

ABSTRACT

ANDREWS, ADDISON WILLIAMS. Cognitive, Collegiate, and Demographic Predictors of Success in Graduate Physical Therapy Education. (Under the direction of Duane Akroyd.)

Success in healthcare education, as defined by timely completion of the academic program, has consequences for individual students, academic institutions, and society. One purpose of this study was to quantify attrition in the physical therapy program at Elon University. The attrition rate in the physical therapy program at Elon University for students admitted between 1998 and 2002 ($n = 198$) was 10%, including those whose graduation was either delayed or denied. Most causes of attrition were for academic difficulties. This attrition rate is higher than the attrition rate in other physical therapy programs but it is lower than the attrition rates for most nursing and medical programs. The primary purpose of this research was to identify cognitive, collegiate, and demographic predictors of attrition in physical therapy education for students at Elon University. Predictors were chosen based on Tinto's model of doctoral persistence. Cognitive predictors addressed in this study were undergraduate GPA, Math GRE, and Verbal GRE. The collegiate predictor chosen was undergraduate institution quality as denoted by average SAT score for entering students at the undergraduate institution. Demographic predictors studied included age, race, and gender. The model including all of these predictors was not significant in predicting attrition. However, once those who experienced attrition for personal reasons were deleted from the data set, the model was able to significantly predict attrition (likelihood ratio = 15.876; $p = 0.044$). Two of the predictor variables, undergraduate GPA (odds ratio = 0.040) and average SAT score for the undergraduate institution (odds ratio = 0.990), were independent, significant

predictors of attrition. The admissions committee in the physical therapy program at Elon University should continue to emphasize the cognitive predictors when making admissions decisions. In addition, admissions committee members should begin to consider of the quality of the applicant's alma mater. These results need to be replicated in other physical therapy programs before the results of this study can be generalized more broadly.

**COGNITIVE, COLLEGIATE, AND DEMOGRAPHIC
PREDICTORS OF SUCCESS IN GRADUATE PHYSICAL
THERAPY EDUCATION**

by
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Biography

Addison Williams “Bill” Andrews, the son of Robert Jackson Andrews and Mary Leila Carwile Andrews, was born and grew up in Wilmington, NC. After graduating with a Bachelor of Science degree from the University of North Carolina at Chapel Hill in 1985, he worked as a physical therapist at Southeastern Regional Rehabilitation Center in Fayetteville, NC for three years. He then went back to UNC – Chapel Hill where he earned a Master of Science degree in Allied Health with a major in Neurologic Physical Therapy in August 1990. Subsequently, he worked at UNC Hospitals in Chapel Hill, NC for seven years. He became a Neurologic Certified Specialist through the American Board of Physical Therapy Specialties in 1997. Since 1997, he has served as an Assistant Professor in the Department of Physical Therapy Education at Elon University in Elon, NC. Bill also works part-time providing patient care services at Alamance Regional Medical Center in Burlington, NC. He enrolled in the Ed.D. program in the Department of Adult and Community College Education with a specialization in Health Professions Education at North Carolina State University in May 2000. Bill is married to Carole Baker Andrews and they have three children, Caroline, Addison, and Leila.

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Chapter I

Introduction

According to Tinto (1993), of the 2.4 million students who matriculated as undergraduates at institutions of higher learning in 1993, over 45% never persevered to completion of either a 2- or 4-year degree. More recently, other investigators have reported an attrition rate of 24%, based on students in 4-year colleges and universities five years after matriculation (Blecher, 2002). This lower attrition percentage discovered by Blecher and associates was attributable in part to the inclusion of those still in school after 5 years and the inclusion of those who transferred to another 4-year institution as ones who persisted and did not drop out. In addition, other researchers have found that attrition was also high in graduate education (Lovitts and Nelson 2000). These investigators found that approximately 50% of students do not persevere to completion of the doctorate.

The effects of attrition are problematic at many levels. Attrition in higher education has implications for specific individuals as well as for the broader society. Students who leave an institution of higher education prior to obtaining a degree experience occupational and monetary consequences for their attrition (Tinto 1993). The personal shame and social stigma of dropping out are not to be overlooked either.

Institutions are impacted by student attrition through the loss of tuition dollars. Students who drop out of an institution of higher education typically are reimbursed at least a percentage of their tuition costs, depending on when in the semester they drop out. Therefore, when a student drops out, the institution loses tuition revenue that it could have had if another prospective student had been allowed to matriculate in the program

instead. Colleges and universities that are heavily dependent on tuition dollars, such as small, private colleges, are adversely affected by this attrition rate. Some institutions have had to close their doors in the past few years because of low enrollments and high attrition (Tinto, 1993).

Student attrition also has consequences for those individuals who were not admitted into the program. In programs with competitive admissions processes, the student who dropped out of the program took a spot that could have been filled by another applicant. The applicant who was denied admission may have been able to successfully complete the program. Instead, that individual had to make other educational, career, or life choices because of the student who was admitted but failed to complete the program.

Furthermore, student attrition also has societal consequences, especially in healthcare professions where workforce shortages periodically exist (Wold and Worth 1990; Dowell 1996; Bolan and Grainger 2003; Shelton 2003). A student in a healthcare professional program who experiences attrition will foretell one less employee practicing in the clinical setting in a few years. In the latest survey conducted by the American Physical Therapy Association (Goldstein 2001), the unemployment rate for physical therapists was only 1.1%; that is, only 1.1% of physical therapists were out of work and looking for work in the field. This was the lowest unemployment rate recorded during the four previous years. In fact, the American Physical Therapy Association has not found it important enough to collect information about unemployment among physical therapists since currently there is essentially full employment in the profession.

Another significant societal implication of attrition is that elderly individuals use a disproportionate amount of health care services. According to the United States Census Bureau (2003), there are over 35 million people in the United States over the age of 65. The number of elderly citizens will increase over the next few decades; subsequently, the demand for health care services will increase during this time. Specifically in the field of physical therapy, the “graying of America” will be one factor which will cause an increase in demand for therapists in the decades to come (American Physical Therapy Association 1998). This demographic influence on the demand for physical therapy services will become stronger by 2010, according to a report published by Vector Research, Inc. for the American Physical Therapy Association (1998).

A significant shortage of physical therapists appears to be looming. Currently, there is essentially full employment of physical therapists who desire full-time work. The demand for physical therapy services, however, will only increase as the average age of the nation’s population continues to increase. The retention of students in healthcare professional programs like physical therapy will help to provide an adequate supply of professionals to provide for the future healthcare needs in the United States.

Problem

Attrition in healthcare education, while significant, has been investigated primarily in medical school (Kassebaum and Szenas 1995; Reede 1999; James and Chilvers 2001) and nursing school (Wold and Worth 1990; Dowell 1996; Bolan and Grainger 2003; Shelton 2003) settings. However, attrition in physical therapy education has been addressed in only a few research articles (Gabard, Porzio et al., 1997; Haskins

1994; Haskins and Rose-St. Prix 1994; Moore, Beitman et al. 2003), despite its impact on healthcare personnel and the subsequent influence on societal well-being.

Elon University's physical therapy program offers an opportunity to investigate attrition in physical therapy. At the time of the study, Elon conferred a Master of Physical Therapy degree on its graduates. Elon University is located in the Piedmont section of North Carolina and has a total enrollment of approximately 4500 students. With an endowment of less than \$60 million and a history of minimal grant funding, Elon is an institution that is heavily dependent on tuition dollars for revenue. Thus the study of attrition is important to Elon University and other private institutions that offer an education in physical therapy. Of the 206 educational programs in physical therapy, 94 of them (45.6%) are housed in private institutions, according to the American Physical Therapy Association (2004). The attrition rate and the factors that predict attrition in the physical therapy program at Elon University may differ from the results found by other investigators. Thus it may not be appropriate to generalize the results of these other studies to Elon University and other similar institutions given philosophical and programmatic differences between institutions of higher learning.

The main intent of the study conducted by Gabard and associates (1997) only was to investigate the efficacy of admissions interviews in physical therapy education; they were interested in retention of physical therapy students primarily in regards to whether the students were subjected to admissions interviews or not. Thus they did not place their findings in the context of a theoretical framework of retention in education. They failed to explore more comprehensively other factors that may predict attrition. Likewise, Haskins and Rose-St. Prix (1994) and Moore and associates (2003) do not place their

results within a theoretical framework of retention in education. Both groups of investigators focus their studies on recruitment and retention strategies for minority physical therapy students; they do not attempt to categorize reasons for attrition in physical therapy education.

In addition, investigators in the fields of medicine (Evans 1975; Clapp 1976; Sarnacki 1982; Strayhorn and Frierson 1989; Hall 1992; Mitchell, Haynes et al. 1994; Cunnington and Norman 1997; Reede 1999) and nursing (Wold and Worth 1990; Griffiths, Bevil et al. 1995; Lewis and Lewis 2000) have looked at the predictability of undergraduate institution quality on success in the professional program. However, there have been no studies in the field of physical therapy that have examined the influence of undergraduate institution quality on any form of success in physical therapy education. Thus we currently do not know whether or not consideration of an applicant's undergraduate institution is justified in the admissions process.

Concerns have been raised about the measurements of institutional quality that have been used in studies of medical students. Those researchers who looked at undergraduate institution quality as a predictor of success in medical school often used average Scholastic Aptitude Test (SAT) scores of entering students as their measure of undergraduate quality (Astin 1971). While average SAT score may be a good indicator of the quality of students who matriculate at a particular institution of higher learning, it may not be the best indicator of the quality of education that the students receive while in college. Astin himself in later publications (Astin 1985) states that a single measure is typically not the best means of determining the quality of the college education obtained at a particular institution.

The Princeton Review (2004) attempts to measure the academic quality of undergraduate four-year institutions in the United States. The Princeton Review, one of several commercially-available guides used by prospective college students and their parents, may or may not provide valid information regarding the quality of the education offered at a specific college or university. The Princeton Review assigns an Academic Rating score to many institutions of higher learning. Several institutions with low enrollments and/or low prestige, however, are not given Academic Rating scores by The Princeton Review. The Academic Rating is developed in part from information obtained from 100,000 on-campus and on-line student interviews conducted annually. College and university administrators also are given the opportunity to provide feedback on the survey results. Admissions selectivity also is a factor used in determining the Academic Rating. The range of possible scores is from a low of 1 to a high of 99.

To date, there are no published studies that have addressed the reliability or validity of The Princeton Review's Academic Rating. Since such a score is available for use by the public, research is needed to establish its validity. One way of establishing concurrent validity is to compare the Academic Rating to a more frequently used standard of undergraduate institution quality. In this study, The Princeton Review's Academic Rating was compared to the commonly accepted average SAT score of entering students as a standard of institutional quality.

