APPENDIX J
Mean Differences in Performance by Age

Group	Variable	n	Mean	SD	t	2-tail critical *p*
Youngest	Admission GPA	35	7.62	.38	1.95	.055
Oldest			7.43	.43		
Youngest	Science Average	35	7.63	.45	2.03	.046
Oldest			7.41	.43		
Youngest	Reading	35	20.45	3.13	1.53	.130
Oldest			19.45	2.25		
Youngest	Carving	35	17.74	2.09	-1.81	.075
Oldest			19.11	3.96		
Youngest	PAT	35	18.85	2.7	-0.49	.624
Oldest			19.28	4.4		
Youngest	Interview	35	26.80	4.8	-0.53	.597
Oldest			27.46	5.6		
Youngest	GPA1	35	6.82	.66	-0.22	.830
Oldest			6.85	.67		
Youngest	GPA2	35	6.93	.63	-0.59	.556
Oldest			7.02	.67		
Youngest	GPA3	35	6.90	.60	-0.16	.874
Oldest			6.92	.65		
Youngest	GPA4	35	7.14	.60	0.53	.598
Oldest			7.06	.57		

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UNIVERSITY OF ALBERTA

A REVIEW OF DENTAL ADMISSIONS

BY

BRIAN DAVID TAJE

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of MASTER OF EDUCATION.

IN

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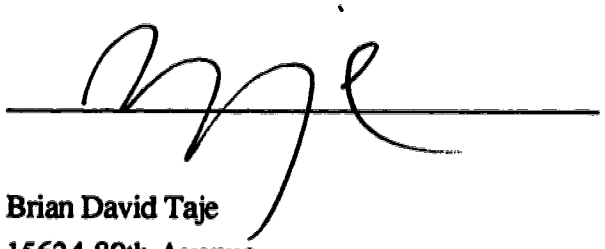

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FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled *A Review of Dental Admissions* submitted by Brian David Taje in partial fulfillment of the requirements for the degree of Master of Education in Counselling Psychology.

Dr. R.C. Kimmis

Dr. G.C. Hess

Dr. W.C. Meyer

January 31, 1994

to

Teri, Elizabeth and Luke

Abstract

A review of admissions decisions from the 1986-92 period for the Faculty of Dentistry at the University of Alberta was completed. This review focused on the relationship between admission variables (predictor variables) and subsequent academic performance (criterion variables) for 316 student records.

Admission variables included Admission GPA; grade-point-average for preadmission science courses (Science Average); Reading Comprehension Test scores (Reading), Carving Test scores (Carving), and Perceptual Ability Test scores (PAT) from the Dental Aptitude Test; scores from the Canadian Dental Association Admission Interview (Interview); age; and years of predentistry. Academic performance was measured by grades and their composite grade-point-averages.

The analysis of marks reflected the complexity of the four year program which evolved from didactic and lab (preclinical) courses in first and second year to clinical courses (working with patients) in the third and fourth year.

Science Average was the most robust predictor variable. It correlated significantly ($p < .01$) with GPA1 through GPA4; didactic, lab and clinical grades, and marks from the fifteen program areas in Dentistry.

Dental Aptitude Test scores were not as consistently or strongly related to academic performance. Reading correlated significantly with GPA1, GPA2, GPA3 but not GPA4. It correlated significantly with didactic and lab grades but not clinical grades. Carving and PAT correlated with GPA3 and GPA4. These tests did not show a significant relationship with didactic grades, but they were significantly related to lab and clinical grades.

Interview correlated significantly with GPA2 and GPA3. As with Carving and PAT, this variable correlated significantly with lab and clinical marks but not with didactic grades.

There was no relationship between age or years of predentistry and GPA.

Science Average, Reading and Carving produced a multiple *R* of .41 (stepwise-regression) with a combined average of all four GPAs.

The sample was separated on the basis of gender. For females (n=98), Reading produced the highest correlation with GPA1. However, Carving and PAT did not correlate with GPA1 through GPA4. For males (n=218), Carving and PAT correlated significantly with GPA1 through GPA4.

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CHAPTER ONE: INTRODUCTION

The purpose of this study was to review the relationship between preadmission variables and academic performance in the Faculty of Dentistry at the University of Alberta. Traditionally, educational psychologists are among the researchers who evaluate admission criteria and education performance. This study is within that tradition.

General Statement of the Problem

It is the purpose of the selection process in the Faculty of Dentistry to identify the best qualified applicants. The question asked is, "Who are the best qualified applicants?" In education research, prediction studies aim at "identifying variables that forecast academic and vocational success ... to determine which criteria to incorporate in the selection process" (Borg & Gall, 1989, pp. 583-584). Admission test scores and grade-point-averages are commonly used to forecast academic success. In addition, standardized interviews have been used when personal attributes were seen as important parameters of the program in question.

Significance of the Study

This study was completed in order to facilitate understanding of admission decisions within the Faculty of Dentistry. According to Boyd and Teteruck (1979), "predictability varies from class to class and among schools. Therefore it is important that validation studies be performed in each school to determine how students perform in that dental school's particular subculture and curriculum" (p. 5). This study assessed the strength and significance of correlations between admission variables and different measures of dental student performance. All post-secondary education, including dental education, is expensive. In Boyd and Teteruck's view, the selection of applicants with the best aptitude reduces failure and attrition. Thus, accurate selection is viewed as being cost-efficient.

Research Objectives

This study was designed to identify and interpret the relationship between the variables used as admission criteria and course marks within the dental program. A review of

research and literature pertaining to this study was completed. Sample means for admission and criterion variables were analyzed. Simple correlations and regression equations were computed in order to measure the magnitude and direction of the relationship between Predentistry and dentistry performance. An examination of students' records with inadequate grade-point-average was also completed. Admission variables for the top and bottom 15% of the distribution were analyzed.

Definitions of Terms

This section is devoted to introducing terms (a) common to this type of study, (b) Dentistry, (c) variables used in this study, and (d) pertaining to the statistics employed in the analysis.

A. COMMON TERMINOLOGY

ADMISSION RATIO: ratio of admitted applicants compared to the total number of applicants to a post-secondary program.

ADMISSION STUDIES: refers to a review of admissions in post-secondary education

BIVARIATE CORRELATION (*r*): in admission studies, measures the relationship between a predictor and criterion variable. Sometimes referred to as a simple correlation.

CRITERION VARIABLE: in admission studies, refers to any measure of academic performance after admission.

GRADE-POINT-AVERAGE (GPA): the mean grade for any group of courses, usually calculated annually.

MULTIPLE CORRELATION (*r*): measures the relationship for a composite of predictor variables with a single criterion variable.

PREDICTIVE-MEASUREMENT RESEARCH: "predictive-measurement" is an ERIC database search term often associated with education admission studies.

PREDICTIVE VALIDITY: the extent to which preadmission variables measure academic performance.

B. DENTISTRY

CLINICAL COURSES: dentistry courses that require students to perform clinical work involving patients or patient care.

DENTAL APTITUDE TEST (DAT): Canadian Dental Association version of the American Dental Admission Test. It includes tests of natural sciences, quantitative reasoning, reading comprehension, and carving and perceptual ability. An academic average score is calculated using the sciences, quantitative reasoning and reading comprehension scores. [The University of Alberta uses the reading comprehension, carving and perceptual ability tests in its admission battery.]

DIDACTIC COURSES: dentistry courses without a lab or clinical component.

C. VARIABLES

Predictor Variables

ADMISSION GPA: admission grade-point-average, as calculated and reported by the Faculty of Dentistry in the admission file. (See Chapter 3 for more information.)

SCIENCE AVERAGE: average grade for science courses completed prior to admission, as calculated and reported by the Faculty of Dentistry in the admission file. (See Chapter 3 for more information.)

READING: refers to the Reading Comprehension Test score from the DAT battery recorded in the dentistry admission file. (See Chapter 3 for more information.)

CARVING: refers to the Carving Test score from the DAT battery recorded in the dentistry admission file. (See Chapter 3 for more information.)

PAT: refers to the Perceptual Ability Test (PAT) score from the DAT battery recorded in the dentistry admission file. (See Chapter 3 for more information.)

INTERVIEW: refers to the Canadian Dental Association *Dental Admission Interview* score recorded in the dentistry admission file. (See Chapter 3 for more information.)

AGE: age of student at the beginning of first-year recorded in the dentistry admission file.

YEARS OF PREDENTISTRY: years of post-secondary education credited by the University of Alberta prior to entering dental school.

Criterion Variables

GPA1: first-year dentistry grade-point-average calculated by the Faculty of Dentistry.

GPA2: second-year dentistry grade-point-average calculated by the Faculty of Dentistry.

GPA3: third-year dentistry grade-point-average calculated by the Faculty of Dentistry.

GPA4: fourth-year dentistry grade-point-average calculated by the Faculty of Dentistry.

COMBINED GPA: the average of GPA1 through GPA4.

DIDACTIC AVERAGE: average grade for dentistry courses not designated in University of Alberta Calendars (1986-92) as *lab* or *clinical.*

LAB AVERAGE: average grade calculated during this study for dentistry courses designated in University of Alberta Calendars (1986-92) as *lab.*

CLINICAL AVERAGE: average grade calculated during this study for dentistry courses designated in University of Alberta Calendars (1986-92) as *clinical.*

AVERAGES FOR THE FIFTEEN PROGRAM AREAS: mean grades calculated during this study for courses from each of the fifteen program areas in dentistry designated in the 1986-92 University of Alberta Calendars (see Appendix A).

D. STATISTICS

CENTRAL TENDENCY: A measure of the "average" performance of individuals.

MEAN: A measure of *central tendency* sometimes referred to as the "arithmetic average". It is found by summing all values and dividing by the number of cases.

VARIABILITY: The extent to which scores differ, spread out, or vary.

VARIANCE: the *standard deviation* squared.

STANDARD DEVIATION *SD:* A measure of the *variability* or dispersion of scores around the *mean.* The larger the standard deviation, the greater is the spread of scores around the *mean.*

CORRELATION *r*: A measure of the extent to which two variables are related; an average product of z scores that is positive if paired z scores have the same sign or negative if signs are opposite. The lowest correlation is 0 and the highest is +/- 1.

Z SCORES: A standard score having a *mean* of 0 and a *standard deviation* of 1.0. The z score indicates the number of standard deviations an individual's score is from the mean of a distribution.

CHAPTER TWO: REVIEW OF LITERATURE

Two areas of research pertaining to college and university admissions are pertinent to this study. This chapter examines how statistics have previously been employed to review admission decisions. It also includes a review of the research literature pertaining to the relationship between admission variables and academic performance in dentistry programs.

Admission Studies

In post-secondary education, admission studies examine the relationship between the variables selected to make admissions decisions and measures of students' academic performance after admission. Some researchers (Linn, 1982; Nairn, 1980; Swinton, 1980; Goldman and Slaughter, 1976; Cronbach, 1971; Cronbach & Glasser, 1965; Brogden, 1946; Taylor and Russell, 1939) have examined why GPA is difficult to predict and debated the validity of admission testing. Other researchers (Kramer, 1985; Kress & Dogan, 1981; Boyd & Teteruck, 1979; Wood; 1979) have evaluated the predictive validity of different admission variables and they have often focused their attention on admission tests.

Using Correlations to Review Admission Decisions

One can measure attributes that relate to academic performance. Correlations consider the degree these measured attributes or variables are related. Ghiselli (1964) provided a general interpretation of the concept of correlation:

> When the scores yielded by two different sets of operations are related, it means that the two variables that they measure have something in common. That is, differences among individuals in one variable are due to some extent to the same factors that determine differences among them in the other variable. (pp. 106-107)

In prediction studies, the score for the first variable is used to predict the score on the second variable. Ghiselli differentiated between the two common types of correlations:

> Simple correlation tells us how well we can predict scores on one variable from scores on another, and multiple correlation tells how well we can predict scores on one

variable from the optimally weighted composite of scores on several other variables. (p. 312)

Correlation coefficients also provide an indication of the magnitude and direction of the relationship.

Grade-Point-Average and Admission Tests

Grade-point-average and admission tests, such as the Dental Aptitude Test (DAT), are two commonly selected variables for education admission studies. Grade-point-average is used as both a predictor and criterion measure of academic performance. Admission test results are used as predictor variables. Preadmission grade-point-average and admission test scores are used individually and as composites to predict college and university academic performance (Borg & Gall, 1989). Upon reviewing research literature pertaining to college and university admission studies in Canada and the United States, grade-point-average appears to be the most commonly used measure of academic performance.

Grade-Point-Average

It is generally recognized that grade-point-average is difficult to predict. Borg and Gall (1989) reported that "many studies have failed to find predictive relationships because a poor criterion was specified ... [and] that GPA is probably a shifting, amorphous criterion" (p. 585). Goldman and Slaughter (1976) attributed the difficulty of predicting GPA to radically different grading standards in different classes and a tendency for low ability students to avoid programs and courses with rigorous grading standards. Boyd and Teteruck (1979) emphasized that grades and grade-point-average are not standardized measures, making comparisons less meaningful. Although there are inherent problems using grades for predicting academic performance, they are the most readily available measure.

