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A Bootstrapped Regression Model of Psychological Predictors of Success in Naturopathic Medical School

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The abstract and thesis of Christa Claire Louise for the Master of Science in Psychology were presented February 25, 1994, and accepted by the thesis committee and the department.

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An abstract of the thesis of Christa Claire Louise for the Master of Science in Psychology presented February 25, 1994.

Title: A Bootstrapped Regression Model of Psychosocial Predictors of Success in Naturopathic Medical School

In response to a need for more primary care physicians and patients' growing attraction to alternative health care, greater numbers of individuals are applying to naturopathic colleges. With increasing numbers of applicants, better methods of predicting potential effectiveness as an N.D. are needed. This study examined factors (both academic and psychosocial) that best predict success in naturopathic school.

Demographic, academic, and psychosocial survey data were collected from thirty-three students who had just completed their second year of naturopathic medical school. This information was correlated with scores on the NPLEX Basic Science exams which were taken the following summer.

Because of the small sample size, a bootstrap resampling technique was used to produce estimates for a hierarchical regression. Demographic variables (sex, age, whether or not English was the first language) and undergraduate major, explained almost 10% of the variance in Basic Science Exams (BSE) scores; however, none of these variables were significant predictors in the first step of the regression. As predicted, the addition of undergraduate grade point

average (GPA) significantly increased the amount of variance accounted for (to 39.9%) in BSE scores. Also as predicted, adding the psychosocial variables to the model increased the amount of variance accounted for to 52%. This addition also made sex a significant predictor, but external locus of control was the only psychosocial variable which was significant in any of the models. The best model contained the psychosocial variables of both internal and external locus of control but not commitment and accounted for 51% of the variance in BSE scores. Sex, undergraduate GPA, and external locus of control were significant predictors. Results are consistent with previous research using data on students from allopathic medical schools.

However, complex relationships exist among the psychosocial variables and between the psychosocial variables and gender. The suppression effect of the psychosocial variables with gender, multicolinearity between the commitment and locus of control variables, and suppression due to common method variance between the internal and external locus of control variables are discussed.

Limitations of bootstrap methodology are considered.

A BOOTSTRAPPED REGRESSION MODEL OF PSYCHOSOCIAL PREDICTORS OF SUCCESS IN NATUROPATHIC MEDICAL SCHOOL

by

CHRISTA CLAIRE LOUISE

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INTRODUCTION

Fewer medical students are choosing to enter the field as primary care medical doctors (M.D.s) (Petersdorf, 1993). This decrease in the number of generalist "allopathic" (against disease) physicians means higher patient loads for the individual general practice physician and less time spent with each patient.

In increasing numbers, Americans are seeking alternatives to traditional allopathic care (Eisenberg et al, 1993). Possible reasons for this include the desire for individualized care and more effective treatment of chronic problems that have not been satisfactorily addressed by medical doctors.

These two factors present a unique opportunity for naturopathic physicians (N.D.s) who offer primary care and alternative forms of treatment. Although N.D.s are trained as classical (medical) diagnosticians, the practice of naturopathic medicine emerges from a foundation of underlying principles encompassing treatment of the whole person, treatment of causes rather than suppression of symptoms, and prevention. Naturopathic treatment modalities include therapeutic use of diet and exercise, physiotherapy (manipulation, massage, etc.), use of botanical medicines, and attention to psychosocial factors. Naturopathic medicine offers many possible ways to treat each cause, being attentive to the patient's unique responses, and focusing on gentle healing methods to aid a person's own self-regulating processes (Germain, 1990).

Because of the growing trend to use alternative health care and the potential role of naturopathic physicians in this system, a better understanding of the factors that lead to success in naturopathic medical school is needed. This study focuses on students in naturopathic medical colleges where holistic care, prevention, and the psychosocial etiology of symptoms are emphasized. This emphasis implies that certain personal characteristics will be especially important determinants of effectiveness in the N.D. population. However, the two types of practice (N.D. and M.D.) require many of the same qualities and so some of the results of the study may be generalizable to the allopathic population.

This study, representing the first phase of a two-phase research project, examines two psychosocial characteristics (commitment and locus of control) as predictors of students' success in naturopathic medical school. Phase I focuses on the first two years of naturopathic medical school and uses scores from the NPLEX Basic Science exams as the measure of academic success. As successful completion of training and eligibility for licensure are only part of what determines physician effectiveness, Phase II of the research will examine other personal characteristics (empathy, orientation to patient's psychological problems, and self-monitoring) to determine their relation to potential clinical effectiveness of the physician.

DESCRIPTION OF THE PROBLEM

CURRENT STATUS OF ALLOPATHIC MEDICINE

Health care expenditures in the United States exceeded $650 billion in 1990 and are projected to reach $1 trillion by 1995. A large proportion of the population has inadequate access to health care and 37 million Americans are uninsured (Council on Graduate Medical Education [COGME], 1992). These factors, coupled with the limited success in preventing and treating chronic health problems, contribute to the perception that health care reform is a pressing need.

One indicator of the need for change is the surprising statistic that in 1992, less than 15% of the medical school graduates were contemplating careers in general medicine. This is a decrease from 36% in 1982 (Petersdorf, 1993). Greater numbers of graduating medical students are opting for careers in high-prestige, high-technology specialties. In the October 1992 report of the Council on Graduate Medical Education, the number one finding was that the U.S. has too few generalists and too many specialists (COGME, 1992).

The overabundance of specialists means higher costs of care, for example, when the patient sees a specialist for a problem that a generalist would be able to treat. It also means that generalist physicians have high patient loads and consequently, less time available for each patient.

The statistic that about one M.D. in five is sued each year in the U.S. (Bergner, 1991) is another indicator of the need for reform. High rates of malpractice claims in the medical professions are caused, in part, by the fact that patients are more likely to sue physicians with whom they have little personal relationship. Not only must M.D.s charge higher fees in order to pay costly malpractice insurance fees, but there are further implications for costs as physicians order expensive, high-tech tests in order to protect themselves in the event of a lawsuit.

TREND TOWARD ALTERNATIVE MEDICAL CARE

In a 1990 national survey (Eisenberg et al., 1993), 34% of respondents reported using at least one alternative form of therapy (for example, osseous manipulation, massage, herbal medicine, lifestyle diets, homeopathy, etc.) in the previous year. Eisenberg et al. extrapolated to the U.S. population and estimated that Americans made 425 million visits to providers of unconventional therapy in 1990, exceeding the number of visits to all U.S. *primary care* physicians (388 million).

In light of the fact that insurance usually does not pay for visits to alternative practitioners, there must be compelling reasons for the prevalence of these visits. Patients appear to be seeking lower-tech options, individualized care, freedom from side effects, and alternative care for chronic and acute problems that conventional medical science has not been able to satisfactorily treat.

The National Institutes of Health (NIH) has established an Office of Alternative Medicine (OAM) and disbursed its first grants for small scale studies designed to obtain preliminary data relevant to the evaluation of alternative medicine (National Institutes of Health [NIH], 1993). Clearly, alternative care is beginning to play a major role in American society.

EMERGENCE OF NATUROPATHIC MEDICINE

Within this context, the field of naturopathic medicine is gaining in recognition. A naturopathic physician (N.D.) is a primary care medical provider trained and licensed to provide holistic, preventive, lifestyle-oriented care in a general practice setting. The N.D. uses a conventional medical diagnostic framework (patient history, physical exam, laboratory tests and diagnostic imaging), but also explores contributing factors in the patient's lifestyle, habits, and attitudes. Treatment modalities include dietary approaches to prevention and treatment of chronic degenerative disease, use of medicinal plants, physical medicine (including exercise therapy, physiotherapy, and ultrasound), homeopathy, behavioral medicine, and oriental medicine (including acupuncture) (Bergner, 1991). Fewer than one percent of N.D.s have been sued for malpractice, and complaints of injury or misdiagnosis are rare (Bergner & Kail, 1992).

Naturopathic physicians are qualified to meet the need for more primary care physicians. An N.D.'s education in basic medical sciences is equivalent to

that of an M.D. in terms of scope of biological and biomedical science education, length of training, and passage of comprehensive board exams. As in an M.D. program, the N.D. usually completes a conventional pre-med undergraduate program, followed by four or five years of graduate level classroom and clinical training at an accredited school. Graduates of the schools must pass 7-14 comprehensive board exams in order to be licensed to practice in one of the eight states or three provinces that currently regulate the profession.

As more patients are turning to naturopathic medicine, greater numbers of students are moving toward a career in the field. Two schools in the United States (in Portland, Oregon and Seattle, Washington) and one school in Canada (Toronto, Ontario) are currently accredited to provide naturopathic training. Because of the rapidly increasing numbers of potential students, a new school opened in Arizona in 1993.