The Princeton Review, however, is the only guide that allows one to assess the academic quality of a college or university irrespective of whether the institution is a liberal arts college or a research-intensive university or some other type of institution. The U. S. News & World Report guide (2003), for instance, ranks institutions but does

not do so in a way that allows for a comparison between liberal arts colleges and research-intensive universities.

Purpose Statement

Based on the aforementioned deficiencies in the research literature, the purpose of this study was to identify cognitive, collegiate, and demographic predictors of success in physical therapy education for students at Elon University.

Research Questions

The following research questions were formulated based on the problems noted above.

1. What percentage of matriculating students are successful in completing the physical therapy program at Elon University with the class in which they entered?
2. In addition to academic reasons, what are the other reasons why students do not successfully complete a physical therapy program with the class in which they entered?
3. Is the Princeton Review's Academic Rating a valid indicator of collegiate quality?
4. What is the predictive ability of cognitive, collegiate, and demographic variables on success, as defined by attrition (i.e. graduating with the class in which the student entered), in physical therapy education?

Conceptual Framework of the Study

The theoretical framework for this study was based on a small section of the longitudinal model of doctoral persistence developed by Tinto (1993). Tinto, known for his work in developing a model of undergraduate retention (1993), understood that differences that affect retention exist between graduate and undergraduate education. His

model of doctoral persistence differs from his model of undergraduate persistence in several respects. “First, the character of doctoral persistence is likely to be much more a reflection of the particular normative and structural character of the specific field of study and the judgments that describe acceptable performance than a reflection of the broader university” (Tinto, 1993, p. 232). Secondly, the doctoral experience is more likely to be shaped largely by the student and faculty communities that exist within the academic department. Social integration at the graduate level is tied into the social fabric of the academic department more so than at the undergraduate level. Social integration into the professional organization also becomes more important at the graduate level. Lastly, the research experiences toward the latter end of the program are significant at the graduate level but minimal at the undergraduate level. Tinto’s complete model of doctoral persistence is presented in Figure 1.

To date, no other models of persistence in graduate education have been proposed independent of Tinto’s model. From inspection of Tinto’s entire model, one notes that there are multiple factors that can derail a student on the road to degree completion. While Tinto’s model for undergraduate retention has been researched extensively, there have been only a few studies published that utilized his model for graduate education retention (Hagedorn 1993; Dickerson, Neary et al. 2000; Welhan 2000). These studies tend to support the underlying construct of the Tinto model. Even though the model represented in Figure 1 has not been researched extensively, the model is still worthy of consideration given Tinto’s notoriety in the area of student retention.

For the purposes of this study, only the influences of certain Attributes listed in the beginning of the Tinto model (including Student Attributes, Educational Experiences,

and Student Background) were analyzed in terms of their ability to predict a successful outcome. In the admissions process, only the Attributes in the Tinto model are known to those making acceptance decisions. The parts of the model labeled Entry Orientations, Institutional Experience, Integration, and Research Experiences become known only after the admissions process has been completed. The focus of this study was to examine variables that are known before a student matriculates into the physical therapy program at Elon University and determine if those pre-admission variables are sufficient in predicting attrition. If not, other variables further into the model may be examined in future studies to determine their ability to predict attrition. The adapted model used in this study is presented in Figure 2. Variables used in this study to represent each attribute are listed in parentheses. Student Attributes are represented by the student's age, race, and gender. Educational Experiences are assessed via the two assessments of undergraduate institution quality, the average SAT score of an institution's entering students denoted by the Astin Scale and The Princeton Review's Academic Rating score. Student Background is characterized by cognitive factors such as the student's undergraduate GPA, Math Graduate Record Exam (GRE) score, and Verbal GRE score. Financial Resources is the only one of Tinto's Attributes that is not represented in the model used in this study. A student's financial resources are not known to admissions committee members. Thus financial resources are not considered when making decisions regarding admission to the Physical Therapy program at Elon University. Given that the current study was designed specifically to examine variables used in the admissions process, Financial Resources as a variable was not included in this particular study.

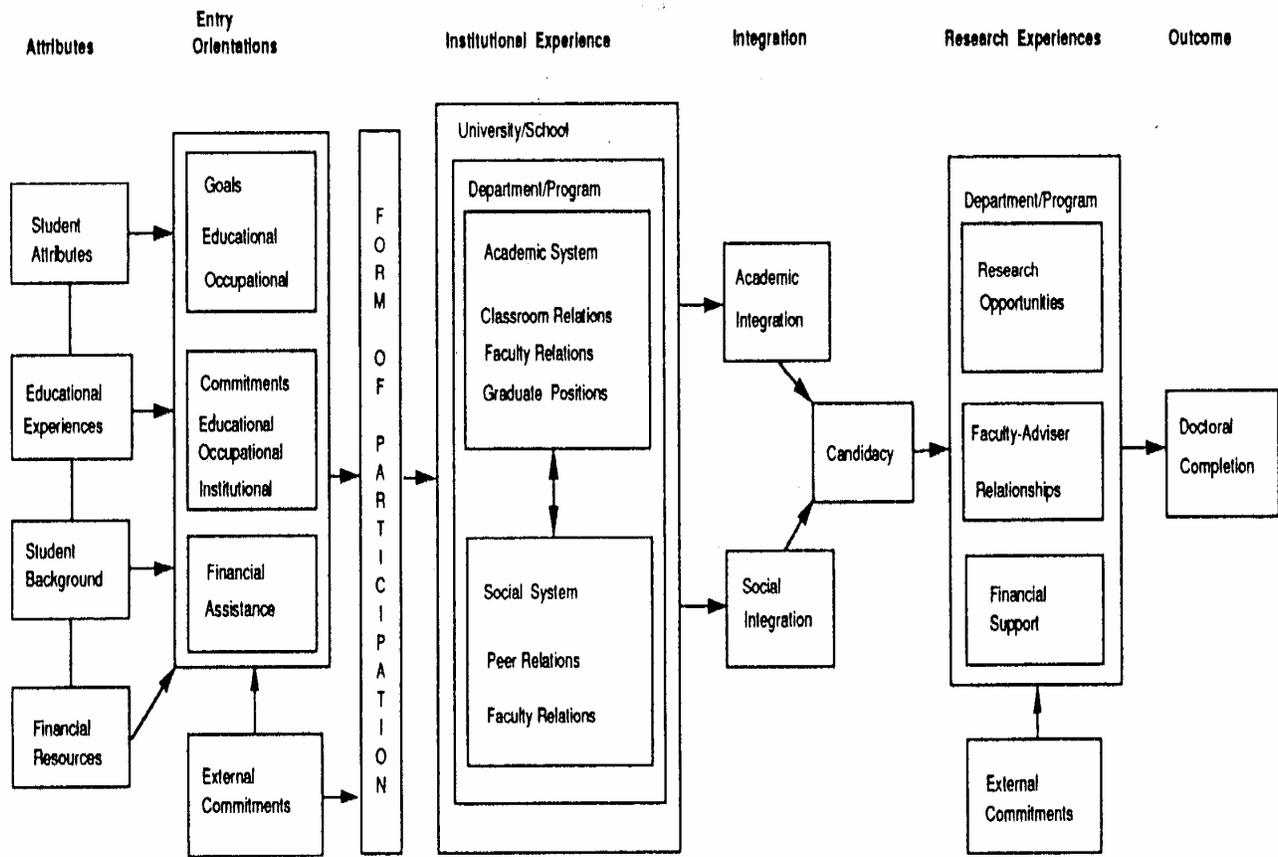


Figure 1. Tinto's longitudinal model of doctoral persistence.

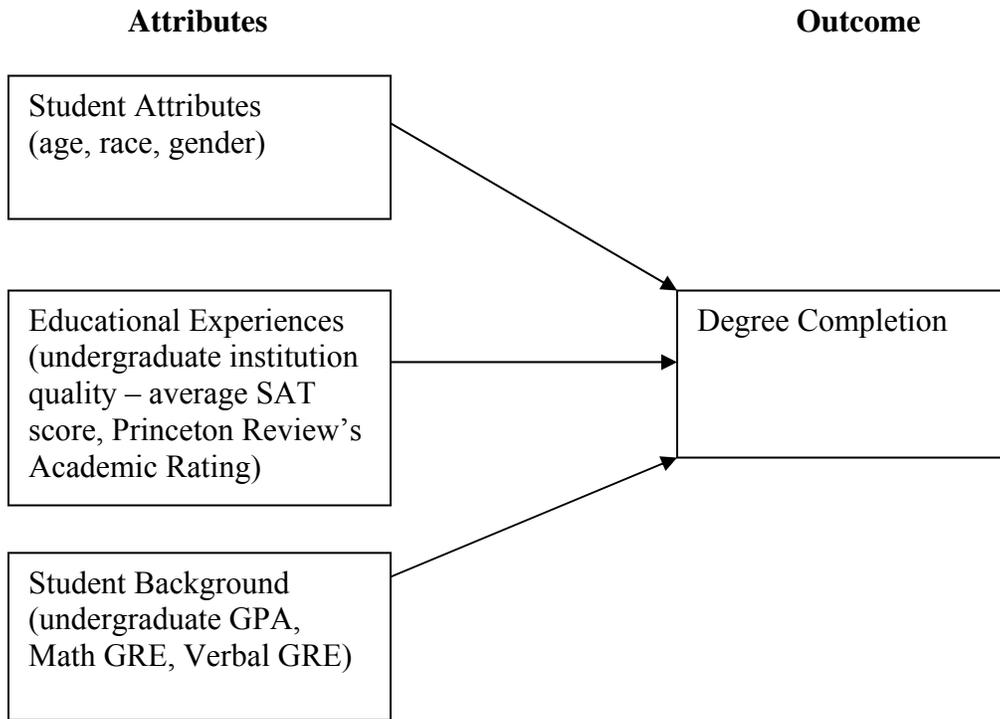


Figure 2. Portions of Tinto’s model utilized in this study.

Significance of the Study

The results of this study should have societal implications given the staffing needs in the healthcare industry and the anticipated increases in the need for healthcare clinicians in the future. There will be an effect of attrition in healthcare education on healthcare personnel availability in future years.

In addition, the results of this study should provide for a broader understanding of attrition, especially in the field of physical therapy. Physical therapy educators in the 206 graduate programs in the United States may be interested in the results of this study. These educators may be interested in this study given their need to better understand attrition and the ability of undergraduate institution quality to predict academic success in

physical therapy education. In particular, the faculty members at Elon University will base admissions decisions of applicants to its physical therapy program in part on the results of this study. Currently, these faculty members strongly consider the cognitive factors that have been shown to predict academic success in physical therapy education. Cognitive factors, specifically science grade point average (GPA) and cumulative undergraduate GPA are the predominant factors used by physical therapy programs in making admissions decisions (Scott, et. al. 1995). Collegiate and demographic factors, however, are not strongly considered either by the admissions committee at Elon University or by other physical therapy programs (Scott, et. al. 1995).