Grade-point-average is a composite variable because it is *composed* of grades from various courses. Ghiselli (1964) explained the significance of composite variables:

> Many types of behaviour we wish to predict, such as academic performance or occupational success, are quite complex. Therefore a single test which measures only a restricted scope of traits will not give good predictions itself. Hence we are likely to use a composite of a number of tests each measuring somewhat different traits so as to obtain better predictions of the complex variable. (p. 174)

For this study, different grade composites are employed. There is Admission GPA, Science Average, GPAs for each year of dental school, grade averages for didactic, lab and clinical courses, and the average grades for the fifteen Program Areas within Dentistry. These various grade composites will provide different measures of students' performance before and after admission to Dentistry.

Goldman and Slaughter (1976) hypothesized that grade-point-average (GPA) would provide a better measure of academic performance than individual grades if it acted like a composite variable. They compared correlations for the same admission variables with first-year college GPA and grades from individual courses. The best admission grades and test scores did not translate to the highest college GPAs. They argued that the reason college freshman GPA is not a reliable composite is because students with better admission qualifications tended to select different programs than less qualified college applicants. They concluded that the classes which formed first-year GPA were *non-equivalent.* First-year GPA did not provide a reliable measure for comparing students' academic performance.

There are important distinctions between dentistry students in this study and the college freshman in Goldman and Slaughter's (1976)study. Courses were rarely added or deleted in the Dentistry Program between 1986 and 1992, and many of the course changes that occurred were simply changes in course title. Prior to admission, Dentistry students completed similar science courses and an English course. As a result, preadmission grade-point-average (GPA) and grade-point-average (GPA) in dental school appear to be good

composite measures. As a result, Goldman and Slaughter's findings would not appear to be relevant to academic performance in the Faculty of Dentistry.

For this sample, Admission GPA and Science Average were composite admission variables. It was of interest to examine how these variables correlated with academic performance.

Admission Testing

Standardized admission tests provide a means of comparing the performance of all students who have taken the same test under similar circumstances (Sax, 1989). Admissions tests are generally seen as offering compensation for inadequacies that exist when students' performance is compared on the basis of grades (Aiken, 1988). For this study, preadmission grades and admission test scores were used in combination to rank applicants.

Many critics have maintained that admission testing is invalid. The American Psychological Association (1985) defined validity as "the degree to which a certain inference from a test is appropriate or meaningful" (p.194). Linn (1982) had the following response to the testing controversy:

> Empirical investigations can determine how well ability tests predict grades in college ... Study findings, however, will not determine how or whether an ability test should be used to make selection or placement decisions.
>
> Justification of test use depends on much more than the predictive validity of a test. Potential benefits and losses for the individual, the institution, and the society at large need to be considered, and the relative importance of the benefits and losses can be expected to vary greatly in the eyes of different people. On the other hand, information about the degree of relationship of test scores to particular criterion measures and the degree to which the observed relationship generalizes across situations and, from one population to another, is one important component in the evaluation of the use of tests for selection and placement. (p. 280)

Linn's position indicates many criticisms of admission testing should address the appropriate or inappropriate use of the tests, and not the validity of the instrument per sé. Cronbach (1971) also believed that the integration of many types of evidence is required in order to determine the validity of an instrument.[1]

Correlation and Explained Variance

A common criticism of admission testing is the percentage of variance in the criterion variable that is predicted or explained by the admission variable is very low (Borg & Gall, 1989; Naim, 1980). Correlations provide a measure of the extent that the predictor and criterion variables behave in a consistent pattern. The degree of relationship between predictor and criterion variables can be calculated by comparing the variances of predictor and criterion distributions. However, within the distribution of predictor scores, a closer examination of the individual scores often reveals that there can be a range of criterion scores for different applicants with same admission score. Even when student's predictor and criterion variables are very similar, differences in their rank on the criterion variable commonly occur. Borg and Gall (1989) reported:

> A simple way to understand *explained variance* is to imagine that scores on variable *B* range from 30 to 70. If *A* explained none of the variance in *B*, we could not predict anyone's score on *B* other than to say that it could be as low as 30 or as high as 70 (a range of 40 points). If *A* explained all of the variance *B*, we could predict anyone's score on *B* perfectly, and so our range of prediction would be 0 points. If *A* explained 30 percent of the variance in *B*, we could use *A* to predict anyone's score fairly accurately within a certain range; for example, our prediction of *B* might be a range of 40 to 60 (a range of 20 points). In other words, as the explained variance increases, we can use a person's score on variable *A* to predict his or her score on variable *B* within an increasingly narrow range. (p. 574)

---

1. Elaborations of the Dental Admission Test will be provided in *Chapter 3*.

For admission decisions, the value of explained variance is that it predicts a narrower range of scores. The following example is an adaptation of Borg and Gall's interpretation of explained variance. Scores on variable *B* range from 40 to 80. If *A* explained none of the variance in *B*, we could not predict anyone's score on *B* other than to say that it could be as low as 40 or as high as 80 (a range of 40 points). If *A* explained 30 percent of the variance in *B*, we could use *A* to predict anyone's score fairly accurately within a certain range; for example, our prediction of *B* might be within a range of 45 to 65 (a range of 20 points). In this case, if a score of 50 approximated a pass/fail cutoff, the chance of selecting a student who would have earned a failing mark is less than if a correlation had not been calculated.

The index for the explained variance, achieved by squaring the correlation coefficient, was discounted by Linn (1982), who also cited similar conclusions from previous studies[2] that reported it was often a misinterpreted or misapplied index for evaluating the predictive validity of admission tests. For admission studies, the relative differences between the correlations for various predictor and criterion variables are of interest.

There are two generally acknowledged restriction of range problems inherent in prediction studies that contribute to small but significant correlation coefficients (Borg & Gall, 1989; Linn, 1982; Boyd & Teteruck, 1979; Ghiselli, 1964). First, admission studies are usually performed on restricted samples. Correlations can only be calculated for admitted applicants. The sample is restricted to higher scoring applicants, and as a result, the correlations between admission and criterion variables is reduced. Secondly, the grades in question are typically assigned within a small range of scores. This restriction of range is seen as weakening the degree of the ensuing correlation. The Kress and Dogan (1981) prediction study of the Harvard School of Dental Medicine for Admission between 1972-1980 provided an extreme example of the restriction of range problems. A small number of the best qualified students were admitted from a highly qualified applicant pool, and students' ensuing grades were assigned one of only five possible scores, which were

2. Linn referred to Swinton, 1980; Cronbach and Glasser, 1965; Brogden, 1946; and Taylor and Russell, 1939.

negatively skewed. Scores from the 131 students admitted during the nine year period were analyzed. Kress and Dogan reported they were unable to calculate any significant correlations between college GPA, the DAT Academic Average or the PAT with dental GPA (r = .00, r =.02, r = .10). The researchers concluded that:

> the estimates are spuriously low because of a restricted range of values on either the predictor or outcome scores, or both ... [and] the range restriction experienced in all validation studies of this type apply to this group of students even more than is the case for accepted dental students in general. (p. 209)

However, Yancey and Stewart (1978) analyzed correlations for dental schools with different admission ratios. They contrasted the results between a private school that only admitted 160 of 3000 qualified applicants and a state school which had to maintain a 90% state residency requirement for its 88 available positions, meaning almost 80 of its accepted applicants had to be state residents. The admission ratio for the private school was less than ten percent while the state school accepted over forty percent of its applicants. If their premise was correct, then the state school should have experienced less restriction of range problems and the correlation between its admission and criterion variables should be higher. Their results supported this trend, but they concluded that differences might not be sufficiently large to warrant concern for most dental schools.

Predicting Academic Success

The general rule for predicting academic success is to examine previous academic success (Wilgosh, Kimmis, & Clarke, 1979; Lunneborg, 1977). Professional schools such as dentistry, medicine and law require students to demonstrate good to superior preprofessional academic performance. In addition to academic performance, other variables such as admission test scores, interview data, and letters of recommendation are often included as a part of admission decisions. Bivariate and multivariate correlations are computed in order to measure the relationship between admission variables and academic success (Borg & Gall, 1989).

Bivariate Correlations

Kramer's (1986) study of first and second year performance in 60 American dental schools between 1983-1984 reported that the best bivariate predictor of first and second year GPA was Admission GPA (r = .45, r =.43). Kramer also reported that the DAT Academic Average score, not used in Canada, was a comparable predictor to Admission GPA (r = .45, r = .39). Cherrick's (1985) review of the DAT reported that scores for Academic Average scale correlated with first year GPA (r =.40), while Du Bois (1985) cited correlation coefficients between .00 and .50 for DAT scores and first year GPA. Kramer's results represent a value calculated for all 60 schools while Cherrick reported a range of correlations for studies completed at individual schools. Boyd and Teteruck (1979) evaluated 18 dental school admission studies between 1958-1978 and they concluded that admission grades were the best predictor variables of overall performance in dental school. Staat and Yancey (1982) reported a correlation of .39 between admission GPA and first year dental GPA for 79 University of Louisville students. The admission GPA of University of British Columbia dental students (n=312) admitted over a ten year period between 1969-1979 correlated .36 with first year GPA and .29 with second year GPA (Wood, 1979). Fémandez-Pabõn (1968) studied the 1955, 1965 and 1966 graduating classes (n=40, n=49, n=47) at the University of North Carolina and determined a .37 correlation between admission GPA and dental GPAs. The stronger correlations with first year GPAs versus second year GPAs supports the assumption that the best predictor of academic success is the most recent measure of academic performance. However, other factors should be considered.

Multiple Regression

A goal of admission studies is to determine the best prediction of academic success. Multiple regression analysis tends to yield stronger correlations than bivariate calculations (Borg & Gall, 1989). Linn (1982) reported, "Grades and tests together provide better prediction than either alone" (p.284). For dental admission, the strongest correlations have

resulted from calculating multiple regression coefficients using DAT scores and GPA together, and in combination with one or two other variables (Kramer, 1986; Boyd & Teteruck, 1979; Dworkin, 1970). Kramer calculated multiple regression coefficients of .52 and .49 using Admission GPA and a DAT composite variable for the 1983-1984 first year and second year students from the records of 60 American dental schools. The Admission GPA included science and nonscience courses. The DAT composite variable included measures from the Quantitative, Reading Comprehension, Perceptual Ability, and Total Science scales. Dworkin calculated multiple correlation coefficients for each of the four years attended by 1966 dental graduates (n=134) from the College of Dentistry at New York University. The multivariate index was derived from admission GPA, scores from the DAT Chemistry and Space Relations scales, and years of college prior to admission. Dworkin reported multiple correlation coefficients for first year at .50, second year at .60, third year at .38 and fourth year at .30. The multiple correlation coefficient was .52 for overall GPA. The results from Dworkin's study also revealed the tendency for correlations between admission variables and the yearly GPAs to progressively decrease, providing some support for the premise that the best predictor of academic success is the most recent measure of academic performance. Dworkin's results were probably related to an increase in clinical courses in the third and fourth years of dental school. Clinical courses usually have low correlations with academic subscales of the DAT.

Other Prediction Studies

An preliminary examination of education admission studies for other programs was completed in order to place dental education within a larger framework. The correlation coefficients and predictive trends in dental education were similar to those found for other disciplines. Ledvinka (1985) reviewed 32 prediction studies of first-year students in Master of Business Administration (MBA) programs. The average correlation for the Graduate Management Admission Test (GMAT) was .30. Undergraduate GPA correlated .24 with first-year GPA in graduate school. Ledvinka also reported that combining

undergraduate GPA and a GMAT composite score resulted in a multiple correlation of .38. The Medical College Admission Test (MCAT) had median correlations from .10 to .20 with freshman class rankings in 73 medical schools (Cole, 1972). In 1976 the Law School Admission Test (LSAT) correlated .31 with first year GPA, .31 with second year GPA and .26 with third year GPA in a seven state study by Carlson and Werts, cited in Melton's (1985) review of the LSAT. Finally, as a result of the participation of 246 different graduate departments, the Graduate Record Examination (GRE) correlated with first year graduate school GPA between .20 and .30 (Cohn, 1985). Jaeger (1985) reported that the multiple correlation for the GRE general test score and undergraduate GPA with first year graduate school GPA was between .32 and .56. Admission studies for other post-secondary professional programs yield correlation coefficients with comparable magnitudes to those reported in the dental literature.

Clinical Courses

The clinical versus didactic difference in dental courses was apparent in the literature. Kramer (1986) concluded that the PAT showed the strongest relationship with pre-clinical operative technique courses for freshman and sophomores (r =.26, r = .26) while demonstrating less of a relationship with GPA (r =.15, r = .14). Conversely, Reading Comprehension correlated less with technique average (r = .13, r = .08) and more with first and second year GPA (r = .30, r = .28).