With growing numbers of applicants, the schools need increasingly discriminating criteria for selection. This study takes a step in the direction of identifying those factors which will be most predictive of the applicants' academic success. Because of the large monetary investment (the student attending naturopathic school will incur a debt comparable to that of a medical student in a traditional program), reducing the rate of drop out due to factors which might have been foreseen is an important potential outcome of this research.

A survey of the admissions procedures at two naturopathic colleges has shown that applicants' psychosocial characteristics are considered important

criteria for admission (A. Hovland, personal communication, March 1993, and S. Campbell, personal communication, April 1993). Although applicants must meet minimal qualifications for undergraduate grade point average and course requirements, the personal interview often determines admission status. These personal interviews assess factors such as motivation, communication skills, adaptability, maturity, ability to handle stress, ability to deal with criticism, and the ability to synthesize concepts and make a decision. While the existing process appears to meet criteria for validity, a standardized, quantitative assessment may be of value.

EXISTING LITERATURE

The following literature review consists primarily of research that has been done in the allopathic medical field. While there are differences between the types of training received in naturopathic and allopathic medical schools, and between the types of people who choose to become N.D.s and M.D.s, the literature pertaining to M.D.s can provide valuable information and research models on which to build research in the naturopathic field. This review focuses on research exploring variables that may predict the success of students in medical school.

ACADEMIC PREDICTORS

Prior to 1985, level of success in medical school was most often defined by scores on the National Board Medical Exams (NBME), with grade point average (GPA) and Medical College Admissions Tests (MCAT) used to predict NBME scores. Most studies investigating only academic predictors of performance in medical school find low positive correlations between undergraduate GPA and performance on the NBME (Sarnacki, 1982). In a canonical correlation between scores on the MCAT and scores on the NBMEI (NBME part I - basic science exams) and NBMEII (NBME part II - clinical exams), less than 15% of the variance of the NBME scores was accounted for by MCAT scores (Hojat,

Veloski, & Zeleznik, 1985). Donnelly and his colleagues (1986) found that the most valuable predictors of scores on the NBMEI were the MCAT score and the student's score on his or her first semester anatomy examination although these correlations were still low. Hojat et al. (1985) found that the MCAT scores were most highly correlated with scores on the NBMEI behavioral science exams.

One conclusion that may be drawn from these studies is that academic variables have limited predictive power in terms of estimating scores on board exams. Because the MCATs are not required for entrance to any of the naturopathic colleges, undergraduate GPA was the academic variable used in this study to predict BSE scores.

PSYCHOSOCIAL PREDICTORS

In the 1980's, researchers began to take a broader view of influencing factors (over and above academic measures), and of "success" (over and above scores on the NBME). Hojat, Borenstein, and Veloski (1988) correlated academic and psychosocial *ratings* of first-year medical residents with scores on the NBMEIII (NBME part III - clinical application) and offers of further residency training. While the academic factor was a significant predictor of the graduate's performance on the NBMEIII, the psychosocial factors in their study (locus of control, sociability, anxiety, and a number of other variables) were better predictors of offers of further residency training. One conclusion that may be drawn from this result is that despite the emphasis placed on the academic

dimensions of clinical competence, the psychosocial predictors may be just as valuable in predicting overall clinical competence.

Hojat, Vogel, Zeleznik, and Borenstein (1988) speculated that certain psychosocial measures might be differentially predictive of scores on the NBMEI and on the NBMEII. The psychosocial variables they explored were stressful life events, general anxiety, test anxiety, emotionality, external locus of control, intensity and chronicity of loneliness, sociability, self-esteem, perception of early parental relationships, and over/under-confidence. Using a hierarchical regression analysis they found that when academic measures (undergraduate science and non-science GPA, and MCAT scores) were used alone as predictors of NBMEI scores, the amount of variance accounted for 32%. When psychosocial measures alone were used, this amoung was 36%, and when both academic and psychosocial measures were used, it was 56%.

McGaghie (1990) suggested that personal variables such as character, integrity, leadership, work habits and motivation to study, service orientation, personality and attitude, altruism, and personal effectiveness are potentially predictive of success as an M.D. He concluded that systematic and cumulative research on the use of qualitative variables in medical school admissions should be pursued. This suggests a shift in emphasis from academic predictors to a mix of academic and psychosocial factors in accounting for variance in clinical competence.

The first phase of this research explored some of the psychosocial dimensions that are particularly relevant to the task of completing the scientifically rigorous first two years of naturopathic medical school. Two psychosocial variables (commitment and locus of control) were examined in relation to the NPLEX Basic Science exam scores. The first two years of naturopathic school consist mainly of in-the-classroom, rote learning, while the latter half of the program focuses heavily on clinical application of knowledge. As a result of these different emphases of the training process, the variables that best predict success in the first, primarily academic, years will be different from those that best predict clinical competency (Zeleznik, Hojat, & Veloski, 1983). Phase II of the research will address the effects of other psychosocial variables that are particularly relevant to clinical effectiveness.

Three classes of variables were included in this study. Four demographic variables, an academic variable, and two psychosocial variables were used to predict success during the first two years of naturopathic medical school. The psychosocial variables are discussed in detail in the following section.

PSYCHOSOCIAL CONSTRUCTS

SELECTION OF CONSTRUCTS

The constructs of commitment and locus of control were chosen because of their intuitive relevance to the successful completion of the scientifically rigorous first two years of naturopathic medical school.

Commitment

For the purposes of this study, commitment refers to an intention to accomplish an action. The degree of commitment signifies the strength of that intention and the assumption is that the stronger the intention - that is, commitment - the higher the likelihood of success, both in terms of completing the action, and of how successful the individual will be in quantitative terms.

Commitment may be viewed in terms of its object (eg. career commitment, goal commitment) or in terms of its antecedents (eg. investments, alternatives, rewards). Career commitment is characterized by the development of personal career goals, the attachment to, identification with, and investment in those goals . It is distinct from job commitment (commitment to a short-term set of tasks), and from organizational commitment (commitment to an institution and to institutional goals) (Colarelli, & Bishop, 1990).

Having a difficult goal, such as that of successfully completing naturopathic school, leads to higher performance only when there is goal commitment (Hollenbeck, Klein, O'Leary, & Wright, 1989). This facet of commitment addresses a *challenge* aspect. An examination of the antecedents of commitment to difficult goals led Hollenbeck, Williams, and Klein (1989) to conclude that commitment to difficult goals was higher when goals were made public, when locus of control was internal, and when subjects were high in need for achievement.

Oliver (1990) found that of three model parameters (investments, alternatives, and rewards), investments showed the most consistent and often the strongest relationships with commitment indices. Although he noted that both rewards and alternatives correlated significantly with about half of his commitment indices, he concluded that, at least from an organizational commitment perspective, the three- parameter model was not supported.

The literature review did not reveal a consolidated measure of commitment that appeared to be particularly appropriate to measure commitment to naturopathic medical school. One of the scales discussed above may have been a good predictor, however, no single measure had suitable face validity. Several scales were combined and used as a measure of commitment.

Locus of Control

Locus of control (LOC) refers to the individual's tendency to attribute success or failure to internal (personal) factors or to external (environmental or

circumstantial) factors. The LOC concept was first developed by Rotter (1966). People are considered to be internal if they perceive events to be contingent on their own behavior, and considered to be external if events are seen to be contingent upon luck, fate, the control of powerful others, the environment, or some factor not under personal control (Marsh & Richards, 1987). Locus of control has been one of the most widely studied personality constructs, in part because of its wide range of generalizability.

Lefcourt (1981) suggested that global measures of LOC afford only weak predictive power to the assumed criteria. He reasoned that the more specific the measure, the greater the power of that measure in predicting the relevant criteria. Further work on the construct has tended to follow Lefcourt's theory and specify the content and purpose of developed measures. Using the Academic Locus of Control (ALC) scale, Trice, Ogden, Stevens, and Booth (1987) found that internal LOC students participated to a greater extent in class than did external students. They also found that students in the most external quartile reported significantly less study time per week than did those students who were described as being internal. And finally, they concluded that effort, to a greater degree than performance, is indexed by the ALC scale.

Lefcourt, von Baeyer, Ware, and Cox (1979) developed two scales relevant to students in an academic setting. These scales, comprising the Multidimensional-Multiattributional Causality Scale (MMCS), were designed to assess the locus of control for achievement and affiliation, and are constructed

from items representing each element of Weiner's (1971) locus and stability of causal attribution model. The four subscales of the MMCS are Ability (stable-internal), Effort (variable-internal), Context/Situation (stable-external), and Luck (variable-external) (Powers & Rossman, 1983). LOC for achievement is, on the face of it, a concept relevant to medical students trying to complete their education, and the Lefcourt MMCS for Achievement Scale was used in this study as a predictor of BSE scores.