Specifically, numerous investigators have identified undergraduate GPA (Levine, Knecht et al. 1986; Guthrie 1990; Roehrig 1990; Rikard-Bell, Marshall et al. 1991; Nayer 1992; Kirchner, Holm et al. 1994; Templeton, Burcham et al. 1994; Scott, Chase et al. 1995; Hayes, Fiebert et al. 1997; Payton 1997; Morris and Farmer 1999; Dockter 2001) and GRE scores (Day 1986; Kirchner, Holm et al. 1994; Scott, Chase et al. 1995; Payton 1997) as significant predictors of success in physical therapy school. Even so, academic success is typically characterized by GPA in the professional program and not by attrition in these studies.

Consideration of the quality of the applicant's undergraduate institution remains equivocal. At Elon, the point basis for applicants to the physical therapy program is given in Appendix A. Points are awarded to applicants based on their undergraduate total GPAs, undergraduate science GPAs, Math and Verbal GRE scores, submitted essays, and letters of recommendation. Currently, there are no points either given or taken away from applicants based on the quality of their undergraduate experience.

Graduate programs tend to use the admissions criteria that have been researched. Investigating additional variables will create opportunities to enhance the odds of students experiencing successful completion of the program.

The results of this study also may be of particular interest to the physical therapy faculty at Elon University since the rate of attrition may be higher than in other programs. In a study of their physical therapy students at College of St. Catherine in Minnesota, Thieman and associates reported an attrition rate of less than one percent (Thieman, Weddle et al. 2003). The attrition rate in Elon's physical therapy program may be higher than one percent, given the author's knowledge of the program. If Elon's attrition rate is indeed higher than in other programs, then identifying cognitive, collegiate, and demographic predictors of attrition may help bring Elon's attrition rate more in line with that of other programs.

The results of this study also may be of interest to high school students interested in a career in physical therapy and their parents. According to one author (Astin 1978), students at more selective colleges have lower grade point averages than similar students at less selective institutions. One reason for this difference in GPA is that there may be less grade inflation at more selective institutions. With this information in mind, where should the high school student with aspirations for enrolling in a graduate program in physical therapy attend college? Should the student attend a less selective college and achieve a higher grade point average? Should the student attend a more selective college but risk obtaining a lower grade point average? Does college selectivity really matter for the student interested in eventually attending a graduate physical therapy program? The results of this study may help physical therapy educators, high school and college

students, school guidance counselors, and parents understand whether undergraduate institution quality has predictive capabilities for success in physical therapy school beyond the well-established cognitive factors.

Definition of Terms

Physical therapy – A healthcare profession with a theoretical and scientific base and widespread clinical applications in the restoration, maintenance, and promotion of optimal physical function (American Physical Therapy Association 2001). The education of physical therapists takes place at the graduate level.

Success in physical therapy education – A successful student is the physical therapy student at Elon University whose graduation from the program was neither delayed nor denied. This definition of success in physical therapy will allow for a direct comparison between the results of this study and those obtained by other researchers (Gabard, Porzio et al. 1997).

Cognitive predictors of success – Standardized tests scores on the Math and Verbal sections of the GRE were used along with undergraduate GPA as indicators of cognitive ability.

Collegiate predictors of success – Collegiate predictors were defined as the quality of the physical therapy student's undergraduate institution.

Undergraduate institution quality – The scale (Astin 1971) of the average SAT score of the institution's freshman class was used as an indicator of undergraduate institution quality. Another indicator of academic quality used in this study was the Academic Rating score published in The Princeton Review (2003).

Chapter II

Review of the Literature

This review of the literature will begin with an examination of the underlying theoretical construct, Tinto's model of doctoral persistence. From there, studies related either to the dependent variable of timely completion of physical therapy graduate study and/or to the independent variables (cognitive, collegiate, and demographic) in physical therapy education will be examined. Where no studies exist, literature from the medical and nursing fields will be explored. Lastly, the few articles utilizing both dependent and independent variables in this study will be discussed.

Tinto's Model of Persistence in Graduate Education

Only a few researchers have purposefully utilized Tinto's longitudinal model of persistence in graduate education in their work (Hagedorn 1993; Dickerson, Neary et al. 2000; Welhan 2000). They all support Tinto's model by identifying factors that influence degree completion. In a presentation at the Annual Meeting of the Association for the Study of Higher Education, Hagedorn (1993) presented results of her survey of persistence in older female graduate students. In a logistic regression analysis of 81 students, the factor that was most predictive of persistence was the Student Attribute of single marital status. The personal attribute of not being married was able to predict whether the older female student completed the degree program or not. Other significant predictors of persistence included positive interactions and relationships with faculty members as well as fellow students. Achieving a high GPA was another significant predictor. Factors included in the Integration phase of Tinto's model also were important

predictors of persistence. Specifically, Academic Integration was important as evidenced by the fact that maintaining a high GPA was a significant predictor. Also, Social Integration was important given that positive interactions and relationships with faculty members as well as fellow students were significant predictors.

In a doctoral dissertation, Welhan (2000) recruited 26 baccalaureate nursing students and 36 graduate nursing students to identify factors the researcher thought were important in determining persistence to graduation. Welhan found that, overall, the persistence patterns emerging from the content analysis and descriptive quantitative analysis were supportive of Tinto's undergraduate and graduate models of persistence. Specific to the graduate students surveyed, Welhan found that the external community was an important, positive reinforcer of the student's persistence to degree completion. In the context of Tinto's model, the student's external community is a part of Student Background and External Commitments. Once again, a factor identified early in one's graduate education program, external community support, was identified as an important indicator of persistence to graduate degree completion.

Dickerson, Neary, and Hyche-Johnson (2000) interviewed 11 Native American graduate students in a nurse practitioner program. These students' struggles to complete the nurse practitioner degree were related to an academic environment they perceived as rigid and judgmental given the frequent evaluations by the professors. These Native American students, in a program in a research-intensive university, felt isolated from both faculty members and fellow students. These students believed their minority race with its different cultural values impeded their persistence in the educational program. Using

Tinto's model, the authors contend that the Student Attribute of race had a negative effect on the students' willingness to persist in completing the program.

In summary, the few studies that have been conducted using Tinto's longitudinal model of graduate education persistence have identified factors early in the model that have an influence on a student's ability to persevere through the different phases of the academic program to completion of a graduate degree.

Attrition in Physical Therapy Education

Success in physical therapy education has been assessed in a variety of ways, including GPA, clinical performance scores, licensure exam scores, and attrition. The most common measure of success in studies of physical therapy education has been GPA in the professional program (Levine, Knecht et al. 1986; Guthrie 1990; Rikard-Bell, Marshall et al. 1991; Kirchner, Holm et al. 1994; Templeton, Burcham et al. 1994; Payton 1997; Morris and Farmer 1999; Watson, Barnes et al. 2000; Thieman, Weddle et al. 2003). These researchers, however, did not indicate whether or not the GPAs of students who dropped out or failed out of the program were included in the analyses. Other outcome measures used in determining success in physical therapy have been scores on performance in the clinical setting (Balogun 1988; Amosun, Balogun et al. 1996; Morris and Farmer 1999; Watson, Barnes et al. 2000; Thieman, Weddle et al. 2003) and success in passing the profession's licensure exam (Dockter 2001; Guffey, Farris et al. 2002; Thieman, Weddle et al. 2003). Fewer studies have been conducted using attrition as the means of determining a successful outcome in physical therapy education (Haskins and Rose-St. Prix 1994; Gabard, Porzio et al. 1997).

In their survey of 22 physical therapy academic programs, Haskins and Rose-St. Prix (1994) sought to compare attrition of minority to non-minority students. Their outcome variable for attrition was called a “mean equity score for graduation.” This score was defined as the proportion of minority students who progressed from enrollment to graduation in comparison to the same proportion for non-minority graduates. Absolute retention rates were never presented from the survey results; only minority to non-minority retention ratios were given. These authors also sought to identify strategies that successfully enhance recruitment and retention of minority students in physical therapy education. The various recruitment and retention strategies were the independent variables; however, they do not fit within the model of doctoral persistence used in the current study.

In the study by Gabard and associates (1997), the authors addressed the ability of applicant interviews to predict attrition in physical therapy education. Secondly, they sought to describe the interview formats currently used in physical therapy education as well as the costs associated with conducting the interviews. These researchers sent questionnaires to the Directors of Admissions at all 63 graduate programs in physical therapy at the time of the study. Forty-three surveys were suitable for inclusion in the data set. Gabard and associates defined the attrition rate as the number of students who graduated at the expected time divided by the number of students who began each program. Thus, the attrition rate in this study should more accurately have been called a retention rate. The mean attrition rate for schools that interviewed their applicants was 0.961 (SD 0.056) while the mean attrition rate for schools that did not interview their applicants was 0.940 (SD 0.087), an insignificant difference using the two-tailed t-test (p

> 0.05). Gabard and associates did not report an attrition rate for the entire sample but it was close to 0.95, based on the fact that the attrition rate was 0.94 for one group and 0.96 for the other. Thus, approximately 5% of physical therapy students who enrolled in the surveyed programs failed to graduate on time.

As part of the survey, admissions directors gave their attrition rate and the causes for attrition. Most of the causes of attrition were academic in nature. The academic reasons for attrition were: failure to meet academic standards, student quit-academic difficulty, or student given part-time program. The non-academic reasons for attrition in the physical therapy programs were: death of student, death of family member, family obligations, financial hardship, pregnancy, student expelled (presumably because of professional and/or behavioral concerns), serious illness, or student quit-career change. There may have been multiple reasons for a student to drop out, but the authors did not make it clear whether a respondent could list multiple reasons for a student dropping out or not. The most common reason physical therapy students did not graduate on time was because they were put in a part-time curriculum as a result of academic troubles in the full-time curriculum. The top three reasons for leaving programs altogether were student quit - academic difficulty, failure to meet academic standards, and being expelled from the program. Thus most causes of leaving the program or going on a part-time program in this sample were academic reasons.

As noted above, the attrition rate in the physical therapy programs surveyed by Gabard and associates (1997), including those who graduated later than their initially expected graduation date, was approximately five percent. Thieman and associates (2003), in their retrospective study of 121 physical therapy students who attended the

College of St. Catherine in Minnesota, noted an attrition rate of less than one percent in their program. Their attrition rate may be lower than the attrition rate noted by Gabard and associates (1997) because Thiemann and associates did not include in their attrition rate those whose graduation was delayed.