The Carving Test and the PAT produced significant correlations with clinical courses (Boyd & Teteruck, 1979) The authors concluded:

> Although Carving can explain only a small degree of the variance in technique grades, it is the best predictor that is available ... [a cutoff score] will certainly not guarantee a student will succeed, however, it will most likely result in student success as false positives are almost impossible to achieve. (p.416)

Wood's (1979) University of British Columbia study reported Carving correlated .24 with third year GPA. Wood did not report a significant relationship between Carving and first

year dental GPA. In 1977, Thompson reported Carving and PAT correlations with pre-clinical courses at .19 and .15 for the Canadian national population (N=859). Bellanti, Mayberry and Tira (1972) studied three classes of dental students (N=344) registered at the University of Missouri Kansas City and they reported Carving correlated .37 with technique grades. Dworkin (1970) did not report a significant correlation between Carving and first or second year dental theory courses. DeRevere (1961) reported Carving correlated .26 with fourth year clinic courses for the University of Pennsylvania class of 1959. One of the difficulties comparing correlations for clinical courses is it is unclear how the variables were defined. For example, similarities or differences between clinical courses and technique courses are unclear in the research literature.

Interview

The research literature pertaining to the admission interview for college admissions and professional programs in post-secondary education, including Dentistry, questions what the interview contributes to the application process (Shahani, Dipboye & Gehrlein , 1991; Sax, 1989; Myslinski & Jeffrey, 1985; Fuller, Killip and Kerber, 1979). Regardless of the specific structure of the interview, it appears that personal attributes such as motivation and communication skills were of primary interest although "Data obtained from the interviews have not usually been accurate predictors of such diverse criteria such as grades [and] supervisory ratings" (Sax, 1989, p. 515). Sax did indicate that structured interviews rather than unstructured interviews yielded better correlations with criterion measures. However, even structured interviews are prone to interviewer biases which can decrease its predictive validity (Sax, 1989, Myslinski & Jeffrey, 1985).

Myslinski and Jeffrey (1985) surveyed 59 American Dental Schools to discover why the interview is such a popular admission prerequisite for dental schools. They reported that approximately 70% of the questionnaires were returned and most interviewers wanted:

> to get to know the applicant as a person. They evaluate [the applicant's] motivation, knowledge about dentistry, communication skills, and most of all, [the applicant's]

> character and personality. They are as concerned with what type of citizen and human being the applicant will be as they are with whether or not [the applicant] will succeed in dental school. By choosing better human beings, they hope to make better students, better dentists and a better dental profession. (p. 177)

Myslinski and Jeffrey appeared somewhat skeptical about the idealization of what the interview can provide, suggesting other factors, which they did not identify, operate to determine the nature of dental practice. They proposed that the interview is underutilized in two ways. It could be used as a tool to evaluate special cases and as a recruitment tool.

The academic admission interview is believed to measure noncognitive attributes such as motivation or communication. Shahani, Dipboye and Gehrlein (1991) concluded that previous research has not determined if the interview possesses value in college admission. According to Shahani *et al.*:

> the few studies that do exist have ignored the crucial issues of whether interviews can improve prediction over the levels achieved with test scores, grades and other paper credentials ... [and] an interview with low validity might be useful if it succeeds in measuring characteristics difficult to measure by other means. On the other hand, a highly valid interview may not be cost effective if it duplicates information provided by standardized tests and other paper credentials. (p.1050)

Shahani *et al. did* not discover any *incremental validity* of interviewer judgments when SAT scores and grades were used to predict academic success for college freshman at a private university (n=331). Although they reported that the admission interview provided information which was distinct from *paper credentials*, it was paper credentials rather than the interview that provided some prediction of GPA. Finally, they reported that the interview was more predictive of liberal arts GPAs (r =.21) than science or engineering GPAs (r = .04). However, if SAT scores and student rank were included in the regression analysis, the interview failed to significantly boost the multiple correlation coefficient.

Fuller, Killip and Kerber (1979) completed a validity study of the Selection Research Inc. (SRI) Structured Dental Interview at the University of Iowa. Fourth year students (n=86) rated themselves and one another, and they were rated by supervising clinical faculty members. Those results were correlated with their SRI interview scores. Fuller *et al.* reported significant ($p < .05$) correlations between clinical supervisors ratings and interview scores. Fuller et al then proceeded to correlate the interview results with students' dentistry performances. Overall GPA correlated .21 with the interview. Technique and operative grades correlated .25 with the interview. They also reported that students with academic problems tended to score lower on the interview.

Staat and Yancey (1982) reported that their interview score correlated .20 with first-year GPA for 77 students at the Louisville School of Dentistry (n=77). The interview covered topics including:

> knowledge of the field of dentistry, the working background of the applicant, the quality of his or her attempted curriculum, recognition of artistic achievement, contributions to community and nonacademic programs, and an overall assessment of the applicants maturity. (p. 500)

Adding the interview variable to the predictor equation did lead to promote an increase in incremental validity (Staat & Yancey, 1982).

At the University of Alberta, its 1993-94 Calendar states that Dentistry applicants will be interviewed by a team to determine if they possess the personal qualities necessary for the profession, including maturity, motivation, initiative, ability to communicate, and personal qualities and interests. A structured interview, recommended by the Canadian Dental Association, is used. More information about the interview is provided in Chapter Three.

Admission Index

The purpose of Staat and Yancey's (1982) Louisville School of Dentistry Study was to improve the predictive validity of the admission variables. They intuitively developed an

Admission Index that weighted academic averages sixty percent and personal and developmental attributes forty percent. Their admission index correlated .67 with first-year dental school GPA. This compared to correlations between first-year GPA and other variables such as .51 for the DAT Academic Average, .39 for admission GPA, .38 for science average and .29 for the PAT score. This informal variable produced a very strong correlation with first-year marks.

Summary of Literature

Admission studies have often reported significant correlations ($p < .05$) between many admission variables and criterion measures such as GPA. The magnitude of reported correlation coefficients was low to moderate (Cherrick, 1985; Du Bois, 1985). It was often calculated as a *Pearson Product-Moment* correlation. Correlation coefficients were usually .40 or less in dental school (Kramer, 1986; Boyd & Teteruck, 1979) and for other post-secondary programs as well (Cohn, 1985; Ledvinka, 1985; Cole, 1972). The coefficient of determination, or explained variance, is an inappropriate *index* for admission studies (Linn, 1982). The value of explained variance is that as r^2 increases, the range of predicted scores decreases (Borg & Gall, 1989). The low correlation coefficients reported in dental admission studies are, in part, attributable to restrictions of range. Range restrictions, which limit the variance and predictive validity of admission variables, occurred because only successful applicants could be studied and grades for dental students were usually assigned within a small range (Kress & Dogan, 1981; Yancey & Stewart, 1978). Grades and GPAs were described as amorphous shifting criterion (Borg & Gall, 1989). Differences in course content between various dental programs and differences in marking contributed to the "amorphous" rubric (Goldman & Slaughter, 1976).

Correlation coefficients provide a means for identifying the best predictor variables. Composite predictor variables that measure somewhat different traits should provide better predictions of complex variables (Ghiselli, 1964). Composite GPAs and equivalent course averages yielded stronger prediction coefficients than GPAs for non-equivalent courses

(Goldman & Slaughter, 1976). Admission GPA, science average and DAT academic tests often provided the best prediction of GPA while Carving and PAT scores were more predictive of Clinical courses (Kramer, 1986; Boyd & Teteruck, 1979). There was some support for the predictive validity of interview scores (Staat & Yancey, 1982; Fuller, Killip & Kerber, 1979), but the utility of standardized interviews was questioned because of a lack of incremental validity (Shahani, Dipboye & Gehrlein, 1991). More recently, some researchers (Staat & Yancey, 1982) have developed an Admission Index which correlated higher than regression coefficients with dental GPA. Dental schools were generally recommended to perform their own prediction studies in order to account for the unique qualities within their programs (Boyd & Teteruck, 1979).

CHAPTER THREE: METHOD

This chapter provides a detailed description of how this study was constructed in order to examine the relationship between admission variables and academic performance for dentistry students admitted during 1986-1992. This chapter is designed so that other investigators could "replicate the study if they so desire" (APA, 1990, p. 25). Chapter Three includes a description of the sample and the variables used in the analysis.

Research Design

This section outlines how the data for this study was organized and analyzed. *Pearson Product-Moment* correlation coefficients were calculated to determine the magnitude of the relationship between predictor and criterion variables. Means and standard deviations, t-tests, correlation matrices, and multivariate correlation's were calculated with the statistical program *SPSS® for the Macintosh.* The *Microsoft Excel (Version 4)* spreadsheet program for Macintosh computers was used to organize and store student records. Variables, such as Didactic or Clinical Average, were also created with the spreadsheet program. The original *Michigan Terminal System (MTS)* admission file and class records were converted to *Microsoft Excel* spreadsheets using *MacTie* computer communication software. A *SYLK* data file was developed using *Microsoft Excel.* It contained the student records provided by the Faculty of Dentistry, including the variables created for this study.

Student Confidentiality

Student names and IDs were unknown to the researcher. Before individual student records were available for organization and analysis, they were assigned coded identification numbers by a member of the Faculty of Dentistry. Individual student records were accessed in class records that were also coded before being released for analysis. The original *MTS* files provided by the Faculty of Dentistry were destroyed upon completion of this thesis. Dr. R.C. Kimmis, a faculty member of the Educational Psychology Department at the University of Alberta, retained a copy of the *SYLK* data file used for this analysis. All other working files were also destroyed upon this project's completion.

Sample

The sample consisted of Doctor of Dental Surgery (DDS) undergraduate students who attended the University of Alberta between 1986 and 1992. The *School of Dentistry* was founded in the Faculty of Medicine in 1917. The Faculty of Dentistry was established in 1944. At University of Alberta, the DDS is a 4 year bachelor degree approved by the Canadian and American Dental Associations. Table 1 outlines fifteen Program Areas in Dentistry designated in the University of Alberta calendars for the period of this study (See Appendix A for which courses were designated in each of the Program Areas).

Table 1.
Dentistry Program Areas and Courses

Anesthesia	Oral & Maxillofacial Surgery
Basic Sciences	*and* Hospital Dentistry
Dental Health Care	Oral Biology
Dental Materials	Orthodontics
Diagnosis	Pediatric Dentistry
Endodontics	Periodontics
Fixed Prosthodontics	Radiology
Operative Dentistry	Removable Prosthodontics

Note: Courses were identified from the University of Alberta Calendars for the 1986-1992 period.

University of Alberta dental students are admitted on a competitive basis. This sample represents approximately one-eighth of the total applicant pool[3]. In 1986, 50 students were admitted from 209 qualified applicants identified from 363 original applications. In 1987, 50 students were admitted from 186 qualified applicants identified in 385 applications. In 1988, 50 students were admitted from 423 applicants. For the 1990 admission class, 50 students from 366 applicants were admitted. In 1991, 30 students were admitted from 208 qualified applicants identified from 371 applications. In 1992, 32 students were identified

3. From unpublished admission summaries provided by the Faculty of Dentistry.

from 272 applicants, of which 146 were qualified. The declining enrollment reflected budget considerations by the Faculty of Dentistry. The majority of admitted students were Alberta residents. Students in this sample normally completed at least two years of university work prior to admission, the Dental Aptitude Test, and the Interview.

Admission Variables and Dental GPAs

The average age of first-year students was 22.5 (*SD*=3.3) and ranged between 19 and 38 years. Approximately two-thirds of the records for 99 female and 221 male students indicated 2 to 4.5 years of admission courses. Table 2 presents the means and standard deviations for the admission variables of students in attendance from 1986-1991.

Table 2.

Admission Variables: Means and Standard Deviations(n=316)

Variable	Mean	*SD*	Possible Scores
Admission GPA	7.53	.40	6.5† or greater
Science Average	7.48	.49	6.5† or greater
Reading	19.96	2.52	15†† - 30
Carving	19.25	3.61	15†† - 30
PAT	19.34	3.17	15†† - 30
Interview	27.11	5.42	40††† maximum

†*Indicated in the University of Alberta Calendar.* ††*The Faculty of Dentistry recommended cutoff score was 15 although some scores were 14 if students had good to excellent grades.* ††† *Cutoffs determined annually.*

With reference to Table 2, the University of Alberta uses a nine-point grading system. According the University of Alberta Calendar, a score of 3 or less constitutes a failing grade. Scores of 4 or 5 are considered *satisfactory*, 6 and 7 are *good* and 8 or 9 are *excellent.* The mean Reading, Carving and PAT scores were between 19 and 20. For this sample, the Carving score had the greatest variance of the three DAT tests.

Table 3 presents the mean GPAs for each of the four years of dental school. Combined GPA is the average GPA for the four years of dental school. It was only

calculated for students who finished the program. (T-Tests for Table 3 are reported in Appendix B.)