APPLICATION OF PSYCHOSOCIAL VARIABLES

During the first two years of medical school study focus is on basic sciences. This requires academic skills that stress rote memorization and intensive acquisition of technical basics. These tasks require a high level of commitment because without commitment to the long-term goal of becoming an N.D., the tendency would be to drop out of school when difficulties are encountered.

Because the subject matter is difficult and presents a significant challenge to most students, a great deal of effort and discipline are required. This implies taking responsibility for the outcomes that result. In terms of locus of control, students who believe their accomplishments are a result of their own efforts (i.e., they exhibit an internal LOC) will tend to assume the responsibility and put greater effort into their undertakings.

INTERRELATIONS BETWEEN CONSTRUCTS

The interrelations between the two psychosocial constructs chosen for this study provide important information in terms of the theory and conceptual framework. Previous research suggests ways in which the variables might be related to each other and whether or not they tap independent dimensions. In addition, relationships between the psychosocial predictors and the demographic characteristics must be considered.

Commitment and Locus of Control

Colarelli and Bishop (1990) found a significant relationship between career commitment and locus of control ($r=.63$, $p<.01$). Hollenbeck et al. (1989), found a statistically significant correlation between their measure of goal commitment and locus of control. Neumann, Finaly, and Reichel (1988) found significant correlations between commitment to college and locus of control. In all of these studies, level of commitment was positively correlated with an increasingly internal locus of control.

In line with the Trice et al. (1987) conclusion, Lefcourt et al. (1979) suggest that "beliefs regarding the efficacy of effort are the most important factors for predicting involvement in the pursuit of given goals" (p. 301). These studies suggest that the constructs of Commitment and Locus of Control are possibly not distinct dimensions.

Locus of Control and Age/GPA/Gender

Hollenbeck et al. (1989) found a nonsignificant relationship between age and their measure of goal commitment. Similarly, Colarelli and Bishop (1990) found that although age was positively correlated with degree of career commitment for their overall sample, when the professional subsample (85 chemists) was examined, this relationship was not significant.

Bishop and Solomon (1989) examined the relationship between age, gender, and locus of control. For younger men and women, no differences were found. However, they did note that older men exhibited a more internal locus of control while older women exhibited a more external locus of control. Because the variability in ages of participants in this study was not large, an effect for age was not anticipated. Murk and Addleman (1992) noted that none of their demographic variables (including current GPA, sex, year in school) was significantly correlated with the I-E Locus of Control Scale scores.

Neumann et al. (1988) detected only a moderate relationship between locus of control and grades, but found a statistically significant correlation between locus of control and the students' overall assessment of their academic progress (satisfaction with performance, effective use of skills, and overall learning), with internally-oriented students reporting more positive self-assessments.

Using the Lefcourt et al. (1979) MMCS locus of control measure, Kanoy, Wester, and Latta (1989) found that high school GPA was a useful predictor of

college GPA *only* for the higher-performing group, and that the locus of control scores were an important predictor only for low performers. They concluded that effort was an important factor in the student's ability to compensate for low academic abilities and concluded that a crucial predictor of college GPA is an internal orientation toward achievement success (as measured by the MMCS).

These findings point to the possibility that undergraduate GPA may not be uniformly predictive of success in naturopathic medical school. The effect of GPA on BSE scores may not be independent of age, sex, and the psychosocial constructs.

RESEARCH GOALS AND HYPOTHESES

Human ability is extremely complex and multidimensional. Therefore it is not surprising that one cannot adequately predict something as complex as success in naturopathic medical school using only one predictor such as GPA. In addition to an academic variable (undergraduate GPA), two psychosocial variables (career commitment and academic locus of control) were examined as predictors of naturopathic students' scores on the Basic Science Exams (BSE). Four demographic variables (age, sex, whether or not English was the first language, and undergraduate major), were also included as control variables.

The general hypothesis of this study was that the psychosocial variables would significantly increase, over academic predictors, the amount of variance accounted for in an individual's success in the first two years of naturopathic medical school as measured by scores on five NPLEX Basic Science Exams. Three specific hypotheses were tested:

1. GPA will be the strongest predictor of performance of the BSE.
2. Commitment will account for a significant amount of variance in BSE scores after removing the variance accounted for by GPA and demographic variables, with higher commitment levels associated with higher levels of performance on the BSE.

3. Locus of control (LOC) will account for a significant amount of variance in BSE scores after removing the variance accounted for by GPA and demographic variables, with the more internally-oriented students receiving higher scores on the BSE.

METHOD

PROCEDURE

Representatives at three naturopathic colleges explained the purposes of the study to potential participants and handed out packets containing a brief explanatory letter, a consent form, a questionnaire, and a self-addressed stamped return envelope (see Appendices A-C). As suggested by Silva and Sorrell (1988), potential participants were allowed to read the consent forms and complete the questionnaires at their leisure. Return of the materials in two weeks was requested but actual time between distribution of the questionnaires and receipt of the last questionnaire was five months.

PARTICIPANTS

In May and June 1993, 95 students in their second year at any one of the three naturopathic colleges who were eligible to take the NPLEX Basic Science Exams were asked to participate (87 actually took the BSE in the summer). By June 15, only 20 questionnaires had been returned. Follow-up over the next four months produced an additional 18 surveys, but five of these had to be eliminated due to lack of a signed consent form or incomplete Basic Science scores (the dependent variable). The remaining 33 participants represented 38% of the potential respondent pool.

INSTRUMENTS

Data for the independent variables came from a 57-item Student Questionnaire (Appendix C) which measured age, sex, whether or not English was the first language, undergraduate major, undergraduate GPA, commitment, internal locus of control and external locus of control. Data for the dependent variable came from Basic Science Exam scores which were collected from NPLEX records.

Student Questionnaire

Basic demographic and academic data (age, sex, whether or not English is the first language, undergraduate major, undergraduate GPA) was requested. The remaining questions used 6-point Likert scales to tap the general constructs of commitment and academic locus of control. TABLE I summarizes the psychosocial variables and their respective items.

TABLE I

MEASUREMENT OF PSYCHOSOCIAL VARIABLES

VARIABLE	SUBSCALE	ITEM #s	SCORING
COMMIT	Career	1-17	Mean score on items
	Goal	18,19,20,21	Mean score on items
	Investment	22,23,24,25,26,27	Mean score on items
	Alternatives	28,29,30	Mean score on items
	Rewards	31,32,33	Mean score on items
LOCINT	Ability	35,39,43,47,51,55	Mean score on items
	Effort	38,42,46,50,54	Mean score on items
LOCEXT	Situation	36,40,44,48,52,56	Mean score on items
	Luck	37,41,45,49,53,57	Mean score on items

Commitment. The first 33 questions measured the student's commitment to the process of becoming a naturopathic physician and are identified in Appendix C by (CO + or -). Both the object of commitment (career, goal) and antecedents of commitment (investments, alternatives, rewards) were surveyed.

Questions 1-17 were a modified version of Colarelli & Bishop's (1990) scale of career commitment based on the Porter, Steers, Mowday, and Boulian (1974) organizational commitment scale. Colarelli & Bishop changed the focus of the Porter et al. scale from organizational commitment to career commitment and added three additional items. The resulting career commitment scale showed internal consistency of .94, and the authors reported that it exhibited good convergent and moderate discriminant validity (Colarelli & Bishop, 1990). For the present study, the items were further modified to reflect commitment to the process of becoming a naturopathic physician and commitment to the field of naturopathic medicine.

Questions 18-21 (CO GO -) measured goal commitment (Hollenbeck et al., 1989). The authors reported that the items exhibited a .71 internal consistency estimate of reliability. Good convergence with alternative measures of the same construct was demonstrated, and correlations between demographic and control variables were not significant, demonstrating good discriminant ability.

Questions 22-27 were derived from a 5-item scale by Pierce and Geyer (1991) and a 7-item scale developed by Oliver (1990). Because the items in the two scales had much overlap and needed to be reworded to fit the population

being studied, six items were developed from the original 12. These items addressed the investment aspect of the commitment construct. Estimates of internal consistency for the original scales from which these items were drawn were .63 (Pierce and Geyer, 1990), and .68 (Oliver, 1990). Oliver found broad support for the validity of his scales (including the alternatives and rewards scales discussed below), but Pierce and Geyer did not report validity evidence.

Questions 28-30 addressed the aspect of alternatives to the present situation and were based loosely on Oliver's questions regarding alternatives. These questions addressed the respondent's commitment to the present situation despite having considered alternative careers. Questions 31-33, based on Oliver's concept of reward, addressed the aspect of rewards relating to the chosen career path.

