission Test. J. med. Educ., 1963, 38, 1044-1050.
- Schlageter, C. W. & Rosenthal, V. What are "normal" medical students like? J. med. Educ., 1962, 37, 19-27.

- Schofield, W. A study of med. students with the MMPI: III, Personality and academic success. J. appl. Psychol., 1953, 37, 47-52.
- Schofield, W. The use of objective personality tests in selection of medical students. J. med. Educ., 1957, 32, 112-119.
- Schumacher, C. F. Interest and personality factors as related to choice of medical career. J. med. Educ., 1963, 38, 932-942.
- Schwartzman, A. E., Hunter, R. C. A. & Lohrenz, J. G. Factors related to medical school achievement. J. med. Educ., 1962a, 37, 749-759.
- Schwartzman, A. E., Hunter, R. C. A., & Lohrenz, J. G. Factors related to student withdrawals from medical schools. J. med. Educ., 1962b, 37, 1114-1120.
- Schwartzman, A. E., Hunter, R. C. A. & Prince, R. H. Intellectual factors and academic performance in medical undergraduates. J. med. Educ., 1961, 36, 353-358.
- Shoemaker, H. A. & Rohrer, J. H. Relationship between success in the study of medicine and certain psychological and personal data. J. Assoc. Am. med. Coll., 1948, 23, 190-201.
- Strother, C. R. The use of projective tests in the assessment of medical school applicants. J. med. Educ., 1957, 32, 120-127.
- Stuit, D. B. Prediction of scholastic success in a college of medicine. Educ. psychol. Measmt., 1941, I, 77-84.
- Waggoner, R. W. & Ziegler, T. W. Psychiatric factors in medical students who fail. Amer. J. Psychiat., 1946, 103, 369-376.
- Walker, H. M. and Lev, J. Statistical Inference. New York: Henry Holt, 1953, pp. 315-347.
- Wantman, M. J. Review of Medical College Admission Test. In Buros, O. K. (Ed.), Fourth mental measurements yearbook. Highland Park, N. J.: Gryphon Press, 1953, pp. 816-819.
- Watson, R. I. Predicting academic success through achievement and aptitude tests. J. med. Educ., 1955, 30, 383-90.

- Wesman, A. G. Review of Medical College Admissions Test. In Buros, O. K. (Ed.), Fifth mental measurements yearbook. Highland Parks, N. J.: Gryphon Press, 1959, pp. 936-938.
- Wispe, L. G. Evaluating selection teaching methods in the introductory course. J. educ. Res., 1951, 45, 161.