Table 3.

Dental GPAs: Means and Standard Deviations

Year	Mean	Standard Deviation	*n*
GPA1	6.83	.67	316
GPA2	6.92	.58	314
GPA3	6.80	.59	284
GPA4	6.97	.61	233
Combined GPA	6.86	.52	233

Admission variables and dental GPAs by gender. Table 4 presents the mean values for admission variables by gender. Female Interview scores were significantly higher than the same Male scores. Male PAT scores were significantly higher than Female PAT scores. All of the other mean differences in Table 4 were insignificant (see Appendix C).

Table 4.

Female and Male Admission Variables: Means and Standard Deviations

	Females (n=98)		*Males (n=218)*	
	Mean	*SD*	*Mean*	*SD*
Admission GPA	7.58	.41	7.51	.39
Science Average	7.51	.48	7.46	.49
Reading	20.23	2.87	19.84	2.34
Carving	18.87	3.61	19.42	3.61
PAT	18.49	2.34	19.72	3.41
Interview	28.10	5.17	26.66	5.48

Table 5 presents the mean dental GPAs by gender. Differences for mean GPAs between Females and Males were insignificant (see Appendix C).

Table 5.

Female and Male Dental GPAs: Means and Standard Deviations

	Female			*Male*		
	Mean	*SD*	*n*	*Mean*	*SD*	*n*
GPA1	6.75	.71	98	6.86	.64	218
GPA2	6.97	.61	98	6.89	.56	216
GPA3	6.82	.60	89	6.80	.58	195
GPA4	7.01	.56	73	6.95	.63	160

Didactic, Lab & Clinical Courses and Program Areas

Table 6 presents the cumulative proportion of didactic, lab and clinical courses through the progression of the four year program, as listed in the University of Alberta Calendars for the period of this study (see Appendix D for Didactic, Lab and Clinical course listings by year).

Table 6.

Proportion of Didactic, Lab and Clinical Courses

	Year			
Courses	1	2	3	4
Didactic	.27 /.27	.31 /.58	.24 /.82	.18 /1.00
Lab	.52 /.52	.33 /.85	.10 /.95	.05 /1.00
Clinical	.06 /.06	.16 /.22	.31 /.53	.47 /1.00

The average grades for didactic, lab and clinical courses, referred to as Didactic, Lab and Clinical Averages, are summarized in Table 7. There was a significant difference between Mean Didactic and Lab Averages (see Appendix E).

The average grades for courses in the fifteen Program Areas of Dentistry are presented in Table 8. Program Areas with the greatest variance in grades were Orthodontics, Dental Materials and Operative Dentistry. Periodontics and Dental Health Care Averages had the least variance.

Table 7.

Didactic, Lab and Clinical Averages

	Didactic			*Lab*			*Clinical*		
Year	*Average*	*SD*	*n*	*Average*	*SD*	*n*	*Average*	*SD*	*n*
Mean	6.90	.57	316	6.95	.55	316	6.94	.54	316
First	6.87	.64	316	6.77	.71	316	6.92	.70	316
Second	6.92	.62	314	7.15	.55	314	6.83	.65	314
Third	6.85	.64	284	7.12	.75	284	6.86	.59	284
Fourth	6.99	.57	233	7.45	1.26	233	7.03	.60	233

Didactic, Lab and Clinical GPAs calculated using corresponding proportion of courses for each completed dental year .

Table 8.

Dentistry Program Areas: Means, Standard Deviations and Ranges Program

Area	Mean	Standard Deviation
Basic Sciences	7.17	.71
Anesthesia	7.01	.50
Dental Health Care	7.13	.49
Dental Materials	7.11	.84
Diagnosis	6.70	.67
Endodontics	7.12	.55
Fixed Prosthodontics	6.69	.70
Operative Dentistry	6.91	.73
Oral & Maxillofacial Surgery	6.83	.60
Oral Biology	6.74	.70
Orthodontics	6.70	.85
Pediatrics	6.57	.57
Periodontics	7.12	.45
Radiology	7.24	.57
Removable Prosthodontics	6.75	.67

(n=233)

Dentistry Admission Requirements

In accordance with the University of Alberta Calendar regarding undergraduate admissions, the final selection of dental applicants is based on their Admission GPA, Science Average, the Dental Aptitude Test Scores, and the Interview scores.

Admission Grades

Admission GPA is a cumulative grade-point-average for at least 2 years of study which can be credited at the University of Alberta. It must include at least six credits of English. There is a provision for applicants with at least four years of predental study. The cumulative average is calculated with the deletion of the lowest annual average, provided it is not the most recent year. However, any applicable science courses during the depleted year remain included in the Science Average. The Science Average is the average of grades from courses including anatomy, biochemistry, biology, botany, chemistry, genetics, microbiology, pharmacology, physics, physiology, psychology, and zoology. Of those science courses, students were required to have at least completed course-work in (a) introductory chemistry, (b) organic chemistry, (c) two of introductory botany, genetics, microbiology or zoology, and (d) introductory physics. Students with Admission GPAs or Science Averages less than 6.5 on the nine-point scale will not be considered for admission.

Dental Aptitude Test

The Canadian Dental Association Aptitude Test[4] is a standardized criterion-referenced test used to select students who demonstrate aptitude for completing dental school. The attrition rate was ten to eighteen percent in American dental schools prior to the use of the DAT. Attrition dropped to three percent when the DAT was implemented in the United States, around 1950 (Teteruck, Boyd & Teteruck, 1979). The DAT was first administered in Canada in 1967. The DAT Reading Comprehension, Carving and Perceptual Ability Test scores were used as admission criteria at the University of Alberta. Test reliability,

4. From Teteruck, Boyd and Teteruck (1979) and Graham and Boyd (1982a) for DAT review and Graham and Boyd (1982b) for Interview review.

based on the KR21 formula, was greater than 0.80 for the three DAT tests. Items were selected with a difficulty level between 0.4 and 0.6, which usually results in a normal distribution. The current 30 point scale is based on the log ability scale from the Rasch psychometric model. The Rasch Model is based on item-response theory and assumes reading comprehension, chalk carving and the PAT measure unidimensional latent traits (Sax, 1989). The Canadian Dental Association previously recommended cutoff scores at the 40th percentile when it used the norm referenced scale (Graham & Boyd, 1982b). DAT scores were not recommended for use as the sole or primary criterion for admission decisions. During the period of this study, the scale was revised and DAT scores for some students were converted to the new scale by the Faculty of Dentistry before the records were released.

Reading Comprehension Test. The Reading Comprehension Test in Dental Sciences contains a written passage with subject matter not normally found in undergraduate courses. Multiple choice test items assess students' comprehension of concepts and ideas presented in the passage. The Reading Comprehension Test was designed to simulate dental science reading demands. Since 1989, the Reading Comprehension Test has adapted 3 shorter passages instead of the original single longer passage in order to make statistical comparisons of the test scores administered at different settings. The average Reading Comprehension score for this sample (Table 2) was 19.96 (*SD*=2.52).

Carving. The Carving test requires applicants to carve a piece of soap (previously chalk) using a ruler and a knife. A figure is carved according to predetermined specifications. The test is graded on the degree to which the surfaces are flat and smooth, the degree to which the angles are correct and clean cut, and the degree to which the finished product is symmetrical. The Carving test measures abilities to follow directions, to visualize in three dimensions, and manual dexterity. The average Carving score for this sample (Table 2) was 19.25 (*SD*=3.61).

Perceptual Ability Test (PAT). The Perceptual Ability Test, developed in 1968, tests perceptual abilities involving line and angle discrimination, block counting, spatial relationships and object visualization. There are two-dimensional and three-dimensional sections each comprising 75 items. University of Alberta uses the average of the two scores for admission purposes. The PAT was designed to test the ability to perceive small differences in shape and form. The average PAT score for this sample (Table 2) was 19.34 (*SD*=3.17).

Dental Admission Interview

A pilot study was completed in 1980 with University of Alberta and University of British Columbia students to assess the Dental Admission Interview. A factor analysis was completed using the following DAT scales (Reading Comprehension, Science, Carving and PAT), and the Admission Interview. Information about the organization of the interview and the types of questions asked are not readily available in order to maintain the integrity of the instrument. Four factors were identified: personality, academic achievement, carving ability and perceptual characteristics. The interview was designed to identify potential student characteristics including: motivation, self-appraisal, maturity, ability to relate, adaptability and responsibility to obtain a personal reaction from the interviewer. These characteristics loaded from .72 to .88, with a mean of .82, on the personality factor. Inter-rater reliability was very high, averaging .95. Eight 5 point ratings comprise the interview score, for a maximum of 40 points. The interview score that was provided in the students' records was the average score of the three raters across the eight sections. A composite interview score was recommended as a better index than indices from a sub-score analysis. The average interview score for this sample was 27.11 (*SD*=5.42). Graham and Boyd (1982b) reported that the interview was reliable but its predictive validity needed to be assessed.

Procedure

In order to complete this analysis, the original dentistry files were merged and sorted. New variables were created. Correlation matrices and step-wise regression coefficients were calculated for the admission variables and the various criterion variables. Gender was treated as a distinct variable and correlation matrices were recalculated on the basis of gender. Identifiable failure and attrition records for first and second year were examined. Means and simple correlations were calculated for the top and bottom fifteen percent of this sample. For this analysis the sample was sorted according to rank on combined GPA and the average of Admission GPA and Science Average

Creating the Data File

A single data file was created in order to calculate the correlation coefficients presented in this study. Spreadsheet files containing all of the converted dental school records were organized by dental year then merged together with the converted admission file. Records were organized by row and identification numbers were sorted in ascending order. Admission and dental school variables were organized by column. The new variables that were created for this study were created using the spreadsheet program and they were also designated by column.

Student records were converted from *MTS* data files listed in Table 9 to Excel spreadsheet files then merged in order to perform this analysis. Faculty of Dentistry files

Table 9.

Files Provided by the Faculty of Dentistry

File Type	*N*
Admission	1
First Year	7
Second Year	7
Third Year	6
Fourth Year	5

containing complete and partial records for 328 students were accessed in 26 separate files. One file contained all of the admission records. The remaining files contained class records from 1986-1992.

Class records included assigned grades and weighted GPAs. A typical dental graduate had records in five files: the admission file and files for each of the four years of dental school. A non-typical dental graduate had records in six files if he or she failed then repeated a year. Twelve records were incomplete. Admission records were incomplete or the admission or dental school records did not have necessary records from corresponding files. Table 10 presents the number of valid records used in this analysis.

Table 10.

Sample size

Year of Dental School	Valid Records
First	316
Second	314
Third	284
Fourth	233

Summary of Admission Criteria

The Faculty of Dentistry did not consider applicants with Admission GPAs (mean = 7.53) or Science Averages (mean = 7.48) less than 6.5. A cutoff score of 15 was used as a guideline for evaluating DAT Reading Comprehension (mean = 19.96), Carving (mean = 19.25) and PAT (mean = 19,34) scores. A cutoff for the Interview (mean = 27.11) score was established annually by the Dental Admission Committee.

Correlation Coefficients

Correlation matrices and regression analysis for dental GPAs were completed with the admission variables and dental GPAs. Didactic, Lab and Clinical variables were created by averaging the grades assigned to the courses designated in those areas. Variables for the fifteen Dentistry Program Areas were also created by averaging the grades to courses designated in each of those areas. Dentistry underwent some course changes during the

period of this study. The Didactic, Lab and Clinical variables, and the variables for the fifteen Program Areas were calculated from whatever courses were completed for each individual record.

Correlation Matrices. Correlation matrices were calculated. Admission Variables were correlated with (a) Admission variables, (b) dental GPAs, (c) Didactic, Lab and Clinical variables, and (d) variables for the fifteen Dentistry Program Areas. Admission variables and dental GPAs were also sorted by gender. Correlation matrices for admission variables and dental GPAs were calculated for males and females. A correlation matrix for dental GPAs was also calculated. Significant and insignificant *Pearson Product-Moment* correlation coefficients were reported. Significant coefficients were reported at the .05 and .01 levels for two-tailed tests.

Multiple Regression Analysis. A *stepwise* multiple regression analysis was calculated in order to generate an *R* value that accounted for an optimal percentage of explained variance.

Exceptional Files. Student records were examined and records that indicated failure or attrition due to inadequate academic performance for first or second year were analyzed. Students who voluntarily withdrew at the completion of a dental year could not be identified from the records that were provided. Student records were ranked twice, on the basis of the admission variables and dental GPA, in order to examine similarities and differences between the top and bottom 15% of the sample. Means and standard deviations were determined. Correlation matrices were also calculated.