Attrition in Other Graduate and Professional Fields

How does the attrition rate for physical therapy compare to the attrition rates in other graduate and professional programs? Some authors contend that the attrition rate for graduate school in general is approximately 50% (Tinto 1993; Lovitts and Nelson 2000). No data are provided to substantiate these claims, though they seem to be generally accepted.

In the field of nursing, student attrition has been studied by different investigators (Mashaba and Mhlongo 1995; Dowell 1996; Bolan and Grainger 2003; Shelton 2003). Mashaba and Mhlongo (1995) mention in their article that according to the South African Nursing Council, the attrition rate, or what they call “wastage”, is between 18% and 50% in the different nursing schools in South Africa. From their surveys of students who dropped out of university-affiliated nursing schools in South Africa, they found that 90% of them were first generation college students. Based on demographics in the United States, probably less than 90% of the nursing students in the United States are first generation college students. Given the numerous differences educationally, racially, economically, and otherwise between nursing students in South Africa and the United States, nursing student attrition in South Africa may not be able to be generalized to the attrition rate in the United States. The Attributes identified in the Tinto model may differ

substantially between students in South Africa and students in the United States so that attrition in nursing schools differs between the two countries.

Closer to the United States geographically and socioeconomically, Bolan and Grainger (2003) examined the attrition rate of students in a Canadian nursing program. All 159 students who were in a nursing program between 1996 and 1998 were surveyed. Sixty-nine questionnaires (43.4%) were returned for data analysis. The authors did not address the possibility of a response bias affecting their results. Nonetheless, they noted that of the 69 respondents to the questionnaire, 48 (69.6% of the respondents) were still in the program and continuing with their classes, 12 (17.4%) had left the program, and nine (13.0%) were progressing behind their original class. Thus over 30% of the nursing students in this one program either were not going to graduate or they were not going to graduate on time.

Shelton (2003) notes in her article that the National League for Nursing Accrediting Commission has set a standard of 20% or less as a desirable attrition rate for all nursing programs. The implication of this professional organization's goal is that a substantial number of nursing programs have attrition rates greater than 20%.

In the field of medicine, the attrition rates of medical students also have been studied and appear to be lower than the attrition rates of nursing students (Fitzpatrick and Wright 1995; Kassebaum and Szenas 1995; Simpson and Budd 1996; James and Chilvers 2001). At the Leeds Medical School in England, Simpson and Budd (1996) found that over a ten year period, 283 or 14% of the medical school students had left the program. Fifty-three percent of those who left did so for academic reasons; the remainder left voluntarily. Thirty percent of those who left had personal problems, nine percent had a

combination of academic and personal problems, and eight percent had health problems. Psychological difficulties were the most common forms of health problems that forced medical students to drop out.

Also in the United Kingdom, James and Chilvers (2002) studied attrition between 1970 and 1995 of medical students at the University of Nottingham. In their review of the 2270 students who had been in that medical school over a 25-year period, they noted that 148 (6.5%) of the students had left the program before graduating.

In the United States, attrition in medical schools has been studied by Kassebaum and Szenas (1995) and by Fitzpatrick and Wright (1995) using national databases. Kassebaum and Szenas (1995) used data from the Association of American Medical Colleges' Student and Applicant Information Management System and from unspecified publications from the Department of Education. They looked nationwide at student performance in medical school between 1984 and 1990. These investigators found the percentages of medical students who failed to graduate within the expected four years were a low of 16.7% in 1984 and a high of 18.8% in 1988. They also reported an attrition rate which they defined as students dismissed or withdrawn from medical school. They found an attrition rate between 2.5% and 4.5% for each matriculating class between 1984 and 1990. The authors did not indicate if this attrition rate was an annual rate or if it covered the entire four-year curriculum. One may surmise the authors meant this as an annual attrition rate given the much higher percentages for those who failed to graduate in four years. That is, the attrition rate reported may mean, for example, that the attrition rate for the students entering in 1984 was 3.8% *per year*. If not, then many more medical students graduated in five years or more than were dismissed or withdrew.

Fitzpatrick and Wright (1995) looked at medical school attrition in the United States between 1973 and 1992 using the annual reports on medical education published in the Journal of the American Medical Association as their data source. To calculate attrition rates, Fitzpatrick and Wright divided the number of medical school graduates for a given year by the number of entering medical school students four years earlier. They noted that the attrition rate increased steadily from the 1970s to the early 1990s. The lowest attrition rate calculated was 2.51% for the class entering in 1975 and the highest attrition rate was 8.02% for the class entering in 1986. However, the authors do not indicate whether students who took longer than four years to graduate were excluded from the calculations. For example, for the cohort of students entering in 1980 and graduating in 1984, the authors do not indicate whether those who entered in 1979 and took five years to graduate were deleted when the number of graduates in 1984 was determined. If not, then the published attrition rate was lower than it would have been otherwise. The different data sets used and the possible different methods of calculating attrition rates may explain why Kassebaum and Szenas found that slightly less than 20% of medical students failed to graduate within four years while Fitzpatrick and Wright found the percentage to be less than 10%.

From these studies, even though attrition rates were calculated differently in each one, one may summarize that the attrition rate is lower for physical therapy students than for medical students and that the attrition rate is highest for nursing students.

Predictive Ability of Undergraduate GPA

Numerous investigators have looked at the influence of undergraduate GPA on some form of success in physical therapy education (McGinnis 1984; Balogun,

Karacoloff et al. 1986; Day 1986; Levine, Knecht et al. 1986; Balogun 1988; Guthrie 1990; Roehrig 1990; Nayer 1992; Sanders 1993; Kirchner, Holm et al. 1994; Templeton, Burcham et al. 1994; Scott, Chase et al. 1995; Hayes, Fiebert et al. 1997; Payton 1997; Morris and Farmer 1999; Watson, Barnes et al. 2000; Dockter 2001; Thieman, Weddle et al. 2003). Most of these investigators found that undergraduate GPA was a significant predictor of success in physical therapy education (McGinnis 1984; Balogun, Karacoloff et al. 1986; Day 1986; Levine, Knecht et al. 1986; Balogun 1988; Roehrig 1990; Kirchner, Holm et al. 1994; Templeton, Burcham et al. 1994; Hayes, Fiebert et al. 1997; Dockter 2001; Thieman, Weddle et al. 2003). Most of these investigators defined success as GPA in the professional program. However, they did not examine success as defined by retention, thus leaving questions about the influence of the independent variables on other aspects of “success.” For instance, Day (1986) studied four graduate programs in physical therapy to identify predictors of final GPA in physical therapy education. Using stepwise multiple regression analysis, Day found that the best predictors of physical therapy GPA were undergraduate GPA, gender, race, and the Analytical section of the GRE. However, she did not look for predictors of attrition in physical therapy education.

Levine and associates (1986) studied two consecutive classes of physical therapy students in one physical therapy program for a total of 56 subjects. Correlation coefficients between undergraduate GPA and physical therapy GPA were 0.50 ($p < .05$) for the first class and 0.19 ($p > .05$) for the second class of students. Despite the low number of subjects, the authors used multiple regressions to identify predictors of success for each class. From the results, they found that undergraduate science GPA was the only

significant predictor of success for the first class; there were no significant predictors of success for the second class.

Balogun and associates (1986) conducted a study to examine the predictors of academic success in the Russell Sage College physical therapy program. They used Pearson Product Moment Correlations and multiple regression techniques in their analysis of 83 graduates of their program. Enrolled students who dropped out of the program were deleted from the statistical analyses. These researchers found a correlation between undergraduate GPA and physical therapy GPA of 0.63 ($p < .01$). From the regression analysis, they found that undergraduate GPA alone explained 40% of the variance in physical therapy GPA.

In a subsequent study of 42 graduates from the same physical therapy program, Balogun (1988) found that undergraduate GPA explained 30.5% of the variance in academic achievement, as measured by a comprehensive written exam administered at the end of the program. Undergraduate GPA also was found to be predictive of clinical performance.

Roehrig (1990) divided students in a physical therapy program into those who experienced academic problems in the program (including those who dropped out or failed out) and those who did not. Using the t-test statistic, Roehrig found a difference between the two groups in their undergraduate overall GPAs. Those who did not experience a problem in the physical therapy program had a higher undergraduate GPA than those who did experience a problem.

Kirchner and associates (1994) examined various admission criteria to gauge their ability to predict physical therapy GPA, scores on a comprehensive written exam in the

curriculum, and attendance at an on-site teaching clinic. They found that undergraduate GPA was one of only two significant predictors of both physical therapy GPA and scores on a comprehensive written exam.

Templeton and her colleagues (1994) at East Carolina University examined the predictive ability of 12 preadmission academic variables on physical therapy GPA. They examined the records of 111 physical therapy students in their program. Using multiple regression, they found that undergraduate science course grades in Chemistry and Physics were significant predictors of physical therapy GPA but that overall undergraduate GPA was not predictive.

Hayes and associates (1997) also identified predictors of physical therapy GPA. They assigned their 107 physical therapy students to either a young, traditional student group or an older, nontraditional student group. Undergraduate cumulative GPA was one of two significant predictors of physical therapy GPA for the younger students; undergraduate GPA was not a significant predictor for the older students.

Dockter (2001) examined the records of 107 physical therapy students at the University of Mary in North Dakota during the years 1996 to 1999. She used Pearson Product Moment Correlation coefficients and multiple regression analyses to find significant predictors of success in physical therapy education. Dockter utilized an independent variable known as “core courses” that was undefined. Undergraduate course GPA in core courses had a correlation coefficient of .316 with first-year physical therapy GPA. Furthermore, undergraduate core course GPA had a correlation coefficient of .341 with scores obtained on the National Physical Therapy Licensing Examination. Dockter

found that the independent variable identified as “total admission score”, comprising mainly undergraduate GPA, was predictive of first-year physical therapy GPA.

Recently, Thieman and associates (2003) identified predictors of multiple aspects of success in physical therapy education. These researchers used multiple regression to determine predictors of physical therapy GPA, clinical grades, and performance on the licensure exam developed and administered by the Federation of State Boards of Physical Therapy. Undergraduate math/science GPA was a significant predictor of physical therapy GPA but not of clinical grades or licensure exam scores. Undergraduate overall GPA was a significant predictor of physical therapy licensure exam performance but accounted for only 6% of the variance in licensure exam scores. None of the independent variables utilized by Thieman and associates in this study was able to predict clinical performance as measured by the Clinical Performance Instrument (American Physical Therapy Association 1997).