Locus of Control. Questions 34-57 (LOC AB/EFF/SIT/LUC + or -) of the Student Questionnaire assessed the student's academic locus of control and are from the Lefcourt et al. (1979) achievement scale of the Multidimensional-Multiattributional Causality Scale (MMCS). The estimate of internal consistency for this scale was .61 and the Spearman-Brown correlation was .77 (Lefcourt et al., 1979). The authors reported data supporting adequate convergent and discriminant validity.

Two 6-item subscales (ABILITY and EFFORT) measured internal locus of control, and two 6-item subscales (SITUATION and LUCK) measured external locus of control. Because the authors of the scale contended that internal and

external items are not necessarily correlated, a separate "internal" score and "external" score was calculated for each participant.

NPLEX Basic Science Exams

The NPLEX BSE series is a set of five 50-item criterion-referenced exams measuring competence in the basic sciences (anatomy, biochemistry, microbiology, pathology, and physiology). These exams are comparable to the National Board of Medical Examiners Part I (NBMEI) exam series and are usually taken at the end of the second year of medical school. Because the exams are criterion-referenced, a unique cutscore (passing score) is established for each form of the exam using the Angoff method. In order to be able to compare scores across administrations, students' raw scores are converted. The cutscore is given a value of 75, raw scores below the cutscore are converted to scores of 0-74 and scores above the cutscore are converted to scores of 76-100. These converted scores were used in the analysis.

DATA ANALYSIS PROCEDURE

To determine if the students who had completed the surveys were different from students who had not, Basic Science Exam scores from participants (N=33) versus non-participants (N=54) were examined (NPLEX, 1993). F tests for equality of variances between the two groups and t-tests for equality of means were performed. The two groups were not significantly different.

Variables that were worded in a negative direction were recoded. Undergraduate major was coded to two categories: science (1),and non-science (0). Missing data (12 of 2112 pieces) was recoded to the average value for that variable to maximize the number of cases available for analysis. Survey subscales were examined for reliability using Cronbach's alpha. All variables were standardized.

Although 38% is not a low response rate for a mail back questionnaire requiring 20-30 minutes of a respondent's time, the modest size of the population made the final sample size of only 33 too small to draw meaningful conclusions about the data when all variables were included in the analysis. With eight variables (sex, age, whether or not English was the first language, undergraduate major, undergraduate grade point average, commitment, locus of control-internal, and locus of control-external) sample size did not reach 10 subjects per variable as recommended for multiple regression. Therefore, bootstrap resampling was

used to compensate for some of the more obvious problems associated with small sample size.

In bootstrapping, repeated samples of the same size as the observed sample are drawn, with replacement, from the collected data. The statistical parameters of interest are calculated for each bootstrap sample and from these sets of parameters, the standard errors of the parameters are computed. These estimates replace the estimate of the standard error that would be obtained from the original data (Stine, 1990). The standard errors are used to produce confidence intervals for the parameters. Stine suggests that for standard error estimates, 100 is sufficient as the number of bootstrap samples. In this study, bootstrapping was used to estimate zero order correlations and regression parameters.

Bootstrapped regressions produce b's which may be interpreted as βs only if *standardized* variables are entered into the equation. These βs are the same as those that would result from a regression on the original data. However, the bootstrap produces confidence intervals around each regression coefficient which are assumed to contain the true value of the coefficient. SPSS (SPSS, 1990) produces a 95% confidence interval for a two-tailed test. In bootstrapping, the measures of fit are the amount of variance accounted for (R^2), whether or not the confidence interval around the regression coefficient contains 0, and the width of the confidence interval. A given β is considered "significant" if the confidence interval does not contain 0.

Using the CNLR (constrained nonlinear regression) command in SPSS (SPSS, 1990) with the model specified as MLR (multiple linear regression), the bootstrapping procedure created 100 samples of size 33 based on the original data, sampling with replacement. The regression parameters for each of the 100 samples and corresponding confidence intervals were calculated.

RESULTS

DESCRIPTIVE STATISTICS

Participants for this study were from three schools: 18 (of a possible 37) from Bastyr College in Washington, 10 (of 36) from National College in Oregon, and 5 (of 14) from the Canadian College in Ontario.

Of the 33 participants, 21 (64%) were female, and 12 (36%) were male. This composition closely matches that found in the population (67% and 33%). Seven respondents (21%) indicated that English was not their first language. Twenty-one (64%) students held undergraduate degrees in a pre-med, hard science, or a health-related field; the other 12 (36%) held undergraduate degrees in social science, language/communications, or business.

F-tests for equality of variance on BSE between participants (N=33) and non-participants (N=54) were not significant at the .05 level. T-tests for equality of means with unequal sample size were performed for each of the five exams. The Bonferoni rule was used to correct for the number of tests performed. None of the t-tests were significant at the .01 level. In terms of the dependent variables at least, students who chose to participate in the study were not significantly different from those who did not.

Descriptive statistics, including means and standard deviations for age, undergraduate grade point average, commitment, internal and external locus of

control, and the basic science average score are presented in TABLE II. Because sex appears to be a significant factor in the analysis, the descriptive statistics are also broken out according to sex of the respondent.

TABLE II

DESCRIPTIVE STATISTICS (Total Sample N=33)

VARIABLE	MEAN	STANDARD DEVIATION	MIN	MAX
AGE	29.30	6.62	22.00	46.00
UGRADGPA	3.30	0.35	2.60	4.00
COMMIT	5.30	0.49	3.53	6.00
LOCINT	4.07	0.78	1.83	5.58
LOCEXT	2.88	0.81	1.50	5.67
BSAVERAGE	83.12	6.05	72.00	92.60

(Males N=12)

VARIABLE	MEAN	STANDARD DEVIATION	MIN	MAX
AGE	27.92	6.69	22.00	46.00
UGRADGPA	3.19	0.26	2.90	3.60
COMMIT	5.22	0.61	3.53	5.88
LOCINT	3.96	0.73	2.00	4.83
LOCEXT	3.28	0.96	1.50	5.67
BSAVERAGE	87.75	5.69	73.00	91.80

(Females N=21)

VARIABLE	MEAN	STANDARD DEVIATION	MIN	MAX
AGE	30.14	6.61	22.00	45.00
UGRADGPA	3.36	0.38	2.60	4.00
COMMIT	5.39	0.41	4.65	6.00
LOCINT	4.13	0.82	1.83	5.58
LOCEXT	2.66	0.62	1.58	3.81
BSAVERAGE	82.18	6.18	72.00	92.60

Of particular note are the differential scores on the locus of control variables for males and females. While males had comparable mean scores on the locus of control internal and external measures (3.96 vs. 3.28), females had higher mean scores on internal locus of control measures (4.13) and lower mean scores on the external locus of control measures (2.66). Scores on the measure of commitment were comparable for males and females with little variability in scores.

RELIABILITY

Cronbach's alpha reliabilities for the five Basic Science exams were .75, .80, .67, .72, and .78. These are fairly typical reliability coefficients for 50-item criterion-referenced exams such as these and reflect the relative homogeneity of the population, i.e. there is limited variability in scores among students who have reached the point of taking the exams. Analysis of the combined five BSE scores resulted in a reliability coefficient of .85.

The psychosocial scales and subscales were also assessed for reliability with Cronbach's alpha. The 33-item Commitment Scale was a combination of five modified scales (conversion from five or 7-point Likert or True/False scales to 6-point Likert scales). Because of poor reliabilities, three subscales (Goal α=.11, Investments α=.53, and Rewards α=.10) were dropped. Three additional items were dropped from the Career subscale (Items 5, 9, and 12). The remaining items were combined into a single scale, measuring commitment to career and commitment over alternatives, with 17 items and a reliability of .81.

Locus of control was measured using the Lefcourt et. al MMCS Achievement scale (1979). Two 12-item Locus of Control Scales (for internal and external locus of control) were used intact. Reliability analysis resulted in .87 for Locus of Control-Internal, and .86 for Locus of Control-External. These reliabilities were higher than those reported by the authors of the scales.

RESULTS OF THE BOOTSTRAPPING PROCEDURE

The variables used in the bootstrapping were:

AGE	Age at beginning of naturopathic medical school;
SEX	Gender of the respondent;
EFL	Whether English was the first language;
UGRADMAJ	Undergraduate major (science or non-science);
UGRADGPA	Undergraduate grade point average;
COMMIT	Average of the scores from the 17 commitment items that were retained;
LOCINT	Average of 12 items assessing internal locus of control (ABILITY and EFFORT);
LOCEXT	Average of 12 items assessing external locus of control (SITUATION and LUCK); and
BSAVERAG	Average of the scores on the five Basic Science exams (dependent variable).

Zero order correlations for all eight standardized independent variables with BSAVERAG were bootstrapped (See TABLE III). Of the zero order correlations, only UGRADGPA was significantly correlated with BSAVERAG (r^2=.26).