CHAPTER FOUR: RESEARCH FINDINGS

The results of this study are reported in four sections of this chapter. Correlations for admission variables and GPAs are reported in the first section. The results of a regression analysis for admission variables and dental GPAs are also included in the first section. Correlations between admission variables and dental GPAs by gender comprise the next section of this chapter. The third section is devoted to an examination of the correlations for admission variables with Didactic, Lab and Clinical variables, and variables for the fifteen Program Areas within the Faculty of Dentistry. Variables for students with unsatisfactory academic standing and student records ranked in either the bottom or top one-sixth of this sample are examined in the final section of Chapter Four.

Admission Variables and Dental GPAs

For the preliminary analysis, a correlation matrix was calculated using admission variables and dental GPAs. The results are presented in Tables 11-13. Table 11 presents

Table 11

Admission Variable Matrix

Admission Variables	1	2	3	4	5	6	7	8
1 Admission GPA	1.00	.76**	.21**	.01	.01	.10	-.13*	-.25**
2 Science Average		1.00	.23**	.01	.08	.07	-.15**	-.31**
3 Reading			1.00	-.04	.08	.07	-.10	-.04
4 Carving				1.00	.24**	.18**	.12*	.10
5 PAT					1.00	-.02	-.06	.03
6 Interview						1.00	.10	.12*
7 Age							1.00	.56**
8 Years of Predentistry								1.00

*$p < .05$ **$p < .01$ (two-tailed test).*

the correlation matrix for admission variables. For the admission variables, clearly the strongest correlation was between Admission GPA and Science Average ($r = .76, p < .01$).

A number of the same courses were used to calculate both values, which accounted for almost 58% of the explained variance. Otherwise, the next strongest relationship was between Carving and PAT (r =.24, p < .01). Reading correlated with Admission GPA (r = .21, p < .01) and Science Average (r =.23, p < .01), providing support for the strong relationship already reported between Admission GPA and Science Average. The lack of correlation between Admission GPA, Science Average or Reading with either Carving or PAT, seem to indicate that these variables are independent. Finally, Interview did not correlate with Admission GPA, Science Average or Reading. Interview correlated (r = .18, p < .01) with Carving but not with PAT. Even though Interview, Admission GPA, Science Average and Reading all have a strong language comprehension component. Interview appears to measure something distinct from the other three variables.

In Table 11, Age correlated significantly with Years of Predentistry (r = .56, p < .01). It is not surprising that many older students attended school longer than younger students. The significant negative relationship between Years of Predentistry and either Admission GPA (r = -.25, p < .01) or Science Average (r = -.31, p < .01) suggested that students who completed the fewest courses prior to admission tended to have higher Admission GPAs.

Table 12.

Correlation Matrix: Dental GPAs

	GPA1	GPA2	GPA3	GPA4
GPA1	1.00	.68**	.53**	.50**
GPA2		1.00	.80**	.70**
GPA3			1.00	.78**
GPA4				1.00

*p < .05 **p < .01 *(two-tailed test)*

Table 12 presents the correlation matrix for dental grade-point-averages. GPA2 and GPA3 had the strongest correlation (r =.80 , p < .01). GPA2, GPA3 and GPA4 all

correlated greater than .70 with one another, providing support for the belief that grade-point-average is the best predictor of grade-point-average. GPA1 only accounted for 25% of the explained variance of GPA4. This trend appears to reflect changes in the University of Alberta dental program after first year.

Table 13.

Correlations between Admission Variables and Dental GPAs by Year

Admission Variables	GPA1	GPA2	GPA3	GPA4
Admission GPA	.30**	.31**	.24**	.18**
Science Average	.31**	.34**	.28**	.21**
Reading	.34**	.25**	.14*	.07
Carving	.04	.21**	.17**	.15*
PAT	.11*	.09	.17**	.15*
Interview	.07	.21**	.18**	.13
Age	.03	.10	.05	.08
Years of Predentistry	.06	-.01	.00	.00

*$p < .05$ **$p < .01$ *(two-tailed test).*

GPA1 still had a stronger correlation with subsequent GPAs (Table 12) than the other admission variables presented in Table 13. The greatest correlation coefficient in Table 13 occurred twice, for Science Average with GPA2 and Reading with GPA1 ($r = .34, p < .01$). Admission GPA and Science Average were the only two admission variables that correlated at the .01 level of significance for each of the four Dental GPAs.

For the *non-grade-based* admission variables in Table 13, Reading had the greatest correlation with GPA1 and GPA2 ($r = .34$; $r = .25, p < .01$) Carving had significant correlations with GPA2 ($r = .21, p < .01$), GPA3 ($r = .17, p < .01$) and GPA4 ($r = .15, p < .05$). PAT did not correlate with GPA2 but it correlated significantly with GPA3 ($r = .17, p < .01$) and GPA4 ($r = .15, p < .05$). Interestingly, PAT also correlated significantly with GPA1 ($r = .11, p < .05$), whereas Carving did not. Dental GPAs did not correlate significantly with Age or Years of Predentistry.

The purpose of the *stepwise-regression* analysis was to optimize the predictive power of the admission variables and assess the incremental contribution of those variables. The first step was to select the admission variable that correlated best with GPA. In accordance

Table 14.

Stepwise Regression of Admission Variables on Dental GPAs

Admission Variables	Beta	Correlation Coefficient *(r)*	Multiple Correlation *(r)*	Increase
GPA1				
1. Reading	.28	.34**	.34	.00
2. Science Average	.29	.31**	.41	.07
3. Years Predent.	.16	.06	.44	.10
GPA2				
1. Science Average	.30	.34**	.34	.00
2. Carving	.18	.21**	.40	.06
3. Reading	.19	.25**	.44	.10
4. Age	.14	.10	.46	.12
5. Interview	.13	.21**	.48	.14
GPA3				
1. Science Average	.25	.28**	.28	.00
2. Carving	.11	.17**	.32	.04
3. Interview	.15	.18**	.35	.07
4. PAT	.12	.17**	.37	.09
GPA4				
1. Science Average	.20	.21**	.21	.00
2. Carving	.14	.15*	.25	.04
Combined GPA				
1. Science Average	.33	.34**	.34	.00
2. Reading	.03	.23**	.38	.04
3. Carving	.02	.15*	.41	.07

*$p < .05$ **$p < .01$. *Variables selected for this analysis were Admission GPA, Science Average, Reading, Carving, PAT, Interview, Age, Years of Predentistry (Years Predent.).*

with stepwise-regression, the next best variable was the variable that correlated as little as possible with the first admission variable but as highly as possible with Dental GPA. Variables in this analysis were only selected if they provided a significant ($p < .10$) contribution to the equation. Table 14 presents the results of the stepwise analysis for GPA with each year of dental school. It was not surprising that Admission GPA was not selected because of its high degree of *collinearity* (Borg & Gall, 1989) with Science Average. GPA2 had the highest multiple correlation with Admission Variables ($r = .48$). The greatest incremental gain using multiple correlation as compared to a simple correlation occurred for GPA2 (.14). The gains due to stepwise-regression for GPA1 and GPA3 were .12 and .09. The multiple correlation coefficient for GPA4 only provided a .04 improvement over Science Average, the best bivariate predictor of fourth year GPA. The stepwise-regression provided .07 gain for Combined GPA. Science Average was the only admission variable common to each stepwise analysis. Reading contributed to the GPA1, GPA2 and Combined GPA regressions, but not for GPA3 or GPA4. Carving contributed to the GPA2, GPA3, GPA4 and Combined GPA regressions. In addition to Carving, PAT was selected for the GPA3 regression. For GPA2 and GPA3 the incremental contribution by Age or Interview to R was minimal. In Tables 13 and 14, Science Average appears to be a better composite admission variable than Admission GPA. In Table 14, Interview did not provide a substantial contribution to the regression analysis.

Gender Differences

The results from the bivariate analysis of Admission Variables with Dental GPAs for females and males are presented in Table 15. Science Average and Admission GPA correlated significantly with each of the four Dental GPAs when gender differences were not considered (Table 15). However, in Table 15 Science Average correlated significantly with each Dental GPA for males while it failed to correlate significantly with GPA4 for females and its level of significance decreased for GPA1. There were also differences in significant correlations between Admission GPA and Dental GPAs for males and females.

Although the correlations for Admission GPA and Science Average with Dental GPAs tended to be higher for males than females, differences in r^2 were minimal.

Table 15.

Correlations between Admission Variables and Dental GPAs by Gender

	GPA1	GPA2	GPA3	GPA4
Female	*n=98*	*n=98*	*n=89*	*n=73*
Admission GPA	.28**	.24*	.21*	.14
Science Average	.25*	.28**	.29**	.17
Reading	.48**	.34**	.15	.26*
Carving	-.19	-.01-	.05	-.08
PAT Score	-.05	-.11	-.11	-.18
Interview	.07	.17	.26*	.17
Age	.02	.10	.03	.05
Years of Predentistry	.00	-.14	-.14	-.13
Male	*n=218*	*n=216*	*n=195*	*n=160*
Admission GPA	.32**	.34**	.25**	.19*
Science Average	.35**	.36**	.27**	.23**
Reading	.27**	.18**	.13	-.03
Carving	.15*	.32**	.28**	.25**
PAT Score	.16*	.17*	.27**	.26**
Interview Score	.09	.22**	.13	.10
Age	.02	.11	.06	.09
Years of Predentistry	.09	.05	.06	.05

*$p < .05$ **$p < .01$ (two-tailed test)*

Reading correlated significantly with GPA1 for females ($r = .48, p < .01$). This was the strongest bivariate correlation determined for any admission variable in the GPA analysis. For females, Reading also correlated significantly with GPA2 ($r = .34, p < .01$). For males, Reading correlated significantly with GPA1 ($r = .27, p < .01$) and GPA2 ($r = .18, p < .01$). By squaring the correlation coefficient, Reading accounted for 23 percent of the explained variance of GPA1 for females, as compared to a value of 7% for males. For

females, Reading also correlated significantly with GPA4 ($r = .27, p < .01$). In contrast, the same relationship for males was $r = -.03$. However, Carving and PAT did not correlate significantly with any Dental GPAs for females. Carving correlated significantly with GPA1, GPA2, GPA3 and GPA4 for males. For males, PAT also correlated significantly with GPA1, GPA2, GPA3 and GPA4. Interview correlated with GPA3 ($r = .26, p < .05$) for females and GPA2 for male s ($r = .22, p < .01$).

Didactic, Lab and Clinical Differences and the Dentistry Program Areas

Table 16 presents the correlations between admission variables and Didactic, Lab and Clinical variables. Didactic correlated best with Reading ($r = .37, p < .01$), Science Average ($r = .33, p < .01$) and Admission GPA ($r = .29, p < .01$). Didactic did not correlate significantly with Carving, PAT or Interview. Clinical correlated

Table 16.

Correlations for Admission Variables and Didactic, Labs and Clinical Courses(n=316)

Admission Variable	*Criterion Variable* Didactic	Lab	Clinical
Admission GPA	.29**	.27**	.12*
Science Average	.33**	.29**	.15**
Reading	.37**	.23**	.06
Carving	.04	.11*	.19**
PAT Score	.09	.14*	.15**
Interview Score	.10	.18**	.16**
Age	.02	.06	.08
Years of Predentistry	-.01	.03	.04

*$p < .05$ **$p < .01$ (two-tailed test)*

significantly with Science Average ($r = .15, p < .01$) and Admission GPA ($r = .12, p < .05$). Science Average was the only variable that correlated with Didactic and Clinical variables at the .01 level of significance. Age and Years of Predentistry did not correlate significantly with Didactic, Lab or Clinical variables.

Table 17 presents the correlations between admission variables and Didactic, Lab and Clinical variables for each year in Dentistry. Admission GPA, Science Average and Reading correlated less with Third and Fourth Year Didactic variables than First and Second Year Didactic variables. Science Average and Reading had greater correlations than Admission GPA with Didactic variables. For Didactic variables, Science Average, Reading and Admission GPA were significantly correlated. Interestingly, Reading had the strongest correlation with the First Year Clinical variable rather than Carving or PAT. Admission GPA, Science Average, Carving, PAT and Interview all correlated significantly with the Fourth Year Clinical variable. Reading was noticeably missing from that group. Interview correlated significantly with Clinical Courses for each of the four years of dental school but it failed to correlate at all with Didactic Courses. It is also of interest to note that in Table 17, the largest correlation was between Interview and Second Year Lab Courses ($r = .40$, $p < .01$) for reasons that are not intuitively obvious. Second Year Lab Courses included Fixed Prosthodontics, Endodontics, Pediatric Dentistry, Radiology, Anesthesia and General Pathology.

Table 18 presents the correlations between admission variables and the fifteen Program Areas in Dentistry. Science Average was the only admission variable that correlated significantly with academic performance for all fifteen Program Areas. If one examines the relationship between Admission GPA and Science Average in Table 18, Science Average had higher correlations with grades in all areas except Dental Health Care. Carving and PAT correlated significantly with 5 of the same Program Areas and they both had insignificant relationships with 7 of the same Program Areas. Periodontics correlated with the fewest admission variables while Endodontics and Radiology were the only two Program Areas that correlated significantly with the six admission variables in Table 18.