Only one study did not find a significant effect of undergraduate GPA (either cumulative or in science/math prerequisite courses) on “success” in physical therapy education. Watson and associates (2000) studied 118 students in the physical therapy program at the University of Texas Southwestern Allied Health Sciences School. The outcome variable used in this study was clinical performance, based on scores provided by each student’s four clinical instructors throughout the curriculum. The authors placed the students in one of four groups depending on their clinical performance scores. Using an ANOVA, the undergraduate GPA did not differ between the four groups of students even though their clinical performance scores differed. Academic performance was not used as an outcome variable in this study. Nevertheless, the authors admitted that they

still continued to give significant credence to undergraduate GPA in their program's admission process.

Based on his review of studies conducted on predictors of academic success in physical therapy education, one author (Payton 1997) concluded that “. . . the physical therapy community should accept as demonstrated that the best single predictor of academic success (i.e. grades) in a physical therapy education program is pre-physical therapy GPA and move on to other important questions” (p. 101). Indeed, in a review of the literature pertaining to admissions procedures in physical therapy programs, another investigator (Nayer 1992) found that 11 of 13 physical therapy educational programs considered undergraduate GPA as the most important criterion for admission. In different studies, two investigators identified factors that weighed heavily in the admissions decisions for applicants to physical therapy educational programs (McGinnis 1984; Guthrie 1990). In both studies, undergraduate GPA was identified via multiple regression as a strong predictor of whether an applicant was admitted to physical therapy school. In fact, McGinnis found that undergraduate GPA was the only significant predictor of admission to physical therapy school in her study of pre-physical therapy majors.

Undergraduate GPA, either cumulative or for math/science prerequisite courses, has been consistently shown to predict success in physical therapy education. The strongest predictive capability is for academic success as measured by physical therapy GPA. None of these studies, however, have examined the ability of undergraduate GPA to predict attrition in physical therapy education. In addition, only a few of these investigators actually included those who dropped out of the program or were dismissed in their analyses (Day 1986; Roehrig 1990; Dockter 2001). In the rest of the studies

discussed, the investigators either examined only graduates of a physical therapy program or they did not mention whether or not they included those who dropped out or were dismissed in their data analyses. Examining only the graduates of a program eliminates those who drop out or are dismissed from the analyses.

Predictive Ability of GRE Scores

Scott and associates (1995) surveyed 292 programs in allied health and gathered information about their admissions criteria and procedures. They found that standardized examinations were not often sought after by the admissions committees in these programs. The GRE was requested by only 20% of the programs while the SAT was only requested by another 19%. Specific to the field of physical therapy, only in the last few years have all educational programs transitioned from a baccalaureate degree to a graduate degree. This explains in part why the predictive value of GRE scores has not been examined as much as the predictive value of undergraduate GPA has. Only a few published studies have examined the ability of GRE scores to predict success in physical therapy education (Balogun, Karacoloff et al. 1986; Day 1986; Kirchner, Holm et al. 1994; Thieman, Weddle et al. 2003). In one of these studies, the investigators found that the Analytic section of the GRE was able to predict physical therapy GPA (Day 1986). However, the Analytic section of the GRE has been phased out since this study was conducted. The Analytic section is no longer available for current students applying to physical therapy school.

In a study mentioned earlier, Kirchner and associates (1994) sought to identify predictors of three dependent variables in a sample of physical therapy students: physical therapy GPA, scores on a comprehensive written examination, and student performance

at an on-site teaching clinic. There were no identified predictors of student performance in the clinical setting. However, GRE scores in addition to undergraduate GPA were significant predictors of both physical therapy GPA and written examination scores.

One other previously mentioned study addressed the predictive ability of GRE scores of physical therapy educational success in 122 students at the College of St. Catherine (Thieman, Weddle et al. 2003). Thieman and associates found in their sample that GRE scores correlated with physical therapy GPA ($r = .304$; $p < .01$). In addition, the best model for predicting physical therapy GPA included GRE scores as one of three factors. However, only 5% of the variance in physical therapy GPA was explained by GRE scores alone. Thieman and his colleagues also identified predictors of performance on the physical therapy licensure exam. GRE scores was one of three factors that provided the best model for predicting licensure exam performance. Once again, however, only a small percentage (i.e. 4%) of the variance in licensure exam scores was explained by GRE scores alone. None of the independent variables utilized by Thieman and associates in this study was able to predict clinical performance as measured by the Clinical Performance Instrument (American Physical Therapy Association 1997).

Based on the two studies conducted in the area (Kirchner, Holm et al. 1994; Thieman, Weddle et al. 2003), GRE scores appear to be significant predictors of success in physical therapy education. Once again, however, neither of these sets of researchers examined the ability of GRE scores to predict attrition in physical therapy education. Also, GRE scores may not predict much of the variance in the outcome variables. Therefore, GRE scores in isolation are not sufficiently acceptable predictors of success in

physical therapy education; they must be used in combination with other significant independent variables.

Predictive Ability of Undergraduate Quality

Despite the strong evidence supporting the consideration of undergraduate GPA in determining success in physical therapy education, some limitations of this independent variable have been noted by different authors (Levine, Knecht et al. 1986; Scott, Chase et al. 1995). For example, Scott and associates indicate that “limitations cited for use of GPA include narrow range of grades, variation between schools in reference to grading standards, and level of institution” (p. 96).

Levine and associates (1986) examined the records of physical therapy students and found that undergraduate GPA correlated moderately with physical therapy GPA ($r = 0.54$). Nonetheless, the correlation was not as strong as the authors had predicted. One reason for the lack of a strong correlation was the differences in the academic demands of the various undergraduate institutions attended by the students. “Students coming from preprofessional programs with high scholastic standards may have relatively low entering GPAs but may be better prepared for the rigorous demands of the professional program than those enrolled in programs with lower standards” (p. 149).

Three investigators have looked at the predictive ability of undergraduate institution quality on an applicant’s ability to be selected for admission into a physical therapy educational program (McGinnis 1984; Guthrie 1990; Sanders 1993). In her study of applicants to physical therapy school, McGinnis (1984) identified each applicant as either a community college transfer student or a four-year university student. This

independent variable was not identified as a predictor of acceptance into physical therapy school in the multiple regression analysis.

Guthrie (1990) used the Q-sort technique score as the dependent variable in a study of students who applied to the physical therapy program at the University of Washington. With the Q-sort technique, the opinions of a group of three to five experts are used to select students for admission into the physical therapy program. Each rater ranks applicants in any way he or she chooses. Rankings are then forced into a normal distribution between one and five. For example, the top 10 applicants are given a score of “five,” the next 15 applicants are given a score of “four,” and so on. Individual applicant scores are then averaged among the different raters to come up with a Q-score. Of the 12 independent variables that predicted Q-sort score, one was whether the student had attended the University of Washington as an undergraduate or not. The authors posited that the reason attending the University of Washington was a significant factor was because those students were in an urban environment where they had access to volunteer opportunities in many different clinical settings and they had the ability to develop relationships with local therapists the faculty members respected. The authors contended that this information would be addressed in letters of recommendation the applicants submitted. The experts may have had a bias toward applicants who were undergraduates at their institution, the University of Washington. Therefore, applicants who were undergraduates at institutions less familiar to the experts may have been placed at a slight disadvantage in the application process.

Sanders (1993) asked the admissions committees of five physical therapy education programs to participate in a simulated student-selection process. Nineteen

participants ranked 74 hypothetical applicants with different scores on nine variables. The raters determined their admissions ranking using any criteria and weightings they chose. The university attended was one such independent variable. This variable was coded as the student attended either a two-year or a four-year college or university. Results from the multiple regression analysis revealed that institution of higher education attended was not a consistent predictor of admissions ranking for the admissions committees surveyed.

While three investigators have studied the predictability of undergraduate institution quality on admission into physical therapy school, no studies have looked at the predictive ability of undergraduate institution on attrition once students are in the physical therapy program. One must look to studies of medical students to find studies that have examined the ability of undergraduate institution type or quality to predict academic success in a health care program.

Numerous investigators in medical school settings have identified undergraduate institution quality as an important predictor of educational success (Evans 1975; Clapp 1976; Sarnacki 1982; Strayhorn and Frierson 1989; Hall 1992; Mitchell, Haynes et al. 1994; Reede 1999). Evans and associates (1975) examined the records of 66 minority students enrolled in the Case Western Reserve University School of Medicine in the early 1970's. These investigators quantified each student's undergraduate institution quality based on Astin cell scores of the undergraduate institution's average SAT for its entering students (see Table 1). Based on regression analyses, they found that undergraduate quality was a significant predictor both of academic success as well as success on Part I of the examination of the National Board of Medical Examiners (NBME). Part I of the

NBME is administered to all medical students in the United States at the end of the second academic year.

Table 1

Conversions of Mean SAT Scores to Astin Cell Scores

Mean SAT (Verbal & Math)	Astin Level
≥ 1236	7
1154-1235	6
1075-1153	5
998-1074	4
926-997	3
855-925	2
≤ 854	1

Also in the 1970's, Clapp and Reid (1976) studied undergraduate institution selectivity in 110 medical students at the University of Missouri at Columbia using Astin cell scores. The addition of institutional selectivity significantly increased the prediction of medical school GPA, instructors' subjective ratings of the students, and score on Part I of the NBME. The authors concluded that undergraduate GPA adjusted by institutional selectivity was considerably more useful than raw GPA for predicting medical school academic success and score on the NBME. They also concluded that GPA adjusted by

institutional selectivity was just as useful for predicting medical school success as Medical College Admission Test science subscores were.

Sarnacki (1982) studied 194 students from the graduating classes of 1979 and 1980 at the State University of New York at Buffalo School of Medicine. Participants were placed in one of four groups based on undergraduate institutional selectivity as determined by Barron's College Admissions Selector (1978). He found a significant inverse relationship between undergraduate selectivity and undergraduate GPA. That is, the more competitive the medical student's undergraduate institution, the lower the undergraduate GPA tended to be. Despite the differences in undergraduate GPA between institutions with higher or lower selectivity, institutional selectivity was not a significant predictor of medical school GPA or NBME scores. "The fact that the significant mean GPA orderings favored the 'less selective' undergraduate institutions but failed to recur in medical school performance suggests that some sort of adjustment to raw GPA should be made on the basis of institutional selectivity before premedical GPA is used as a predictor of future academic performance" (p. 168). Sarnacki suggests that admissions committees should add points to the GPA of the medical school applicant who graduated from a highly selective college or university. Likewise, he suggests that admissions committees should subtract points from the GPA of an applicant who graduated from a less selective institution.