TABLE III

BOOTSTRAP ZERO ORDER CORRELATIONS OF BSAVERAG WITH INDEPENDENT VARIABLES

			95% CONFIDENCE INTERVAL		
VARIABLE	r	STANDARD ERROR	LOWER	UPPER	r^2
SEX	-.20743	.17293	-.51642	.10156	.043
AGE	-.11673	.19203	-.49776	.26429	.014
EFL	.18919	.13997	-.08854	.46691	.036
UGRADMAJ	.04421	.19037	-.33352	.42196	.002
UGRADGPA	.50592	.12986	.24825	.76359*	.256
COMMIT	.19323	.21948	-.24227	.62873	.037
LOCINT	.26839	.19176	-.11210	.64889	.072
LOCEXT	-.22644	.19300	-.60941	.15652	.051

*Significant

Five regression models were estimated initially. Based on the results of these bootstrapped regressions, three additional models were estimated to clarify the relationship of the psychosocial variables to each other. A summary of the models and results is presented in TABLE IV. BSAVERAG (standardized Basic Science Exam (BSE) average score) was the dependent variable for all models.

TABLE IV

SUMMARY OF BOOTSTRAPPED REGRESSION MODELS

MODEL	VARIABLES IN THE MODEL	VARIANCE ACCOUNTED FOR	SIGNIFICANT VARIABLES
1	SEX AGE EFL UGRADMAJ	9.6%	
2	SEX AGE EFL UGRADMAJ UGRADGPA	39.9%	UGRADGPA
3	SEX AGE EFL UGRADMAJ UGRADGPA COMMIT	46.4%	UGRADGPA SEX
4	SEX AGE EFL UGRADMAJ UGRADGPA LOCINT LOCEXT	51.3%	UGRADGPA SEX LOCEXT
5	SEX AGE EFL UGRADMAJ UGRADGPA COMMIT LOCINT LOCEXT	52.2%	UGRADGPA SEX
6	SEX AGE EFL UGRADMAJ UGRADGPA LOCINT	43.5%	UGRADGPA SEX
7	SEX AGE EFL UGRADMAJ UGRADGPA LOCEXT	50.5%	UGRADGPA SEX
8	SEX AGE EFL UGRADMAJ UGRADGPA COMMIT LOCEXT	52.0%	UGRADGPA SEX

In the first step (Model 1)(TABLE V), demographic variables were entered as a block: SEX (0=male, 1=female), AGEI (age upon entering naturopathic medical school), EFL (whether English was the first language, 0=no, 1=yes,), and UGRADMAJ (undergraduate major, 0=non-science, 1=science). This model accounted for almost 10% of the variance in BSE scores. The confidence

intervals for the regression coefficients all contained zero; however, of the demographic variables, the EFL variable had the smallest interval and, in fact, the 90% confidence interval did not contain zero.

TABLE V

MODEL 1: BOOTSTRAP REGRESSION: DEMOGRAPHIC VARIABLES

VARIABLE	β	STANDARD ERROR	95% CONFIDENCE INTERVAL LOWER	UPPER	R^2
OVERALL					.096
SEX	-.20627	.16254	-.52879	.11624	
AGE	-.11157	.18927	-.52873	.26399	
EFL	.22282	.15466	-.08407	.52971	
UGRADMAJ	-.03279	.18063	-.39120	.32562	

Leaving the block of demographic variables in the model for purposes of control, UGRADGPA (undergraduate grade point average) was entered (Model 2). As predicted, higher average undergraduate GPAs were correlated with higher BSE scores. This model accounted for 39.9% of the variance in BSE average scores, an increase of 30.3% over that accounted for by the demographic variables. The confidence interval for the regression coefficient for GPA did not include zero. (See TABLE VI).

TABLE VI

MODEL 2: BOOTSTRAP REGRESSION: DEMOGRAPHIC VARIABLES AND GPA

VARIABLE	β	STANDARD ERROR	95% CONFIDENCE INTERVAL LOWER	95% CONFIDENCE INTERVAL UPPER	R^2
OVERALL					.3989
SEX	-.36837	.14893	-.66388	-.07288	
AGE	.04388	.14553	-.24488	.33265	
EFL	.16422	.13981	-.11319	.44164	
UGRADMAJ	-.04856	.17145	-.38876	.29165	
UGRADGPA	.59039	.11033	.37147	.80931*	

*Significant

In Model 3, COMMIT (combined score on Commitment to Career and Commitment/Alternatives) was added to the model which increased the amount of variance accounted for to 46%, (an increase of 6.1% over the variance accounted for by GPA with demographic variables left in for control). The regression coefficient for the commitment variable was not significant. However, adding COMMIT to the model made SEX significant (confidence interval -.66 to -.07), with males associated with higher average BSE scores than females.

COMMIT was removed and the two variables measuring locus of control (LOCINT - standardized score on internal [ABILITY and EFFORT] locus of control scale, and LOCEXT - standardized score on external [SITUATION and LUCK] locus of control scale) were entered (Model 4 in TABLE IV). This model accounted for 51% of the variance in BSE average scores. The increase in

the amount of variance accounted for over and above the model with just the demographic variables and GPA was 11%. The confidence intervals for three coefficients - SEX, UGRADGPA, and LOCEXT - did not contain zero (See TABLE VII). Males scored higher on the BSE, higher undergraduate grade point average was associated with higher BSE scores, and *lower* external locus of control scores were associated with higher BSE scores.

TABLE VII

MODEL 4: BOOTSTRAP REGRESSION: DEMOGRAPHIC VARIABLES, GPA, AND LOCUS OF CONTROL VARIABLES

			95% CONFIDENCE INTERVAL		
VARIABLE	β	STANDARD ERROR	LOWER	UPPER	R^2
OVERALL					.513
SEX	-.44999	.13346	-.76471	-.23504*	
AGE	.04733	.14426	-.23891	.33357	
EFL	.13439	.12844	-.12047	.38926	
UGRADMAJ	-.10999	.15679	-.42109	.20111	
UGRADGPA	.57842	.12709	.32625	.83059*	
LOCINT	.10234	.15579	-.20679	.41176	
LOCEXT	-.32674	.16187	-.64793	-.00556*	

*Significant

The full model (Model 5 in TABLE IV), with all eight variables accounted for 52% of the variance in BSE average scores. However, only the confidence intervals for GPA and SEX did not contain zero (See TABLE VIII).

TABLE VIII

MODEL 5: BOOTSTRAP REGRESSION: DEMOGRAPHIC VARIABLES, GPA, AND ALL PSYCHOSOCIAL VARIABLES

VARIABLE	β	STANDARD ERROR	95% CONFIDENCE INTERVAL LOWER	95% CONFIDENCE INTERVAL UPPER	R^2
OVERALL					.522
SEX	-.50083	.14111	-.78083	-.22083*	
AGE	.04786	.15445	-.25861	.35431	
EFL	.15506	.13463	-.11209	.42221	
UGRADMAJ	-.13500	.14661	-.42593	.15592	
UGRADGPA	.58017	.11803	.34596	.81438*	
COMMIT	.11927	.20366	-.28483	.52337	
LOCINT	.08177	.16133	-.23835	.40191	
LOCEXT	-.27344	.19956	-.66946	.12258	

*Significant

Of these first five models, Model 4 (TABLE VI) (with all variables except COMMIT entered) was identified as the best model. Although it did not account for the most variance (only 51% as opposed to 52%), it was more parsimonious (seven as opposed to eight variables). Furthermore, Model 4 removed a psychosocial variable (Commitment) that appeared to be multicolinear with other psychosocial variables (internal and external locus of control). Correlations between the commitment variable and the locus of control variables were high: $\underline{r}$=.33 between commitment and internal locus of control and $\underline{r}$=-.50 between commitment and external locus of control.

To explore the joint effect of SEX and the psychosocial variables, models using each of the three psychosocial variables - COMMIT, LOCINT, and

LOCEXT - without the others were examined (see Models 3, 6, 7 and 8 in TABLE III). With none of the psychosocial variables in the model, the coefficient for sex was not significant (Model 2). With any one or more of the three psychosocial variables in the model (Models 3-7), the coefficient for sex was significant. This pattern is known as suppression and implies that the psychosocial variables are removing variance from sex that is unrelated to BSE scores, increasing the *proportion* of variance in SEX related to BSE scores.

To help interpret the suppression effects and multicolinearity occurring in the data, zero-order correlations using the original data were examined (see TABLE IX). COMMIT and LOCEXT had a significant correlation (r=-.50) as did LOCEXT and SEX (r=-.37). Two other combinations of psychosocial variables had noteworthy, but nonsignificant correlations: LOCINT and COMMIT (r=.33), and LOCINT and LOCEXT (r=-.30).