Table 17.

Correlations for Admission Variables and Didactic, Lab and Clinical Courses by Dental Year

Admission Variable	Year of Dentistry First n=316	Second n=314	Third n=284	Fourth n=233
	Didactic			
Admission GPA	.31**	.33**	.23**	.15*
Science GPA	.32**	.35**	.30**	.21**
Reading	.39**	.35**	.29**	.28**
Carving	.02	.10	.03	-.05
PAT	.10	.07	.10	.06
Interview	.09	.11	.10	.08
Age	.01	.06	.02	.04
Years of Predentistry	-.03	-.03	-.03	.01
	Lab			
Admission GPA	.23**	.27**	.20**	.13*
Science GPA	.25**	.27**	.23**	.11
Reading	.23**	.16**	.11	-.03
Carving	.04	.28**	.04	.11
PAT	.12*	.10	.10	.07
Interview	.06	.40**	.18**	.16*
Age	.08	.06	.05	-.01
Years of Predentistry	.07	-.04	-.01	-.01
	Clinical			
Admission GPA	.13*	.09	.18**	.15*
Science GPA	.13*	.14*	.19**	.18**
Reading	.28**	.07	.03	.01
Carving Score	.10	.21**	.21**	.18**
PAT Score	.05	.11	.17**	.16*
Interview Score	.15**	.15**	.19**	.13*
Age	.05	.21**	.07	.08
Years of Predentistry	.06	.10	.02	.01

*$p < .05$ **$p < .01$ *(two-tailed test)*

Table 18.

Correlations between Admission Variables and Dentistry Program Areas

Dentistry Program Areas	Admission GPA	Science Average	Reading	Chalk Carving	PAT	Interview
Basic Sciences	.41**	.41**	.30**	.13*	.02	.19**
Anesthesia	.31**	.33**	.22**	.09	.06	.10
Dental Health Care	.25**	.23**	.23**	-.04	.09	.13*
Dental Materials	.13	.18**	.24**	-.06	.11	-.16*
Diagnosis	.22**	.22**	.28**	.04	.05	.19**
Endodontics	.28**	.28**	.17**	.22**	.18**	.23**
Fixed Prosthodontics	.23**	.26**	.12	.20**	.17*	.13
Operative Dentistry	.13	.19**	.06	.23**	.20**	.06
Oral & Maxillofacial Surgery	.20**	.29**	.23**	.15*	.11	.11
Oral Biology	.25**	.28**	.36**	-.09	.01	-.02
Orthodontics	.23**	.27**	.23**	.12	.23**	.21**
Pediatrics Dentistry	.14*	.21**	.18**	.00	.12	.12
Periodontics	.17**	.21**	.07	.08	.09	.10
Radiology	.22**	.28**	.25**	.22**	.26**	.16*
Removable Prosthodontics	.23**	.28**	.10	.25**	.20**	.15*

*$p < .05$ **$p < .01$ *(two-tailed test)*

Selected Records

From the files provided by the Faculty of Dentistry there were seven records that were obviously unsatisfactory. Table 19 presents profiles of four identified first-year failure records and three identified second-year failure records. Three of these students repeated first-year while the fourth did not continue. The Admission records of the first year students were similar to the sample means reported in Table 19. Some of the preadmission scores for students reported in Table 19 are clearly above average, while other scores are relatively low.

Table 19.

Profiles of 1st and 2nd Year Failure Records

Variable	*Student*				Table 2 Means
First Year					
Admission GPA	7.9	8.1	7.2	7.7	7.53
Science Average	7.9	8.3	7.4	7.4	7.48
Reading	16	25	16	17	19.96
Carving	17	16	25	25	19.25
PAT	21	20	19	16	19.34
Interview	29	26	33	38	27.11
Age	20	22	22	25	
Years of Predentistry	2	2	3	4	
Gender	M	F	F	M	
GPA1	5.8	6.2	5.0	4.5	
Unsatisfactory Grades	3	16	7	7	
Second Year					
Admission GPA	7.9	7.1	7.0		7.53
Science Average	7.8	7.0	6.6		7.48
Reading	23	21	16		19.96
Carving	21	21	19		19.25
PAT	23	23	17		19.34
Interview	32	16	30		27.11
Age	20	20	21		
Years of Predentistry	2	2	3		
Gender	M	M	M		
GPA	4.6	6.2	5.8		
Unsatisfactory Grades	19	3	3		

Unsatisfactory Grades = number of grades that were 4 or less on a nine-point scale , including incompletes and withdraws

Tables 20-25 present results from a series of calculations that were completed in order to examine trends — similarities and differences between students who were ranked in the top or bottom fifteen percent of the sample.

Table 20 presents the preadmission variables and marks for year 1 through 4 for students in the sample who were ranked on a combined average of Admission GPA and Science Average. While the marks for students in the bottom 15% were below 7.0, the marks for the top 15% group were significantly higher (see Appendix F).

Table 20.

Means and Standard Deviations of Admission Variables and GPAs Sorted by Top and Bottom Admission Variables

	Bottom 15%		*Top 15%*	
	Mean	*SD*	*Mean*	*SD*
Admission GPA	7.02	.14	8.15	.27
Science Average	6.85	.20	8.23	.28
Reading	18.94	1.85	20.34	3.12
Carving	18.31	2.95	19.09	3.34
PAT	18.23	2.57	19.40	3.47
Interview	24.57	5.22	25.66	5.25
Age	23.94	4.17	22.11	3.40
Years Predentistry	3.67	1.69	2.63	1.11
GPA1	6.49	.51	7.15	.66
GPA2	6.49	.48	7.18	.64
GPA3	6.55	.47	7.16	.54
GPA4	6.81	.50	7.25	.66

(N = 233; n = 35) Note: A Combined Average of Admission GPA and Science Average was used to rank the top 15% and bottom 15% of the above sample.

Table 21 divides the sample on a combined average of all four years in Dentistry. The admission variable means in Table 21 are similar for both the top and bottom groups. For example, Science Average was 7.27 for the bottom group and 7.37 for the top group. The largest reported difference for admission variables in Table 21 was for the Interview. Dental GPAs were significantly different (see Appendix G)

Table 21.

Means and Standard Deviations for Admission Variables and GPAs Sorted by Top and Bottom GPA

	Bottom 15%		*Top 15%*	
	Mean	*SD*	*Mean*	*SD*
Admission GPA	7.37	.36	7.71	.52
Science Average	7.27	.43	7.73	.55
Reading	19.37	2.61	20.80	3.22
Carving	17.77	2.58	19.20	3.98
PAT	18.83	3.49	20.29	4.42
Interview	25.63	5.22	28.14	6.02
Age	22.63	3.63	23.26	3.94
Years Predentistry	3.34	1.45	3.57	1.56
Mean Dental GPA	6.09	.19	7.71	.25
GPA1	6.07	.45	7.63	.38
GPA2	6.09	.31	7.74	.32
GPA3	6.08	.31	7.70	.34
GPA4	6.13	.54	7.78	.33

(N = 233; n = 35) Note: Averages for all four years in the Faculty of Dentistry were used to sort the top 15% and the bottom 15% of the sample.

The pattern of correlations for the two groups presented in Table 22 is very dissimilar. For the top 15%, Admission GPA, Science Average and Reading are strongly correlated with academic performance throughout the program. For the bottom 15% of the distribution, the relationship between preadmission variables and performance throughout the Dental Program is weak.

Table 23 presents the correlations for the top and bottom groups that were sorted by a combined average of dental GPAs. The admission variables did not correlate with academic performance for the bottom 15%. For the top 15%, correlations occurred for Admission GPA , Science Average and Reading with academic performance in first and second year. The most significant correlation reported in Table 23 is for GPA1 and GPA4

Table 22.

Correlations for Admission Variables and GPAs Sorted by Top and Bottom Admission Variables

	Bottom 15%			
Variable	***GPA1***	***GPA2***	***GPA3***	***GPA4***
Admission GPA	.11	.00	.02	.11
Science Average	-.07	.00	-.20	-.18
Reading	.47**	.11	.21	.32
Carving	.14	.14	.16	.30
PAT	-.05	-.06	.07	-.01
Interview	.26	.17	.01	.18
Age	-.22	.15	.11	-.01
Years Predentistry	.17	.08	.02	-.07
GPA1	1.00	.52**	.40*	.43*
GPA2		1.00	.70**	.60**
GPA3			1.00	.77**
GPA4				1.00
	Top 15%			
	GPA1	***GPA2***	***GPA3***	***GPA4***
Admission GPA	.57**	.54**	.47**	.41*
Science Average	.49**	.50**	.52**	.39*
Reading	.56**	.37**	.33	.31
Carving	-.08	-.04	.00	-.06
PAT	-.10	-.11	.04	.00
Interview	-.17	-.15	-.09	-.16
Age	-.10	-.11	-.21	-.10
Years Predentistry	.08	-.31	-.33	-.03
GPA1	1.00	.82**	.73**	.68**
GPA2		1.00	.89**	.80**
GPA3			1.00	.91**
GPA4				1.00**

*(N = 233; n = 35) *p < .05 **p < .01 two-tailed test*

Table 23.

Correlations for Admission Variables and GPAs Sorted by Top and Bottom GPA

	Bottom 15%			
Variable	***GPA1***	***GPA2***	***GPA3***	***GPA4***
Admission GPA	.05	.15	.15	-.18
Science Average	.14	.20	.19	-.23
Reading	.24	.22	.02	-.08
Carving	-.03	.03	.06	-.02
PAT	.08	.27	.01	.06
Interview	.18	-.12	.17	-.22
Age	-.11	.07	.10	.07
Years Predentistry	-.17	.26	.25	.03
Mean Dental GPA	.42*	.58**	.60**	.38*
GPA1	1.00	.28	.05	-.43*
GPA2		1.00	.36*	-.19
GPA3			1.00	.02
GPA4				1.00
	Top 15%			
	GPA1	***GPA2***	***GPA3***	***GPA4***
Admission GPA	.28	.38*	.05	.11
Science Average	.38*	.44**	.14	.21
Reading	.34*	.34*	.08	-.03
Carving	-.09	.08	.05	.15
PAT	.03	.03	.14	.09
Interview	.03	.06	.02	-.09
Age	-.14	.22	.01	.01
Years Predentistry	-.11	.03	-.02	-.04
Mean Dental GPA	.68**	.80**	.77**	.65**
GPA1	1.00	.47**	.32	.10
GPA2		1.00	.48**	.39*
GPA3			1.00	.45**
GPA4				1.00**

*N = 233; n = 35) *p < .05 **p < .01 (two-tailed test)*

from the bottom 15%. Grade-point-average does not usually correlate negatively with grade-point-average. For Table 23, the spreadsheet upon which this table is based is presented in Appendix H and indicates that GPA for many students in this group decreased from year-one to year-four.

Finally, Tables 24 and 25 were sorted on GPA1. Means for the admission variables in Table 24 were all less than those from the original sample. The difference between GPA1 and GPA4 in Table 24 is .66. For the original sample, the difference between first and fourth year Dental GPAs was .14. Students with the lowest first year grades showed more improvement than the average student over the four years of the program. The results in Table 25 suggests that GPA1 generally did not provide a good indication of later performance in dental school (See Appendix I for t-tests).

Table 24.

Means and Standard Deviations for Admission Variables and GPAs Sorted by Bottom 15% of GPA1

	Mean	Standard Deviation
Admission GPA	7.43	.34
Science Average	7.30	.36
Reading	18.53	2.70
Carving	18.53	3.09
PAT	18.97	3.43
Interview	26.67	5.00
GPA1	5.81	.26
GPA2	6.26	.41
GPA3	6.39	.48
GPA4	6.47	.56

(N = 233; n = 35)

Table 25.

Correlation Matrix for Admission Variables and GPAs: Sorted by Bottom 15% of GPA1

		1	2	3	4	5	6	7	8	9	10
1	Admiss. GPA	1.00	.77**	.11	.24	.35*	.18	.28	.16	.07	-.14
2	Science Average	1.00		.24	.24	.15	.22	.07	.34*	.27	.04
3	Reading			1.00	-.17	.13	.11	.18	-.13	-.22	-.16
4	Carving			1.00	.27	.16	-.01	.22	.24	.04	
5	PAT					1.00	.08	.31	-.10	-.04	-.02
6	Interview						1.00	.07	.09	.21	.04
7	GPA1							1.00	.00	-.01	-.25
8	GPA2								1.00	.75**	.46**
9	GPA3									1.00	.62**
10	GPA4										1.00

(N = 233; n = 35) p < .05 p** < .01 (two-tailed test)*

CHAPTER FIVE: DISCUSSION

This thesis focuses on an examination of the admission variables and academic performance of students admitted to the Faculty of Dentistry from 1986 to 1992. This study was designed to address the problem of identifying the best predictors of academic success in Dentistry. The results are of significance because they facilitate an understanding of admission decisions. This discussion will focus will be on the overall selection procedure, the relationship between the individual admission variables, and academic performance. Academic performance will be examined as a composite variable and it will be subdivided to reflect the various components of the program.