Strayhorn and Frierson (1989) studied the academic success of Black and White medical students at the University of North Carolina at Chapel Hill. They determined undergraduate competitiveness as the mean Medical College Admission Test score of students who attended that particular college or university. They found that Black

students had attended less competitive undergraduate institutions. As expected, undergraduate institution competitiveness was a predictor of medical school academic success in White students. However, Strayhorn and Frierson found that for Black students, undergraduate competitiveness was a negative predictor of medical school success. In other words, Black students who attended less competitive colleges or universities performed better in medical school than Black students who graduated from more competitive undergraduate institutions. The authors attribute this paradox to insecurities these Black students may have developed in their predominantly-white yet highly selective undergraduate institutions.

Hall and Bailey (1992) examined 420 students who matriculated in the Dartmouth Medical School between 1982 and 1986. They described the undergraduate college or university of each entering medical student as having high, medium or low selectivity based on Astin scores. Based on the results of one-way analysis of variance, there were significant differences in undergraduate science GPA between the three groups. Undergraduate science GPA was 3.43 for students from colleges with low selectivity; undergraduate science GPA was 3.15 for students from colleges with high selectivity. However, there were no differences in first-year medical school GPA between the three groups. Once again, these researchers contend that college selectivity should be a weighting factor when admissions committees consider an applicant's GPA.

Mitchell and associates (1994) used data from students in 12 medical schools in their study of predictors of 1st-year medical school GPA. Undergraduate selectivity was again based on average SAT scores of the entering class at that particular college or university. These researchers used regression analyses along with corrected correlations

to describe the prediction of 1st-year medical school GPA. Since the participants in the study were only students selected for medical school admission, correlations were corrected by the investigators because of the restricted range of scores on the preadmission variables. Standard deviations for undergraduate selectivity and the other independent variables were used to correct for the restricted range of values for these variables. They found a median corrected correlation of 0.58 between two predictor variables, undergraduate GPA and undergraduate selectivity, and 1st-year medical school GPA. The correlation between undergraduate GPA alone and 1st-year medical school GPA was slightly lower at 0.53.

Lastly, in her review of these and other articles examining the preadmission predictors of academic success in medical school, Reede (1999) concluded that “the addition of college selectivity as measured by the average scholastic aptitude test scores for matriculants enhances the predictive strength of the grade point average” (p. 73).

Not only is undergraduate quality as measured by selectivity a predictor of medical school success, admissions committees appear to make their decisions accordingly. Based on national information about college graduates, Astin posited that an applicant’s admission to medical school is enhanced by attending a selective private university and is diminished by attending a public four-year college (Astin 1978). In their survey of 114 medical schools, Mitchell and associates (1994) found that admissions committees consider the quality of the applicant’s degree-granting undergraduate institution to be of moderate importance in the decision-making process.

Fewer studies have examined the ability of undergraduate institution quality to predict any measure of success in nursing school (Astin 1978; Strouck 1979; Griffiths,

Bevil et al. 1995; Lewis and Lewis 2000). In his results published in a magazine for nurses, Stronck (1979) reported on the colleges and universities from which transfer students to the Intercollegiate Center for Nursing Education in Washington came. The Intercollegiate Center grants a baccalaureate degree in nursing and its administration is shared by a consortium of four independent institutions: Eastern Washington State College, Fort Wright College, Washington State University, and Whitworth College. Stronck claimed that these students' GPAs differed based in part on the institutions they transferred from. Those who came to the Intercollegiate Center from institutions that graded rigorously performed better in the nursing program. Unfortunately, Stronck did not describe how he measured his variables nor did he present the results explicitly in this article.

Griffiths and associates (1995) examined 98 nursing students to identify predictors of success on an anatomy/physiology exam developed by a single nursing faculty member and given before the students took anatomy/physiology in the nursing program. In this program, an undergraduate course in anatomy/physiology was a prerequisite for entrance into nursing school. One of the variables entered into the regression equation was the "type of college" at which the prerequisite course was taken. As with the study by Stronck (1979), this group of researchers failed to define this independent variable. Griffiths and her colleagues identified the type of college attended as one of two significant predictors of performance on the anatomy/physiology exam. Type of college explained 18% of the variance in scores on the entrance anatomy/physiology exam.

Lastly, Lewis and Lewis (2000) studied 168 nursing students who transferred to a midsized Midwestern university's nursing program between 1991 and 1994. The dependent variable in their study was academic success as defined by a cumulative GPA in the nursing program of 2.5 or higher. Fifty-three percent of the students were successful in the program using the authors' definition of success. One of the independent variables used in the study was the type of institution from which the student transferred. Students were noted to have transferred from either a 2-year or a 4-year institution. From logistic regression analyses, these researchers found that type of institution was a significant predictor of success in nursing school. An odds ratio of 2.10 indicated that the odds of a successful nursing student transferring from a 4-year institution were over twice the odds of a successful nursing student transferring from a 2-year institution (95% confidence interval: 1.10, 4.03).

In summary, no published studies have looked at the ability of undergraduate institution quality to predict success of any type in physical therapy school. Studies examining the impact of undergraduate institution quality conducted in medical education and to a lesser extent in nursing education, however, indicate that the quality of the undergraduate institution has been consistently identified as a significant predictor of educational success.

Predictive Ability of Age

Several groups of researchers have investigated the predictive ability of age on different aspects of success in physical therapy education. Of these, some have not found age to be a predictor of success (Hahn 1984; Williams 1984; Rikard-Bell, Marshall et al.

1991; Hayes, Fiebert et al. 1997) while others have (Peat, Woodbury et al. 1982; Amosun, Balogun et al. 1996; Dockter 2001; Thieman, Weddle et al. 2003).

Hahn (1984) looked at the records of 35 graduates of a physical therapy program. Using Pearson Product Moment Correlation coefficients, Hahn did not find a relationship between age and physical therapy GPA.

Williams (1984) studied 59 graduates of one physical therapy school over a 3-year span of time. Using regression analysis, Williams also did not find age to be a significant predictor of physical therapy GPA.

Rikard-Bell and associates (1991) examined the records of 799 physical therapy students at the University of Sydney in Australia. They placed their participants in one of two groups. Participants in Group A were over 23 years of age while participants in Group B were 23 years of age and younger. In the vast majority of the mandatory courses in the physical therapy curriculum, Group B students, the younger students, performed just as well as the Group A students. In one course, older students performed better while the younger students performed better in a different course. Performance was measured by the participant's GPA in the physical therapy program.

Hayes and associates (1997) studied the files of 107 students enrolled in a physical therapy program. They placed the participants in one of two groups based on their age at matriculation in the program. Using t-tests, the authors did not find a significant difference between the younger and older groups in final physical therapy GPA. Multiple regression did not show age as a significant predictor of physical therapy GPA.

On the other hand, Peat and associates (1982) are some of several researchers who found a significant relationship between age and one form of success in physical therapy education. Peat and associates found that even though age was not related to clinical performance, age was significantly related to academic success. Younger students performed better academically than the older students did.

Amosun and colleagues (1996) studied the records of 97 students who had enrolled in a physical therapy program in Nigeria. Academic success was assessed via examinations throughout the curriculum. Clinical success was assessed via practical exams administered during the 3rd and 4th years of the program. Using Pearson Product Moment Correlations, the researchers found a significant, negative relationship between age and academic success ($r = -0.22, p < 0.05$). They also found a significant, negative relationship between age and clinical success ($r = -0.41, p < 0.001$). Using regression analysis, the authors found that age on admission was one of the significant predictors of academic success. Age accounted for 10.7% of the variance in academic success in the program. Likewise, age was also a predictor of clinical success which accounted for 16.4% of the variance in the clinical performance scores. Therefore, these researchers found that the older the student, the less successful the student tended to be in the academic and clinical aspects of the program.

In the United States, Dockter (2001) studied 107 physical therapy students admitted to the physical therapy program at the University of Mary in North Dakota between 1996 and 1999. The Pearson Product Moment Correlation coefficient between age on admission and physical therapy GPA was $-0.312 (p < .01)$, a significant and negative correlation. Results of a stepwise multiple regression analysis indicated that age

was one of two significant predictors of first-year physical therapy GPA. However, age alone explained 8.4% of the variance in first-year physical therapy GPA. A reasonable interpretation of these results is that younger students tended to perform better academically in the first year of the physical therapy program. Age was not a predictor of performance on the National Physical Therapy Licensing Examination.

In their study of 122 physical therapy students, Thieman and associates (2003) examined the relationship between age and final physical therapy GPA using Pearson's Correlation coefficient. As with the other studies, these authors did not indicate whether the variables in question were normally distributed. A normal distribution of the data is a necessary condition for Pearson Product Moment Correlation coefficients (Hatcher and Stepanski 1994). Once again, the correlation was significant and negative ($r = -0.328$; $p < .01$), indicating that the younger students performed better academically in the program. Age was one of three variables comprising the best regression model predicting final physical therapy GPA. Age alone in the model accounted for 7.5% of the variance in physical therapy GPA. Clinical performance was another outcome variable assessed by these investigators. Clinical performance was assessed via scores obtained on the Clinical Performance Instrument (American Physical Therapy Association 1997) for each of four clinical experiences. In addition, an average clinical performance score based on all four clinical experiences was calculated. Age was significantly correlated only with scores from the second clinical experience ($r = -0.313$, $p < .05$). Younger students had better scores on the second clinical experience than the older students. Otherwise, age was not related to clinical performance in this study. Age also was not related to nor was it predictive of performance on the National Physical Therapy Licensure Examination.

Based on these studies, the predictive ability of age on academic success in physical therapy education is equivocal. Some researchers suggest age is predictive of academic performance; some suggest it is not. If age is indeed a significant factor, the evidence indicates that younger students have more success in the curriculum than older students do.

Predictive Ability of Race

Moore and associates (2003) surveyed 74 physical therapy students who had completed one year of a physical therapy curriculum at one of nine accredited educational programs. Forty-four students were White while the other 30 students belonged to one of the minority races. Students were asked for their thoughts about finishing the program and the factors that may enhance or inhibit their completion of the degree. Though the authors only presented descriptive statistics, they found that slightly more minority students (67%) had considered leaving the academic program than White students (59%) had. Forty-three percent of the minority students considered leaving for personal reasons while only twenty-three percent of the White students expressed the same sentiment. For example, one minority female indicated that she considered dropping out “because of stress, demands, and because I couldn’t balance things at times” (p. 63). Overall, minority students stated that finances, the physical therapy profession, and self-confidence posed big challenges to their completing the program more than White students did. One should note, however, that despite these different perceptions by students of different races, none of the students surveyed had actually dropped out or failed out of the physical therapy program in which they were enrolled.