TABLE IX

ZERO-ORDER CORRELATIONS WITH ORIGINAL DATA

							LOC OF CONT	
	SEX	AGE	EFL	MAJ	GPA	COM	INT	EXT
SEX	1.00							
AGE	.16	1.00						
EFL	.07	.11	1.00					
MAJOR	-.05	-.15	.22	1.00				
GPA	.24	-.21	.10	.08	1.00			
COMMIT	.16	-.05	-.05	.26	.07	1.00		
LOCINT	.11	-.30	-.02	.12	.26	.33	1.00	
LOCEXT	-.37*	-.12	-.17	-.16	-.08	-.50*	-.30	1.00

*Significant

COMMIT, LOCINT, and LOCEXT were broken into their component subscales and zero-order correlations were examined for these variables (see TABLE X). As expected, the two subscales of LOCINT (EFFORT and ABILITY) correlated highly (r=.73) as did the two subscales of LOCEXT (SITUAT and LUCK r=.62), indicating that the subscales tap slightly different aspects of the higher level (LOCEXT and LOCINT) constructs. At the .01 level, Commitment to Career (COMMCAR) correlated positively with the EFFORT subscale of LOCINT (r=.49) and negatively with both the SITUATION (r=-.44) and LUCK (r=-.44) subscales of LOCEXT. Commitment over Alternatives (COMMALT) did not correlate strongly with any other variable.

TABLE X

ZERO-ORDER CORRELATIONS AMONG PSYCHOSOCIAL SUBSCALES

	EFF	ABI	SIT	LUC	COCAR		COALT
EFFORT	1.00						
ABILITY	.73*	1.00					
SITUAT	-.14	-.16	1.00				
LUCK	-.41*	-.27	.62*	1.00			
COMMCAR		.49*	.28	-.44*	-.44*	1.00	
COMMALT		.03	-.08	-.24	-.21	.24	1.00

*Significant

ALTERNATE METHOD OF PREDICTION

As an alternative method of prediction (Cohen & Cohen, 1975, p. 115), the sum of standardized scores (sign as predicted) was computed and correlated with average Basic Science Scores:

BSAVERAG=EFL+UGRADMAJ+UGRADGPA+COMMIT+LOCINT-LOCEXT-SEX-AGEI.

The result ($\underline{R}^2$=.24) was significant at the .01 level. This type of composite score, where all variables are viewed as equally important, does not account for as much variance as the regression model. In addition, it does not shed light on the question of which factors influence success in naturopathic medical school. Since this method accounts for less variance than in the regression model (where $\underline{R}^2$=.51), the differential weighting of the variables must be important to the prediction of BSE scores.

DISCUSSION

SUMMARY OF STUDY

The premise of this study was that the addition of psychosocial variables would significantly increase the amount of variance accounted for in Basic Science Exam scores of second year naturopathic medical students over and above that of academic factors when controlling for demographic characteristics. This hypothesis was supported although the precise nature of the psychosocial construct is not immediately apparent. In comparing the results of eight regressions, six relationships merit discussion. These include:

- The amount of variance accounted for by demographic factors alone;
- The strong relationship of undergraduate grade point average to basic science exam scores;
- The increase in the amount of variance accounted for by the psychosocial variables;
- The effect of gender in relation to the psychosocial variables and BSE scores (a case of suppression);
- The relationship of internal locus of control to external locus of control and BSE scores (a case of common method variance); and
- The high correlation between locus of control and commitment (a case of multicolinearity).

DEMOGRAPHIC PREDICTORS OF BASIC SCIENCE EXAM SCORES

When entered into the model as a block, the demographic variables accounted for almost 10% of the variance in BSE scores although no variable by itself was significant. None of the recent literature surveyed reported variance accounted for by demographic factors alone, although a 1975 study did address the effect of age and sex on rates of attrition from medical school (Gough & Hall, 1975). Ashikawa, Hojat, Zeleznik, and Gonnella (1991) examined the effect of undergraduate major on performance on the NBMEI exams and found no significant correlations, although they did find that students with undergraduate majors in the humanities and arts were more likely to drop out of medical school than were students with undergraduate majors in the natural or behavioral sciences. In line with the Ashikawa et al. findings, this study did not identify a significant correlation between undergraduate major and performance on the BSE.

It is surprising that the undergraduate major of the student was not significant. It might have been anticipated that students whose undergraduate major was in a science field would score higher on the basic science exams but this relationship was not seen. From a theoretical point of view, what a person lacks in terms of undergraduate preparation might be compensated for by added commitment/effort. Due to limited sample size, finer distinctions between science and non-science background and commitment, as they relate to prediction of BSE scores, could not be made. These relationships merit further study.

As discussed later in this paper, the gender variable became significant when a psychosocial variable was added to the model. However, in general, no clear pattern of demographics and BSE scores was found.

ACADEMIC PREDICTORS OF BASIC SCIENCE EXAM SCORES

In terms of the specific hypotheses, the bootstrapped multiple regressions indicated that, as predicted, undergraduate GPA accounted for the largest portion of variance in Basic Science Exam scores, while controlling for sex, age, whether or not English was the first language, and undergraduate major.

The results of this study are comparable to those found by Hojat, et al. (1988). Without controlling for demographic characteristics, they entered undergraduate GPA and MCAT scores as a block and found that when academic measures alone were used as predictors of NBMEI scores, the amount of variance accounted for was 32%. In this study, the amount of variance accounted for was 30% using a single academic predictor and controlling for demographic factors.

PSYCHOSOCIAL PREDICTORS OF BASIC SCIENCE EXAM SCORES

Effect of Psychosocial Predictors on Gender Variable

A correlation between sex and career commitment was not found in either the Colarelli and Bishop (1990) study or in the present study. Colarelli and Bishop did, however, find a significant positive correlation between age and career commitment. In the present study this correlation was negative but not

significant, perhaps due to limited variability in this sample. Because Colarelli and Bishop do not report descriptive statistics, no comparison can be made.

Neither the zero order correlations nor the regressions in Models 1 and 2 showed gender to be a significant predictor of BSE scores. However, with the addition of *any* psychosocial variable into the model, gender became a significant predictor. This is a case of suppression where the psychosocial variable served to suppress irrelevant variance in the gender variable, making the portion of variance that SEX shares with BSE scores a significant *proportion*. By removing the psychosocial differences for gender unrelated to BSE scores, what is left in SEX has a stronger relationship with the Basic Science Exams.

Without any of the psychosocial variables in the model, the β for sex was -.21. When LOCEXT was the psychosocial variable in the model, the β for sex was -.50 (compared to β=-.39 when LOCINT was in the model, and β=-.42 when COMMIT was in the model). Males are associated with higher BSE scores after the gender-psychosocial variable relationship is removed from BSE scores.

After controlling for the slightly higher commitment, *or* higher internal LOC, *or* lower external LOC of females, males perform better on the BSE. It is difficult to determine what causes this relationship. Perhaps it is cognitive style or socialization of males toward the sciences.

Effect of Psychosocial Variables on Prediction

As hypothesized, additional predictive power was obtained with the inclusion of psychosocial variables in the model. Model 4, including all variables

except COMMIT, is the most parsimonious model and accounts for more than 50% of the variance in BSE scores. In this final model, the proportion of variance accounted for over and above the model with the academic predictor, while controlling for demographic characteristics, was 11%.

When Hojat et al. (1988) added to their model 14 psychosocial measures, including a measure of external locus of control, an additional 24% of variance in NBMEI scores was accounted for ($\underline{R}^2$=.56 as compared to $\underline{R}^2$=.51 in the present study). They found that the best psychosocial predictor of success on the NBMEI (in a model with academic predictors included) was their index of overconfidence. They did not report any zero order correlations, making it impossible to compare the variance accounted for by any single predictor. It should be noted that their lack of control for demographic characteristics may have had some effect on the results. Including demographic variables in their model might actually have increased the amount of variance accounted for. In the present study when a model estimated without the demographic variables (academic and psychosocial variables only), the amount of variance accounted for decreased from 52% to 30%, despite the fact for the model with *only* demographic variables, the amount of variance accounted for was less than 10%.

In the present study, the interpretation of the higher order "psychosocial variable" is not straightforward but is complicated by instances of multicolinearity and common method variance. To explore the separate or joint effects of the psychosocial variables, Models 3-8 (see TABLE III) were compared.

The only combination of variables in which one of the psychosocial variables was significant was when COMMIT was *not* in the model but *both* LOCINT and LOCEXT were included. In this case, the coefficient for LOCEXT was significant (Model 4) with low scores on LOCEXT associated with higher BSE scores. The coefficient for the LOCINT variable was not significant.