Exceptional Records

Approximately 99% of the students in this sample completed first and second year. The failure rate for first and second year was less than 3%, and most of those students successfully repeated failed courses. As noted earlier, in Tables 19-25, the admission records of students who were unsuccessful were not dramatically different from those of successful students. On the basis of these results, it is difficult to imagine how the Faculty of Dentistry could have improved selection decisions for the 1986-1992 period.

Grade-Point-Average

Dental GPAs, grades for didactic, lab and clinical courses, and marks averaged for the fifteen Program Areas were the three criterion used in this study. Goldman and Slaughter (1976) demonstrated that GPAs for non-equivalent classes were less reliable criterion than grades from individual classes for predicting college GPA. Their criticisms would not appear relevant to this study, because all students were evaluated in similar courses.

The old adage in prediction studies is 'the best predictor of academic success is previous academic performance.' In a study of 60 American dental programs, Kramer (1986) reported that previous university grades were the best predictors of first and second year dental GPA (r = .45, r = .43). Wood's (1979) University of British Columbia ten-year admission study indicated Admission GPA was a good predictor variable (r = .36).

For this investigation, there were two measures of previous academic performance — Admission GPA and Science GPA. Admission GPA was the average of the grades from at least two years of previous university or college courses. Science Average was the calculated grade-point-average of all science courses, including required science courses. Science Average was *the* most robust admission variable. Of all the admissions variables it was the one that had the strongest relationship with academic performance in all four years of the program (Tables 13 and 14).

It is of interest to note from Table 12 that GPA1 and GPA4 only correlated .50 ($p <$ .01), whereas the correlation between GPA3 and GPA4 was .78 ($p < .01$) . Thus, as the program evolves, the correlation's between the admission variables and dental GPAs seem to mirror this change. The most obvious change in the dental program occurred as clinical courses replaced lab courses.

In this regard, the program was examined in relation to its component parts. Table 16 depicts this analysis of the didactic, lab and clinical courses. Science Average, of all of the admission variables, shows the strongest relationship with all three areas. As students move from the classroom to the clinic, the relationship between academic performance and Carving, PAT and the Interview increases.

Table 18 provides an analysis of the relationship between the admission variables and marks in the fifteen program areas, which offers the most comprehensive 'picture' of the Dentistry Program. Science Average is the only variable to correlate significantly with academic performance in all program areas.

In summation, when one examines the performance of dental students in this sample, the simple statement that 'nothing predicts better than past performance' is generally correct; however, past performance should be modified to 'past performance in *Science* Courses.' One could speculate on why science courses are more strongly related to academic performance. It would seem to the author that the nature of task demands or rigor of these courses best approximates the rigor and/or nature of task demands of the courses

in Dentistry. Courses from other *nonscience* programs may require something different from the student.

Dental Admission Test

Admission test scores are employed as predictor variables because they contribute useful information about applicants (Linn, 1982). One reason for admission testing is grading discrepancies occur between and within institutions (Sax, 1989). Standardized norm-referenced admission tests provide a means of ranking applicants' performance on a common variable. Another purpose of admission testing is to account for prerequisite skills that might not otherwise be measured. This discussion will now continue with a review of the relationship between the Dental Admission Test and academic performance.

The Dental Admission Test is used for both of the aforementioned purposes. The Reading Comprehension Test, which is part of the DAT battery, was designed to simulate dental science reading demands (Graham & Boyd, 1982a). Its inclusion as an admission variable would appear to compensate for some of the inadequacies of grade comparison. The Carving and Perceptual Ability Tests from the DAT battery are seen to be measuring fine-motor-skills and visual-spatial abilities that are not measured by previous grades or the Reading Comprehension Test (Table 11).

Reading Comprehension Test

The Reading Comprehension Test was the best predictor for didactic grades in this study ($r = .37, p < .01$), but the test was generally unrelated to clinical performance (Table 16). Its correlation with first year clinical courses, which only totaled 6 credits, was an exception to the trend. In Table 13, Reading was the best predictor for GPA1 ($r = .34, p < .01$), which was mostly comprised of didactic and lab courses. Reading correlated less with succeeding GPAs. The Reading Comprehension Test also correlated with Admission GPA and Science Average (Table 11), suggesting that there is some overlap. In sum, the Reading Comprehension Test seems to be primarily related to academic performance in didactic courses.

Upon an examination of the variables in Table 15, it is obvious that the relationship between the Reading Comprehension Test and dental GPA is stronger for females than males. For females, Reading correlated .48 ($p < .01$) with GPA1. This is the strongest correlation between preadmission variables and GPA reported in this study. For males, the relationship between the Reading Comprehension Test and academic performance in first year was not as strong. It was surprising to discover a correlation between Reading and GPA4 for females, considering the high proportion of clinical courses. When one examines the relationship between the Reading Comprehension Test and academic performance, it is obviously a better predictor for females than for males.

Carving and Perceptual Ability Tests

Carving and PAT are the other two admission test variables used by Dentistry. They correlated best with clinical grades and not at all with grades for didactic courses (Table 16). The Carving Test and PAT did not correlate with admission grades or the Reading Comprehension Test (Table 11). Thus the visual-spatial and fine-motor skills measured by these scales are not related to the other preadmission variables. Carving and PAT correlated with GPA3 and GPA4, while only the PAT correlated with GPA1 and Carving with GPA2 (Table 13). Thus as the program changes from Didactic-Lab to Lab-Clinical courses, the visual-spatial and fine-motor skills measured by Carving and PAT become more relevant to academic performance. The results from this study support previous findings (Kramer, 1986; Boyd & Teteruck, 1979; Wood, 1979) that indicated Carving and Perceptual Ability Tests are the best available predictors of academic performance in clinical courses.

Some of the previous research referred to correlations between the Perceptual Ability Test and pre-clinical dentistry courses. For example, Kramer's (1986) review of 60 American Dental Schools reported that pre-clinical technique courses correlated with the PAT. In this study, a pre-clinical technique variable did not exist. Didactic, Lab and Clinical variables were simply created on the basis of their designation in the program of

studies. It appears that lab courses approximate pre-clinical technique courses, however lab courses include courses from basic sciences and other didactic courses. In any event, the PAT did correlate with lab courses, probably offering some support of Kramer's results.

Carving and PAT appeared to be relatively good predictors for clinical course grades (Table 16) Since the establishment of cut-off scores or minimal standards for the Carving Test and the PAT, there have been low failure and attrition rates that differed from rates reported prior to the DATs' inception (Graham & Boyd, 1982a). Boyd and Teteruck (1979) concluded that cutoff scores make it almost impossible to select students with inadequate visual-spatial or fine-motor skills.

Interview

Myslinski and Jeffrey (1985) reported that the use of the Dental Admissions Interview is controversial, particularly because of its substantial cost in terms of the extra work for faculty members. However, Graham and Boyd (1982b) demonstrated that it does measure a personality factor. In order to more fully understand the relationship between Interview and academic performance, its relationship with GPA, then Didactic, Lab and Clinical Courses, will be discussed.

The Interview correlated with GPA2 and GPA3 (Table 14). However, in Table 15 it is apparent that the relationship between the Interview and GPA is misleading. For males it correlated .22 ($p < .01$) with GPA2, but it did not correlate significantly for females. The opposite occurred for GPA3. For females the Interview correlated .26 ($p < .01$) with GPA3 but it did not correlate significantly for males. Previous studies have reported a relationship between interview scores and dental GPA (Staat & Yancey, 1982; Fuller, Killer & Kerber, 1979). However, to simply say that the Interview correlates with academic performance is too broad of an interpretation for this sample.

A more helpful picture is provided by examining the relationship of the Interview with Didactic, Lab and Clinical grades (Table 16). Interview correlated with academic

performance in lab and clinical courses, but not at all with didactic courses. In Table 17, the Interview correlated each year with clinical courses, as well as with second, third and fourth year lab courses.

Concerns raised by Shahani, Dipboye and Gehrlein (1991) about the *incremental contribution* of the interview seem less important if it contributes information that is distinct from GPA and admission test scores. In fact, the Interview did not correlate with Admission GPA, Science Average, Reading or the PAT (Table 11).

Interestingly, Interview scores did correlate with the Carving Test but the relationship was relatively weak ($r = .12, p < .01$). These results seem to indicate that the interview contributes something distinct to the admission process and that it correlates positively with clinical and lab marks.

With final regards to the Interview, it correlated .40 ($p < .01$) with second year lab courses. This relationship is not easily understood. Upon a closer examination of the Dentistry Program, this result would have made more sense to this researcher had it represented courses which involve patient contact. To try and gain some perspective, a correlation was calculated between Interview and DENT347 (a communication course designed to help students understand the significance of interpersonal communication). The results indicated an insignificant coefficient of .19 (although Reading correlated significantly ($r = .30, p < .01$) with the communication course). Upon examining Table 18, Interview only correlated .19 ($p < .01$) with Diagnosis courses, notably less than its correlation with second year lab courses. The magnitude of the correlation ($r = .40$) between Interview and second year lab courses presently defies understanding.

Age and Years of Predentistry

A *post hoc* analysis of student academic performance on the basis of age was completed and *T-Tests* did not yield any significant differences in academic performance between the youngest and oldest students who completed the four year program (Appendix J).

Students' age and their years of Predentistry were included in the original correlation matrix. They did not correlate with academic performance. However, these two variables did correlate with one another (Table 11). Age and years of Predentistry tended to increase together. More interestingly, both variables correlated negatively with admission grades. Two possible explanations are offered. The results might simply indicate that it is more difficult to maintain high grades over a greater number of courses. The results might also indicate that the brightest and most motivated students spend the shortest period of time qualifying for Dentistry. In either case, age and years of Predentistry did not appear related to academic performance.

Gender Differences

In Table 5 there were mean differences in the academic performance of males and females. A post hoc analysis of GPA on the basis of gender indicated the differences were not significant (Appendix C).

Table 15 highlights gender differences for Carving, PAT and Reading. For males, Carving and PAT correlated significantly with each year of Dentistry. Carving and PAT did not correlate with academic performance for females. For females, Reading correlated significantly for GPA1, GPA2 and GPA4. For males, the relationship was limited to GPA1 and GPA2. These results are interesting but essentially inexplicable, and they appear to warrant further investigation.

Regression Analysis

Once the bivariate correlations had been calculated, a regression analysis was completed. Borg and Gall (1989) posited that the goal of admission studies is to identify the best predictors of academic success. A regression analysis was performed in order to generate the highest possible *R* value from the admission variables. The *stepwise-regression* analysis presents some interesting results.

The regression discussion will begin with an analysis of academic performance for each of the four years in dentistry. In Table 14, the strongest coefficient resulted for

second year GPA at .48, while the weakest coefficient was for fourth year GPA at .25. With the notable exception of Reading, which had the highest correlation with GPA1 (r = .34), the DAT and Interview variables contributed relatively little to the regression analysis.

The regression analysis for Combined GPA yielded a respectable coefficient of .41. Science Average provided the largest contribution with respect to R. Reading, which was a better predictor of GPA for females than males, was the second variable chosen, adding .04 to R. The inclusion of Carving contributed .03 to the analysis.

This regression analysis also provides an opportunity to offer some comments about the concept of incremental contribution (Shahani, Dipboye & Gehrlein, 1991). It appears that the question of incremental contribution cannot simply be answered by examining correlation coefficients. The results from the regression analysis do not suggest that the Interview or PAT should be excluded from the admission process. As mentioned earlier, perhaps the best way to evaluate the question of incremental contribution for the Interview would be to evaluate failure and attrition rates before and after its introduction.

Finally, with regard to the regression analysis, it should be noted that Admission GPA was never included in the stepwise method due to its high degree of collinearity with Science Average (Table 11; $r = .76, p < .01$).

Conclusions

The following conclusion are offered, keeping in mind that this sample consisted of a high number of overqualified students.

With regard to the admission variables, Dentistry might want to consider a more prominent role for Science Average, as opposed to Admission GPA. Emphasizing the Science Average would seem to recognize its contribution to the fifteen Program Areas, to Clinical and Lab courses and to the multiple regression analysis. If one would consider changes to an already effective admission process, these changes would focus on a relative increase in the weighting assigned to Science Average.

The analysis of the Dental Program into its component parts, by year, by didactic, lab and clinical classes, and by the fifteen Program Areas within Dentistry, could probably be refined. On the basis of their more intimate knowledge, Faculty members from Dentistry could refine the division of the program more so than an outsider. It is envisioned that this form of subdivision might further highlight interesting relationships between admission variables and academic performance in the Faculty of Dentistry.

Finally, this discussion will conclude with some possible research directions identified by this study. There is some indication that gender differences should be empirically elaborated. The results also seem to indicate that questions regarding the incremental contribution of admission interviews might best be pursued by examining *pre* and *post* interview failure and attrition rates.