In regards to whether race actually relates to or predicts an outcome in a physical therapy program, two separate studies have examined such a relationship (Day 1986; El Ansari 2003). El Ansari (2003) examined 300 physiotherapy students enrolled in a university in Oxford, England. He did not find a difference in grades in the professional program between White and minority students. However, the number of participants was very low for the minority group in his study. Only seven of the 300 students (2.4%) belonged to the minority group.

On the contrary, Day (1986) found that race was a predictor of physical therapy GPA. She studied 522 post-baccalaureate students who had been admitted to one of four master's degree physical therapy educational programs. Fifty-two of the 522 (10%) participants belonged to a minority race. Day found via multiple regression analysis that cumulative professional GPA was predicted by three independent variables, one of which was race. White students performed better academically than minority students did. Differences in academic preparation between minority and White students may be a factor that explains differences between racial groups in performance in physical therapy school.

The effect of racial bias may be another reason why race was a predictor of a good outcome in the educational program, even though the racial make-up of the faculty members in these programs was not given. In fact, one study indicates that physical therapy clinicians may exhibit racial bias when listening to a patient report given by physical therapy students of different races (Haskins, Rose-St. Prix et al. 1997). These investigators found that clinicians gave higher ratings on the clarity of the presentation and the overall rating of the presentation to White, Hispanic, and Asian students than they

did a Black student. Furthermore, the White and Asian student received higher scores on communication than the Black student did. The White student received a higher rating on the organization of the information than the Black student did. The differences in scoring between the students existed despite the fact that the students were reciting the exact same patient information to the clinicians. One factor confounding the results of this study was that the Black student spoke English with a distinct Haitian accent. Part of the Black student's lower scores may be attributable to the clinicians' difficulty in understanding clearly what the Black student was saying.

Predictive Ability of Gender

The results of studies that have examined the influence of student gender on success in physical therapy education are inconclusive (Day 1986; Young 1990; Rikard-Bell, Marshall et al. 1991; Payton 1997; Stith, Butterfield et al. 1998; El Ansari 2003). Day (1986) identified predictors of final GPA in four physical therapy educational programs. In only one of those programs did she find that student gender was a predictor of final GPA in the professional program. Gender was a significant predictor in that program along with GRE-Analytical score, preadmission overall GPA, year of admission, and age. Unfortunately, Day did not identify which gender, male or female, was the positive predictor of GPA in that particular program.

Rikard-Bell and associates (1991) examined the academic performance of physical therapy students at the University of Sydney in Australia. Using t-test analyses and ANOVAs, they did not find any significant difference in the performance of male and female students through the three and one-half year program. Moreover, they did not see a difference in academic performance between the sexes when the participants were

separated into two age groups. Males performed just as well as females whether they were younger, college-age students or older, more mature students. Further analyses did reveal, however, that females performed better than males in the final year of the curriculum, when students were taking more clinically-based courses and fewer foundational science courses like anatomy and physiology.

In his meta-analysis of articles published between 1983 and 1994, Payton (1997) identified factors that predict academic success in physical therapy educational programs in the United States. He found from his review that gender was not a predictor of academic performance.

El Ansari (2003) studied 234 women and 65 men who had enrolled in a physical therapy program at a university in the United Kingdom. He found a significant difference between men and women in mean grades across nine modules in the curriculum. The mean grade for the men was 53.5 ± 11.1 while the mean grade for the women was 57.5 ± 8.7 , a difference which was significant at $p = 0.004$. Thus, “across the nine physiotherapy modules, women performed significantly better than men” (p. 175). The results of surveys administered to the students indicated that female students were more satisfied with the educational program than men were. In a separate study conducted in the United States (Stith, Butterfield et al. 1998), women reported higher levels of satisfaction with physical therapy clinical education experiences than men did. Thus, there may be a relationship between the lower grades obtained by men in the study by El Ansari (2003) and their lower levels of satisfaction with the educational program. Lower levels of satisfaction may lead to lower grades among the men. Of course, the corollary may also

be applicable to this sample; lower grades may lead to lower levels of satisfaction among the men.

With the exception of one study which found that females performed better than male students (El Ansari, 2003), other studies conducted in the field of physical therapy education have not found a difference between males and females in regards to academic performance.

Combination of Dependent and Independent Variables

In physical therapy education, only two studies have examined attrition, the dependent variable used in this study (Haskins and Rose-St. Prix 1994; Gabard, Porzio et al. 1997). Neither of them examined any of the independent variables utilized in the current study.

Only in medical education have studies been conducted examining the relationship between any of the independent variables utilized in this study and attrition. The results of the relationship between undergraduate GPA and attrition in medical school are inconclusive. The results of one study indicate that there is a lower risk of failure or academic difficulty for students with higher undergraduate grade point averages (Caraiga-Lo, Enarson et al. 1997). However, other researchers (Herman and Veloski 1981) reported that undergraduate science GPA did not influence the incidence of attrition in a medical school.

In a 10-year retrospective survey that examined the influence of age on attrition in medical education, some investigators (Simpson and Budd 1996) found that the “mature” students left the program at a lower rate than would be expected by chance (chi square = 6.35, $p < .05$).

Summary

The attrition rate in physical therapy education is lower than it is for other graduate programs in general and for medical education and nursing education in particular. Undergraduate GPA has consistently shown to be a predictor of various measures of academic success in physical therapy education.

The influence of GRE scores in physical therapy education has not been studied extensively. From the results of a couple of studies, it seems that GRE score may be a weak predictor of success in physical therapy education.

The predictive ability of undergraduate institution quality on success in physical therapy education has not been studied. However, undergraduate quality has shown to be a predictor of some types of success in medical education and even somewhat in nursing education.

The accumulated evidence is not conclusive as to whether age is a predictor of success in physical therapy education. If it is, the evidence indicates that older physical therapy students may be less likely to be successful.

Similarly, the accumulated evidence of whether race is a predictor of success in physical therapy education is inconclusive. In those studies that have found a significant difference, students of a minority race in the United States had less success than White students in physical therapy education. If such a disparity in educational outcomes actually exists, the causes are only speculative at this time and they are probably multifaceted.

Likewise, some investigators have identified better academic performance in physical therapy education among females while other investigators have not found a

significant difference between the genders in educational outcomes. Once again, the causes of such disparities, if they actually exist, are not currently known.

The independent variables discussed in this chapter, characterized as ‘Attributes’ in Tinto’s model of doctoral persistence (1993), are only known to faculty members prior to making decisions regarding the admissibility of applicants to a graduate program in physical therapy. Other aspects of Tinto’s model such as Institutional Experience and Integration would not be known to faculty members until after the students had already matriculated in the program. Because predictors of a successful outcome in graduate education are only pertinent to members of an admissions committee if they are known prior to admission, the factors known as ‘Attributes’ in Tinto’s model are the only factors that can be considered in the admissions decision-making process. Therefore, Attributes are the only predictor variables considered in this study.

Chapter III

Method

Design of the Study

Using a correlational design with secondary data, this study consisted of a longitudinal, structured review of academic records of students who enrolled in a graduate physical therapy program at Elon University. This review of academic records was chosen because information necessary for addressing the research questions was contained therein. Use of academic records provides for prompt access to the data, faster data analysis, and controlled costs (Creswell 2003). Records for all participants in this study were maintained in the Elon University Department of Physical Therapy Education and in the university's Registrar's Office. This study was approved by the Institutional Review Boards at Elon University and North Carolina State University under expedited reviews.

The remainder of this chapter will describe the participants in this study and explain the instrumentation used to collect and store the data, including how the individual variables were measured. Lastly, statistical analyses used to address the aforementioned research questions will be described.

Participants

The population for this study consisted of all students who had enrolled in the graduate program in physical therapy at Elon University in Elon, North Carolina at any point in time. Participants for this study included the subset of students in this particular program who matriculated between 1998 and 2002. Students who enrolled in subsequent

years were not included in this study since they had not had sufficient time to complete the program when this study was conducted.

Elon University is a private, coeducational institution of higher learning located in the town of Elon, NC in the Piedmont region of the state. Currently, the total student body size is approximately 4500 students. While the institution began as Elon College in 1889, the Department of Physical Therapy Education was not instituted until 1997. Physical therapy is one of three graduate programs in the university. The class size in the physical therapy program has been between 24 and 52 students per year. The charter class matriculated in January of 1998. For the participants in this study, the program, including the clinical practica, lasted 2½ years. Thus, the charter class graduated in May of 2000. The participants received a Master of Physical Therapy degree at graduation and were qualified to take the national licensure exam.

All students enrolled between 1998 and 2002 were included in this study to obtain the most complete picture of attrition and allow for meaningful statistics. All students enrolled during this time period needed to be included as participants since appropriate regression analysis requires at least 15-30 participants for each independent variable in the regression equation (Hatcher and Stepanski 1994). With nine independent variables, the total cohort of students enrolled in the program during this time period (n = 198) met the requirements for regression analysis.

Instrumentation

The admission and academic records of the participants were reviewed. Data for all variables were recorded from the original documentation (e.g. transcripts for undergraduate GPA). Thus knowledge of the participants' performance on the

independent variables did not influence the investigator's documentation of the outcome variable, as was the case in a previous study (Algozzine and Ysseldyke 1980). These investigators found that teachers' and psychologists' ratings of children's potential performance in reading and mathematics were influenced by selected information in referral statements read prior to the testing of the children. The value for the outcome variable in the current study, attrition, is an objective factor that does not require the judgment of the investigator. Attrition was gleaned directly from the academic record without prejudice.

The variables discussed below and summarized in the following Table 2 can be categorized as: success in physical therapy education, cognitive predictors, collegiate predictors, a control variable, and demographic predictors.

Success in physical therapy education.

Success in physical therapy education, defined as completing the 2 ½ year physical therapy curriculum at Elon University with the participant's entering class, was the outcome variable in this study. In this study, the causes of a student's inability to complete the program in a timely manner were characterized using the categories established by Gabard (1997). The personal causes for being unsuccessful in completing the program were: death of the student, death of a family member, family obligations, financial hardship, pregnancy, serious illness, and student quit-career change. The academic causes for being unsuccessful in completing the program were: failure to meet academic standards, student quit-academic difficulty, student expelled, and/or student given a part-time program.

Table 2

Description of Variables Utilized in This Study

Variable Name	Type of Variable	How Measured (Range)
Success in physical therapy education	Nominal	Attrition – inability to complete program in timely manner
Cognitive Predictor #1	Continuous	Math GRE (200-800)
Cognitive Predictor #2	Continuous	Verbal GRE (200-800)
Cognitive Predictor #3	Continuous	Undergraduate cumulative GPA (4.0 scale)
Collegiate Predictor #1	Ordinal	Average SAT of undergraduate institution's freshman class; characterized using Astin scale (1-7)
Collegiate Predictor #2	Continuous	Princeton Review's Academic Rating of Undergraduate Institution (0-100)
Control Variable	Continuous	Prerequisites taken at alma mater (0-12)
Demographic Predictor #1	Continuous	Age
Demographic Predictor #2	Nominal	Race
Demographic Predictor #3	Nominal	Gender

Cognitive predictors.