Internal and External Locus of Control. The correlation between LOCINT and LOCEXT was low (r=-.30), indicating that the two scales do in fact measure different aspects of the locus of control construct. However, the results of this study indicate that the aspect of locus of control related to external attributions is more (negatively) predictive of BSE scores than is the (positively predictive) aspect related to internal attributions. This finding is contrary to what was hypothesized. It was anticipated that degree of commitment and/or internal locus of control would be more predictive of BSE scores than would external locus of control. In this case, a negative predictor (LOCEXT) is more powerful than a positive predictor (LOCINT).

The increase in the LOCEXT β when LOCINT is in the model suggests common variance between the two locus of control variables unrelated to BSE scores. The significance of LOCEXT *only* when LOCINT was also in the model but COMMIT was not indicates that this communality is something that COMMIT does not tap. One explanation is that common method variance exists between LOCINT and LOCEXT, but does not exist between COMMIT and either of the locus of control variables. This could be explained by the academic

focus common to both LOCINT and LOCEXT but not to the COMMIT variable.

Kanoy et al. (1989) found that locus of control scores were important predictors of academic performance (college GPA) only for the low performers. In the present study, undergraduate GPA was not found to be correlated with either locus of control measure. In the multiple regression, GPA was associated with higher scores on the BSE which is also associated with higher LOC scores.

Commitment and Locus of Control. One definition of multicolinearity is that there is a high degree of correlation between independent variables. This was the case with the commitment variable and both the internal locus of control (r=.33) and the external locus of control (r=-.50) variables. Because of the correlation among these three variables, the proportion of *unique* variance that any of them shared with BSE scores was not significant when all were in the model.

The apparent relationship between commitment and locus of control prompted further analysis. Correlations between six subscales - Commitment to Career (COMMIT), Commitment over Alternatives (COMMIT), Ability (LOCINT), Effort (LOCINT), Situation (LOCEXT), and Luck (LOCEXT) - were examined. This analysis revealed a significant correlation between Commitment to Career and the Effort subscale of LOCINT. If the individual believes that one's own effort will bring desired results, that individual will tend to be more committed to a path than if the individual believes that nothing one does will have any effect. Or conversely, the association may be related to the belief that

one's commitment (internally motivated) gives the individual some control over personal outcomes, making him or her more likely to believe that effort expended will lead to reward.

There were also significant negative correlations between Commitment to Career and both subscales of LOCEXT (Situation $\underline{r}$=-.44 and Luck $\underline{r}$=-.44). The commitment variable was highly correlated with *both* subscales of the LOCEXT variable but with only one subscale (EFFORT) of the LOCINT variable. This high correlation with both LOCEXT subscales meant that the information tapped by the COMMIT variable was redundant. COMMIT and LOCEXT may be measuring opposite poles of a similar construct or they may be measuring different constructs that are strongly related. The latter explanation seems more plausible. The COMMIT variable is intended to measure an *intention*. Both LOCINT and LOCEXT are measuring *beliefs*.

Whatever the cause and effect, from the results of this study it may be concluded that those highly committed to their careers believe control is due to their effort and not situation or luck. The absence of a significant correlation between the ABILITY subscale and the COMMIT subscales seems to indicate that beliefs about one's ability are distinct from beliefs about one's effort.

Colarelli and Bishop (1990) used a single scale as their measure of locus of control (as opposed to the two subscale measure used in this study) and also suggested that commitment to career and locus of control are highly correlated. Their finding was borne out by this study where commitment was found to be

highly correlated with both internal locus of control (positive) and with external locus of control (negative).

Using a single scale to measure locus of control, Bishop and Solomon (1989) reported that older females in their study were significantly more external than males in their age group or younger females. However, they did not find significant differences between older females and younger males in career commitment of the MBA students they studied. The present study, using the dual internal and external LOC scales indicated that older females were less internal in their locus of control than were younger females. However no significant relations were found between age and performance on the basic science exams.

DISCUSSION OF HIGHER ORDER CONSTRUCT

Evidence for the hypothesis that the addition of psychosocial variables to a model predicting BSE scores would add significantly to the amount of variance accounted for was provided by this study. The most intriguing aspect of the results was the complex relationship that exists among the psychosocial variables.

The Kobasa et al. (1982) higher order construct of *hardiness* was developed specifically to account for the observation that some people remain healthy despite exposure to pathogens (a sort of psychosocial resistance to disease). The overall construct of hardiness has been discounted because of the researchers' inability to assess commitment, locus of control, and challenge as distinct and separate traits. This study confirms the lack of independence between

commitment and locus of control as they relate to an area other than personal health, but suggests ways in which the three measures used in this study are intricately woven, making the higher order construct a valuable, if currently equivocal predictor.

GENERALIZABILITY

The size of the sample (N=33) for this study was limited by the size of the entire population (87) of eligible participants. However, two facts indicate that generalization beyond the sample may be appropriate. First, participants were not significantly different from non-participants in terms of the dependent variable. Second, in light of the finding that sex is a significant factor in the analysis, the similar compositional breakdown by sex of the participants (63% female) and of the total population (66% female) is important. The proportion of participants from each of the schools did not match the population; however, statistics gathered by NPLEX indicate that BSE scores are comparable among the three schools. It is possible that self-selection occurred relative to the psychosocial variables. However, because the sample appears to be representative of the population in terms of BSE scores and gender, generalizability beyond the sample seems appropriate.

COMMENTS ON BOOTSTRAP METHODOLOGY

The use of bootstrapping procedures in this research allowed for examination of the stability of results in light of the small sample size. The size of a confidence interval is determined by the size of the standard error, that is, large standard errors produce large confidence intervals. We are 95% confident

that the true value of the coefficient lies somewhere within the interval, and the only "test" for significance in the bootstrapped regressions is whether or not the confidence interval around the regression coefficient contains 0. While three βs had confidence intervals that did not contain 0, the size of the intervals for each of these variables was large (.53 for sex, .50 for undergraduate major, and .64 for LOCEXT). For example, the true regression weight for sex could lie between -.24 and -.76 which represents a span of influence from weak to very strong. In order to reduce the size of the interval a larger sample would be needed.

FUTURE RESEARCH

This study has identified factors important to success in the first two years of naturopathic medical school. However, the magnitude of the impact of these factors remains a question. Although bootstrapping is a valuable tool, interpretation of the results in terms of the content of the variables must be approached cautiously. By the summer of 1996, there will be at least twice as many students taking the NPLEX Basic Science Exams, thereby substantially increasing the population pool. If this aspect of the research is repeated with refinements in the instrument and a larger sample, better interpretation will be possible.

Although the commitment variable did not prove to be a significant predictor in this study, it may still be a valuable construct. The commitment variable in this study exhibited less variability than did either internal or external

locus of control. It may be assumed that students choosing a challenging course of study have a high degree of commitment; however, there may also have been a social desirability effect with the use of the commitment scale. It is possible that a scale which taps the identification aspect (i.e., how much one identifies with the career as opposed to how committed to that career one is) may have more predictive power. Future research will explore this facet.

In addition, future research should address the issue of test anxiety. It is possible that even with a high degree of commitment, the effects of test anxiety may counteract the amount of effort the student devotes to studying.

Phase II of this research examines different psychosocial variables in the naturopathic medical student community and may shed light on the results of the current study.

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APPENDIX A

May 1, 1993

Dear Student:

In the fall of 1992 a validity study was done to see how well the NPLEX Clinical exams actually measure what they are supposed to measure. The conclusion was that the exams do a good job of measuring technical knowledge. The validity coefficient was .53 which is very good for an exam of this type.

As you know, becoming a good N.D. means more than just having technical knowledge that can be substantiated through a multiple-choice exam. In order to identify some of the other factors that may be associated with clinical competence, a second study is being done to examine the relationship between personal characteristics (as measured by the attached questionnaire) and technical competence (as measured by the exams).

In order to do this study I need your consent to participate, and your willingness to fill out the attached questionnaire. What you will receive in return is a chance to see the results of the study, and the knowledge that you have participated in important research which helps raise the credibility of the naturopathic profession.

Whether or not you decide to participate, be assured that your decision will not, in any way, affect your NPLEX scores or your relationship with (CCNM/NCNM/JBC). All information that you release will be **strictly confidential**. No one other than me will see it. All reported results will be in aggregate form, assuring your anonymity.

Please fill the questionnaire and return it to (name of school contact) within two weeks. If you have any questions, you may call me at (503) 250-9141 and I will return your call.

If you choose to participate, please answer every question and be honest in your responses but don't ponder the questions for too long. There are no "correct responses". Your honest initial reactions are most important.

Thank you for your help. The final report will be available from (name of school contact) in April 1994.

APPENDIX B

INFORMED CONSENT FORM

I, _____, agree to take part in this research project studying potential predictors of success in naturopathic medical school.