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APPENDICES

APPENDIX A.

Supplement to Table 1 *Dentistry Program Areas and Corresponding Courses*

Basic Sciences

ANAT	412		
	413		
	417		
	419		
MMID	422		
PATH	422		
PMCOL	470		
BACT	422		

Anesthesia

DENT	386		
DENT	387		
	436		

Dental Health Care

DENT	340	442	492
	341	443	493
	347	445	496
	394	446	498
	396	490	499

Dental Materials

DENT	309		
	359		

Diagnosis

DENT	332	432	483
	382	433	
	383	482	

Endodontics

DENT	365	416	
	366	465	
	415	466	

Fixed Prosthodontics

DENT	310	363	414
	311	364	464
	312	413	

Operative Dentistry

DENT	317		
	318		
	367		
	368		
	417		
	418		
	467		
	468		

Oral & Maxillofacial Surgery and Hospital Dentistry

MED	434		
DENT	475		
	488		
	489		

Oral Biology

DENT	301	350	456
	302	355	
	303	357	
	304	358	
	306	455	

Orthodontics

DENT	380	480	
	430	481	
	431		

Pediatric Dentistry

DENT	378	429	
	379	478	
	428	479	

Periodontics

DENT	326	377	477
	327	426	
	376	427	

Radiology

DENT	334	435	
	384	485	
	385		

Removable Prosthodontics

DENT	321	372	472
	322	421	
	371	422	

Note: Courses were identified from the University of Alberta Calendars for the 1986-1992 period.

APPENDIX B

Supplement to Table 3 *Dental GPAs*

Variable	n	MEAN	SD	*r*	t	2-tail critical *p*
GPA1	314	6.83	.66	.68**	-2.98	.003
GPA2		6.91	.58			
GPA1	284	6.82	.65	.54**	0.46	.649
GPA3		6.80	.59			
GPA1	233	6.81	.64	.51**	-3.81	.000
GPA4		6.97	.61			
GPA2	284	6.89	.57	.80**	3.83	.000
GPA3		6.80	.59			
GPA2	233	6.84	.57	.70**	-4.11	.000
GPA4		6.97	.61			
GPA3	233	6.81	.57	.78**	-6.19	.000
GPA4		6.97	.61			

APPENDIX C

Supplement to Tables 4 and 5 *Gender Differences (pooled variance)*

Group	Variable	n	Mean	SD	t	2-tail critical *p*
Male	Admission GPA	218	7.5	.39	-1.44	.157
Female		98	7.6	.41		
Male	Science Average	218	7.5	.49	-.80	.426
Female		98	7.5	.48		
Male	Reading	218	19.84	2.4	-1.29	.197
Female		98	20.23	2.87		
Male	Carving	218	19.42	3.6	1.26	.207
Female		98	18.86	3.6		
Male	PAT	218	19.72	3.4	3.24	.001
Female		98	18.49	2.3		
Male	Interview	218	26.67	5.5	-2.20	.029
Female		98	28.10	5.17		
Male	GPA1	218	6.86	.64	1.42	.157
Female		98	6.75	.72		
Male	GPA2	216	6.89	.56	-1.18	.239
Female		96	6.97	.61		
Male	GPA3	195	6.80	.59	-0.38	.704
Female		89	6.82	.60		
Male	GPA4	160	6.96	.63	-0.62	.537
Female		73	7.01	.56		

APPENDIX D
Supplement to Table 6 *Didactic, Lab and Clinical Course Listings*

Didactic Courses

First Year			*Second Year*		
DENT301	DENT311	DENT340	DENT350	DENT367	DENT384
DENT302	DENT317	DENT341	DENT357	DENT371	DENT386
DENT304	DENT321	DENT347	DENT358	DENT376	DENT394
DENT306	DENT326	ANAT419	DENT359	DENT378	DENT396
DENT309	DENT334		DENT363	DENT380	PMCOL470
			DENT365	DENT382	
Third Year			*Fourth Year*		
DENT413	DENT432		DENT455	DENT490	
DENT415	DENT438		DENT456	DENT492	
DENT417	DENT442		DENT465		
DENT421	DENT445		DENT467		
DENT426	DENT446		DENT478		
DENT428	MED434		DENT480		
DENT430			DENT482		

Lab Courses

First Year	*Second Year*	*Third Year*	*Fourth Year*
DENT306	DENT355	DENT443	DENT493
DENT310	DENT364	DENT436	
DENT312	DENT366		
DENT318	DENT379		
DENT322	DENT385		
ANAT412	DENT387		
ANAT413	PATH422		
ANAT417			
MMID442			

Clinical Courses

First Year			*Second Year*		
DENT327			DENT368	DENT377	DENT383
DENT332			DENT372	DENT382	
Third Year			*Fourth Year*		
DENT414	DENT429		DENT464	DENT477	DENT489
DENT416	DENT431		DENT466	DENT479	DENT493
DENT418	DENT433		DENT468	DENT481	DENT497
DENT422	DENT435		DENT472	DENT483	DENT498
DENT427	DENT439		DENT475	DENT485	DENT499

Note: Courses were identified from the University of Alberta Calendars for the 1986-1992 period.

APPENDIX E

Supplement to Table 7 *Differences in Mean Didactic, Lab and Clinical Averages*

Variable	n	MEAN	SD	*r*	t	df	2-tail critical *p*
Didactic	233	6.88	.55	.59**	-1.55	232	.122
Clinical		6.93	.53				
Didactic	233	6.88	.55	.76**	-2.30	232	.022
Labs		6.93	.52				
Clinical	233	6.93	.53	.69**	-0.22	232	.824
Labs		6.93	.52				

APPENDIX F

Supplement to Table 20 *Admission Variables and GPAs Sorted by Top and Bottom Admission Grades*

Group	Variable	n	Mean	SD	t	2-tail critical *p*
Top	Admission GPA	35	7.02	.14	-22.08	.000
Bottom			8.15	.27		
Top	Science Average	35	6.85	.20	-23.85	.000
Bottom			8.23	.28		
Top	Reading	35	18.94	1.8	-2.28	.026
Bottom			20.34	3.1		
Top	Carving	35	18.31	2.9	-1.02	.309
Bottom			19.09	3.3		
Top	PAT	35	18.22	2.6	-1.61	.113
Bottom			19.40	3.5		
Top	Interview	35	24.57	5.2	-0.87	.389
Bottom			25.66	5.2		
Top	GPA1	35	6.49	.51	-4.67	.000
Bottom			6.14	.66		
Top	GPA2	35	6.48	.48	-5.13	.000
Bottom			7.18	.64		
Top	GPA3	35	6.55	.47	-4.95	.000
Bottom			7.15	.54		
Top	GPA4	35	6.80	.50	-3.18	.002
Bottom			7.25	.67		

APPENDIX G

Supplement to Table 21 *Admission Variables and GPAs Sorted by Top and Bottom Combined GPA*

Group	Variable	n	Mean	SD	t	2-tail critical *p*
Top	Admission GPA	35	7.37	.36	-3.10	.003
Bottom			7.70	.52		
Top	Science Average	35	7.27	.43	-3.88	.000
Bottom			7.72	.55		
Top	Reading	35	19.37	2.6	-2.04	.046
Bottom			20.80	3.2		
Top	Carving	35	17.77	2.6	-1.78	.079
Bottom			19.20	4.0		
Top	PAT	35	18.82	3.5	-1.53	.130
Bottom			20.28	4.4		
Top	Interview	35	25.62	5.2	-1.87	.066
Bottom			28.14	6.0		
Top	GPA1	35	6.06	.45	-15.70	.000
Bottom			7.63	.38		
Top	GPA2	35	6.09	.31	-21.89	.000
Bottom			7.74	.32		
Top	GPA3	35	6.08	.31	-20.64	.000
Bottom			7.69	.34		
Top	GPA4	35	6.13	.54	-15.47	.000
Bottom			7.78	.33		

APPENDIX H
Supplement to Table 23 *DATA for 4th Year Admission Variables and GPAs Sorted by Combined Dental GPA N = 233 n = 35*

1	2	3	4	5	6	7	8	9	10	11	12	13
6	5.9	5.7	4.7	1	7.6	7.7	19	18	19	24	21	3
5.5	5.7	5.7	5.7	1	7.4	7	18	17	16	33	22	3
5.9	5.7	5.4	5.6	1	7.5	7.3	19	23	16	20	22	3
5.5	5.7	5.7	6.4	1	7.2	7.4	18	17	19	33	30	3
5.3	5.8	6	6.6	1	7.2	7.1	21	16	13	24	21	3
6.1	5.7	6	6.1	1	7.1	6.9	18	17	16	28	23	2
5.5	6.2	6.1	6.1	2	7	6.6	19	23	17	22	21	2
6	5.8	6	6.1	2	8.2	7.8	20	28	28	31	21	4
6	5.5	6.4	6	2	7.6	7.3	18	22	18	28	22	4
5.2	5.9	6.3	6.6	1	6.9	7	16	17	16	23	30	2
6	6.3	6.1	5.6	1	7.3	7	17	17	21	28	21	3
5.3	6.3	5.8	6.7	2	7.2	7.2	18	13	19	17	20	2
6.7	6.1	5.7	5.7	1	7.5	7.7	22	17	16	24	21	3
6.3	5.9	6.1	6.1	1	7.1	7	19	19	16	19	21	3
6.6	6	5.7	6.2	1	7.4	7.4	18	19	16	25	25	4
5.9	6.2	6.1	6.3	1	7.1	7	21	23	21	16	20	2
6.4	5.8	5.5	6.9	1	7.1	7	21	19	19	28	21	3
6.3	5.9	6.3	6.1	1	7.3	7.2	18	23	16	22	20	2
5.7	5.8	6.3	6.8	1	7	6.6	16	17	19	30	21	3
6.4	6.5	6.1	5.7	1	7.6	7.7	21	16	16	22	21	2
6	6.2	6.4	6.1	2	8.1	7.5	19	19	16	29	20	3
6.3	6.3	5.8	6.4	2	7.6	7.1	18	16	19	26	27	4
5.8	6.5	6.3	6.2	2	7.5	7.4	21	19	21	30	21	4
7.2	6.9	6.4	4.3	1	7.5	7.5	21	17	17	35	24	4
5.9	6.2	6.1	6.6	1	7.5	7.5	21	17	17	25	20	2
7	5.9	6.2	5.9	1	7.2	7.2	22	19	19	33	20	3
6.3	6.3	5.9	6.5	1	7.1	6.9	19	16	16	27	30	8
6.2	6.4	6	6.4	2	7.2	7.3	21	21	17	18	21	3
6.7	6.1	6.1	6.1	1	6.5	6.5	16	19	17	19	21	3
6.1	6.3	6.5	6.1	1	7.6	7.9	30	17	16	35	20	4
6.2	6.1	6.6	6.2	2	7.8	8.6	19	19	17	31	21	3
6.1	6.2	6.7	6.1	1	7.1	6.9	16	17	21	24	34	8
6	6.4	6.2	6.5	1	7.2	6.9	21	16	17	20	22	4
6.1	6.1	6.2	6.9	1	7.9	7.4	21	30	16	27	19	2
5.8	6.6	6.5	6.4	2	8	8	16	16	19	21	28	6

1. GPA1; 2. GPA2; 3. GPA3; 4. GPA4; 5. Gender (1=male, 2=female); 6. Admission GPA; 7. Science Average; 8. Reading; 9. PAT; 10. Carving; 11. Interview; 12. Age; 13. Years of Predentistry

APPENDIX I

Supplement to Tables 24 and 25 *GPAs Sorted by Bottom 15% of GPA1*

Variable	n	MEAN	SD	*r*	t	df	2-tail critical *p*
GPA1	34	5.78	.26	.07	-5.88	33	.000
GPA2		6.28	.44				
GPA1	34	5.78	.26	-.05	-6.02	33	.000
GPA3		6.37	.49				
GPA1	34	5.78	.26	-.241	-5.97	33	.000
GPA4		6.48	.57				

Supplement to conversation regarding Tables 24 and 25 during Oral Examination *GPAs Sorted by Bottom 15% of GPA2*

Variable	n	MEAN	SD	*r*	t	df	2-tail critical *p*
GPA2	34	6.00	.21	.32	-1.80	33	.080
GPA1		6.14	.45				
GPA2	34	6.00	.21	.53**	-3.64	33	.001
GPA3		6.20	.37				
GPA2	34	6.00	.21	.40**	-4.49	33	.000
GPA4		6.37	.52				

This *post hoc* analysis is pursuant to the conversation regarding the relationship between low dental GPA predicting low dental GPA. There was some question as to whether or not the Table 24 analysis would yield different results if academic performance was ranked on GPA2 because of the change in the program between first and second year. There was a greater tendency for students who were in the bottom 15% of GPA2 to earn low grades in GPA3 and GPA4, as compared to students who performed in the bottom 15% of GPA1.