I understand that the study involves my completion of a 57-item questionnaire, along with my consent to allow Christa Louise to correlate my responses with the scores on my NPLEX Basic Science exams which I will be taking in the summer of 1993.

Christa has explained that the purpose of this study is to learn which personality attributes may be associated with performance on the Basic Science exams.

I will not receive any direct benefit from taking part in this study, but this research may aid in future selection of those students most likely to succeed in an N.D. program.

Christa has offered to answer any questions I have about the study and what I am expected to do. She has promised me that all information I give will be kept confidential to the extent permitted by law, and that the names of all people in the study will be kept confidential. I understand that my responses to any questionnaire item will not, in any way, affect my NPLEX scores or licensing potential.

I understand that I do not have to take part in this study, and that I may withdraw from it at any time without affecting my NPLEX scores or my relationship with NPLEX or CCNM.

I have read and understand the above information and consent to be a participant in this research.

Date: _____ Signature: _____

If you have any concerns or questions about this study, please contact Laurie Skokan at (503) 725-3901, or the Chair of the Human Subjects Research Committee, Office of Grants and Contracts, 105 Neuberger Hall, Portland State University, (503) 725-3417.

APPENDIX C

Student Questionnaire

NAME:_____

SEX: ____ MALE ____ FEMALE

AGE WHEN ENTERING NATUROPATHIC COLLEGE: _____

AGE AT GRADUATION FROM NATUROPATHIC COLLEGE: _____

IS ENGLISH YOUR FIRST LANGUAGE?: ____ YES ____ NO

UNDERGRADUATE MAJOR: _____

UNDERGRADUATE GRADE POINT AVERAGE: _____

For the following questions, circle the number that best describes how much you agree with the statement as it relates to your own life:

1. What I am doing now is helping me develop my proficiency to be a naturopathic physician. (CO +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

2. I am willing to put in a great deal of effort beyond that normally expected in order to be successful as a naturopathic physician. (CO +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

3. I endorse naturopathic medicine to my friends as a great career. (CO +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

4. I feel very little loyalty for this career. (CO -)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

5. I would accept almost any type of task assignment in order to keep working in the field of naturopathic medicine. (CO +)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

6. I find that my values and those associated with naturopathic medicine are very similar. (CO +)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

7. I am proud to tell others that I am studying to become a naturopathic physician. (CO +)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

8. The field of naturopathic medicine really inspires the very best in me in the way of study performance.(CO +)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

9. It would take very little change in my present circumstances to cause me to leave school. (CO -)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

10. I am extremely glad that I chose to become a naturopathic physician over other careers that I have considered.(CO +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

11. There is not much to be gained by sticking indefinitely with my decision to become a naturopathic physician. (CO -)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

12. I am thinking of going into a different field of study. (CO -)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

13. There is not enough opportunity for advancement as a naturopathic physician. (CO -)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

14. For me, this is the best of all possible careers in which to work.(CO +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

15. Deciding to become a naturopathic physician was a definite mistake on my part. (CO -)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

16. I have a good chance to use my skills and abilities by becoming a naturopathic physician. (CO +)

---

1 2 3 4 5 6

DISAGREE STRONGLY — AGREE STRONGLY

17. My present course of study is leading me in the career direction I want. (CO +)

---

1 2 3 4 5 6

DISAGREE STRONGLY — AGREE STRONGLY

18. I take my goal of becoming a naturopathic physician seriously.(CO GO +)

---

1 2 3 4 5 6

NEVER — ALL OF THE TIME

19. I believe it is unrealistic for me to expect to reach my goal of becoming a naturopathic physician.(CO GO -)

---

1 2 3 4 5 6

NEVER — ALL OF THE TIME

20. It is quite likely that my goal of becoming a naturopathic physician may need to be revised depending on how things go.(CO GO -)

---

1 2 3 4 5 6

DISAGREE STRONGLY — AGREE STRONGLY

21. I care a great deal if I achieve this goal or not. (CO GO +)

---

1 2 3 4 5 6

DISAGREE STRONGLY — AGREE STRONGLY

22. I feel that I have spent more time in pursuit of my N.D. degree than I would have spent preparing for any other profession.(CO IN +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

23. All in all, I have devoted a great deal of time, energy, and resources into my schooling here. (CO IN +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

24. I would have to give up a lot if I quit school at this time.(CO IN +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

25. I've made investments in this place which are important to me.(CO IN +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

26. I have invested much more of my time, energy, and resources in getting my naturopathic degree than most other people in the profession. (CO IN +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

27. I have invested a great deal of money in my pursuit of becoming a naturopathic physician.(CO IN +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

28. In the past three years, I have considered various other careers in fields other than naturopathic medicine.(CO AL -)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

29. There are very few other professions in which I would consider being involved.(CO AL +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

30. Overall, it would be difficult to find a profession for which I felt myself to be better suited.(CO AL +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

31. I have developed a lot of close friendships as I have gone through this program. (CO RE +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

32. I enjoy learning the information that will make me an effective naturopathic physician. (CO RE +)

---

1 2 3 4 5 6

NEVER ALL OF THE TIME

33. I am learning information that helps me improve my own health. (CO RE +)

---

1 2 3 4 5 6

NEVER ALL OF THE TIME

36. When I receive a poor grade, I usually feel that the main reason is that I haven't studied hard enough for that course. (LOC ACH EFF -)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

35. If I were to receive a low mark it would cause me to question my ability. (LOC ACH AB -)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

36. Some of the times that I have gotten a good grade in a course, it was due to the teacher's easy grading scheme. (LOC ACH SIT +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

37. Sometimes my success on exams depends on some luck. (LOC ACH LUC -)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

38. In my case, the good grades I receive are always the direct result of my efforts. (LOC ACH EFF +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

39. The most important ingredient in getting good grades is my academic ability. (LOC ACH AB -)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

40. In my experience, once a professor gets the idea you're a poor student, your work is much more likely to receive poor grades than if someone else had handed it in. (LOC ACH SIT -)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

41. Some of my lower bad grades seem to be partially due to bad breaks. (LOC ACH LUC -)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

42. When I fail to do as well as expected in school, it is often due to a lack of effort on my part. (LOC ACH EFF +)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

43. If I were to fail a course, it would probably be because I lacked skill in that area. (LOC ACH AB -).

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

44. Some of my good grades may simply reflect that these were easier courses than most. (LOC ACH SIT -)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

45. I feel that some of my good grades depend to a considerable extent on chance factors, such as having the right questions show up on an exam. (LOC ACH LUC -)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

46. Whenever I receive good grades it is always because I have studied hard for that course. (LOC ACH EFF +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

47. I feel that my good grades reflect directly on my academic ability. (LOC ACH AB -)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

48. Often my poorer grades are obtained in courses that the professor has failed to make interesting. (LOC ACH SIT -)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

49. My academic low points sometimes make me think that I was just unlucky. (LOC ACH LUC -)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

50. Poor grades tell me that I haven't worked hard enough. (LOC ACH EFF +)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

51. If I were to get poor grades I would assume that I lacked ability to succeed in those courses. (LOC ACH AB -)

---

1 2 3 4 5 6

DISAGREE STRONGLY AGREE STRONGLY

52. Sometimes I get good grades only because the course material was easy to learn. (LOC ACH SIT -)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

53. Sometimes I feel that I have to consider myself lucky for the grades that I get. (LOC ACH LUC -)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

54. I can overcome all the obstacles in the path of academic success if I work hard enough. (LOC ACH EFF +)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

55. When I get good grades it is because of my academic proficiency. (LOC ACH AB +)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

56. Some of the low grades I received seem to me to reflect the fact that some teachers are just stingy with marks. (LOC ACH SIT -)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

57. Some of my bad grades may have been a function of bad luck, being in the wrong course at the wrong time. (LOC ACH LUC -)

---

1 2 3 4 5 6

DISAGREE AGREE
STRONGLY STRONGLY

APPENDIX D

Guide to Acronyms

BSE	NPLEX Basic Science Exams (five exams)
LOC	Locus of Control LOCINT - Internal Locus of Control LOCEXT - External Locus of Control
M.D.	Medical (allopathic) physician
MMCS	Multidimensional-Multiattributional Causality Scale (measure of locus of control) ABILITY (LOCINT Stable-Internal) EFFORT (LOCINT Variable-Internal) LUCK (Stable-External) SITUATION (LOCEXT Variable-External)
NBME	National Board of Medical Examiners (M.D. Board exams): NBMEI=Basic Science exams NBMEII=Clinical exams NBMEIII=post-residency exams
N.D.	Naturopathic physician
NPLEX	Naturopathic Physicians Licensing Exams (N.D. Board exams) BSE=Basic Science exams CLE=Clinical exams