The first cognitive predictor used in this study was the student's best score on the Math section of the GRE. The lowest possible score on this exam was 200; the highest possible score was 800. Many students took this exam more than once. The highest score

obtained by the student, regardless of the attempt on which it was obtained, was recorded directly from the GRE report sent to Elon by the Educational Testing Service, the organization that administers the GRE.

The second cognitive predictor used in this study was the student's best score on the Verbal section of the GRE. The lowest possible score on this exam was 200; the highest possible score was 800. Again, many students took this exam more than once. As with the Math GRE, the highest score obtained by the student, regardless of the attempt on which it was obtained, was recorded directly from the GRE report.

The reliability of the GRE has been examined by various investigators (Kingston and Turner 1984; Bennett, Rock et al. 1987; Wilson 1988). Generally, they have found the reliability of the Math and Verbal sections of the GRE to be good. Specifically, Kingston and Turner (1984) studied 3475 examinees who chose to take the GRE more than once. Correlation coefficients for the relationships between the first and second attempts, using KR-20, were 0.93 for the Verbal section and 0.91 for the Math section for those who retook the GRE within two months of the first attempt. The correlation coefficients decreased slightly as the time between test intervals increased. For example, the correlation coefficients were 0.89 for the Verbal section and 0.86 for the Math section for those who retook the GRE four months after the first attempt. Kingston and Turner concluded that scores in the Verbal section were more stable than scores in the Math section. Despite the lower reliability coefficients as the time between attempts increased, both sections of the GRE still exhibit strong test-retest reliability (Hatcher and Stepanski 1994) up to four months between administrations of the test.

Bennett and associates (1987) used a split-half reliability coefficient to examine the reliability of GRE scores for over 440,000 nondisabled examinees. Split-half reliability coefficients were calculated from the variance of the difference scores from the two separately timed portions for each section. Split-half reliability coefficients for the Verbal and Math sections were 0.89 and 0.90 respectively. Once again, both sections of the GRE exhibited positive and strong relationships (Hatcher and Stepanski 1994).

Similarly, Wilson (1988) found good reliability for the GRE Math and Verbal sections. In his sample of 15, 298 people who took the GRE twice, the test-retest coefficients were 0.86 for each section, irrespective of the time interval between tests. The internal consistency reliabilities were 0.92 for the Verbal section and 0.91 for the Math section. These various investigators found that both the Math and Verbal sections of the GRE exhibit good reliability.

In a study conducted by Rock and associates (Rock, Werts et al. 1982), these researchers found that the GRE has construct validity and does not exhibit psychometric bias between population subgroups (White males, White females, Black males, and Black females). Despite the scrutiny of the reliability and validity of the GRE, the literature supports the GRE as a reliable and stable variable.

The third cognitive predictor used in this study was the student's cumulative undergraduate GPA. Generally, low grades were not calculated in the GPA as long as the same course was repeated at the institution and resulted in a higher grade. The scale went from a low of 0.0 to a high of 4.0. The cumulative GPA was determined by the student's undergraduate institution and was obtained from the student's official transcript. Transfer

credits from other undergraduate institutions were not considered part of the GPA unless the institution attributed grade points specifically for those transfer credits.

Collegiate predictors.

Two measures of undergraduate institution quality were utilized in this study. First, based on the literature, the average SAT scores for the entering students at the participant's undergraduate institution were recorded. Combined Math and Verbal SAT scores were obtained from work conducted by The Princeton Review (2003). Average SAT scores were then converted to the ordinal Astin scale (1971) utilized by previous researchers in medical school settings (Evans 1975; Clapp 1976; Sarnacki 1982; Strayhorn and Frierson 1989; Hall 1992; Mitchell, Haynes et al. 1994; Cunnington and Norman 1997; Reede 1999). Conversions of average SAT scores to Astin cell scores are presented again in Table 3.

Table 3

Conversions of Mean SAT Scores and ACT Scores to Astin Cell Scores

Mean SAT (Verbal & Math)	Astin Level
≥ 1236	7
1154-1235	6
1075-1153	5
998-1074	4
926-997	3
855-925	2
≤ 854	1

The second measure of undergraduate institution quality in this study was the Academic Rating score developed by The Princeton Review (Franek, Meltzer et al. 2003). The Academic Rating was developed in part from information obtained from 100,000 on-campus and on-line student interviews conducted annually. College and university administrators also were given the opportunity to provide feedback on the survey results. Ratings were based on information about how hard the students worked, how much the students felt they received from their efforts, and the helpfulness and abilities of their professors. Admissions selectivity also was a factor used in determining the Academic Rating. The range of possible scores was from 1 to 99. Duke University and Yale University were among the schools with Academic Ratings of 99.

To date, there are no published studies that have addressed the reliability or validity of The Princeton Review's Academic Rating. Since such a score is available for use by the public, it should have its validity established. One way of establishing concurrent validity is to compare the Academic Rating to a "gold standard" of undergraduate institution quality. In this study, The Princeton Review's Academic Rating was compared to the commonly accepted average SAT score of entering students as a standard of institutional quality.

Control variable.

Given that the quality of a participant's alma mater may not be as influential a predictor if the participant took many courses at some other institution, a control variable was established. There were 12 prerequisite undergraduate courses students had to take prior to admission into the physical therapy program. Eight of the courses were science courses: two general biology courses, two general chemistry courses, two general physics

courses, human anatomy, and human physiology. Students also had to have an English composition course, a statistics course, and two psychology courses. Some participants in the study, especially the older students, may not have taken all or even many of these prerequisite courses at their alma mater. Some participants may have begun their college careers at a community college and then transferred many credits to the 4-year institution from which they eventually graduated.

To control for the fact that many prerequisite courses may not have been taken at the institution from which the student graduated, a control variable was entered into the analyses. The number of prerequisite courses taken at the participant's alma mater was recorded from transcripts sent in with the admissions packet.

Demographic predictors.

Age was included as an independent variable to address the differences in age among participants in the data set. The quality of the older participant's undergraduate institution may not be as strong a predictor of attrition as the traditional student in his or her 20's, given the potential effects of intervening life experiences. Therefore, age, defined as the participant's age in years at matriculation into the graduate program in physical therapy, was entered as an independent variable in the data set.

Another demographic predictor utilized in this study was the student's race. Each student was placed in one of the following five racial categories: White, Black, Hispanic, Asian, and American Indian. Racial identity was determined from the student's self-selected response on his or her application to the program.

The third demographic predictor utilized in this study was gender. Gender was determined from the student's self-selected response on his or her application to the

program. Males were coded with a score of “0” while females were denoted by a score of “1.”

Data Analysis

The data analysis was conducted using The SAS System 8e for Windows (2001). A participant with missing data was excluded from any analyses that involved the variable with the missing data. The driving research questions are reiterated below, along with an indication of the statistical procedures that were used to address the questions.

1. What percentage of matriculating students are successful in completing the physical therapy program at Elon University with the class in which they entered? Percentages of those who did and did not successfully complete the program in a timely manner were calculated.
2. In addition to academic reasons, what are the other reasons why students do not successfully complete a physical therapy program with the class in which they entered? Causes of attrition were placed in one of the categories given by Gabard and associates (1997).
3. Is the Princeton Review’s Academic Rating a valid indicator of collegiate quality? To test for the concurrent validity of The Princeton Review’s Academic Rating, a Pearson Product Moment Correlation coefficient was used to examine the strength of the relationship between an institution’s Academic Rating and the average SAT score of the institution’s entering students. Pearson’s correlation was appropriate given that both The Princeton Review’s Academic Rating and the college’s average SAT score are continuous variables. The statistical level of significance chosen for this question was $p \leq 0.05$.

4. What is the predictive ability of cognitive, collegiate, and demographic variables on success, as defined by attrition (i.e. graduating with the class in which the student entered), in physical therapy education? Logistic regression was used with attrition entered as the dependent variable and Math GRE, Verbal GRE, undergraduate GPA, undergraduate institution average SAT score, Princeton Review Academic Rating, age, race, and gender entered as independent variables. The number of prerequisites taken at the student's alma mater also was entered into the regression equation as a covariate. Logistic regression was appropriate given that the dependent variable was nominal; participants either graduated with their class or they did not. Logistic regression also was appropriate given that the independent variables were mostly continuous except for the ordinal Astin cell scores of institutional average SAT and race and gender which were categorical. Once again, the statistical level of significance chosen for this research question was $p \leq 0.05$.

Chapter IV

Results

In order to provide a meaningful background for the research results in this study, the demographic characteristics of the participants in this study will be presented first, followed by descriptive statistics for the other independent variables. Descriptive statistics for the dependent variable, attrition, will be provided in the results of Question One. The remainder of this section will provide results of the remaining research questions Two through Four.

Participants

There were a total of 198 participants in this study. All participants in this study had obtained a bachelor's degree from an accredited four-year institution of higher learning in the United States. Students came to Elon's physical therapy program with undergraduate degrees from universities in states in all regions of the United States, including Maine, California, Washington, New York, and Florida. As expected, most of the participants came from North Carolina (n = 76; 38.4% of the sample), Virginia (n = 26; 13.1%), and South Carolina (n = 12; 6.1%). Thus, over half of the participants attended college in the mid-Atlantic states of Virginia, North Carolina, and South Carolina. The most commonly represented universities were the University of North Carolina at Chapel Hill (n = 18) and Elon University (n = 14).

The participants were varied demographically. The youngest participant upon matriculation into the physical therapy program was 21 years of age, while the oldest participant was 42. The average age of the participants \pm the standard deviation (s.d.) was

24.91 ± 3.97 years. The median age was 23. Thus, the distribution of age was skewed toward the higher ages. Most of the participants were in their early 20's, within a year or two of graduating from college. One hundred seventy-nine (90.4%) of the participants were White, while the remaining participants (n = 19) were members of a minority race. Of the participants of a minority race, nine characterized themselves as African-American or Black, four as Hispanic, five as Asian, and one as Native American. Seventy-five (37.9%) of the participants were male; 123 (62.1%) were female.

Descriptive Statistics of Other Independent Variables

The means, standard deviations, ranges, and number of missing values for the cognitive and collegiate predictors of success, as well as the control variable (i.e. number of prerequisites taken at the alma mater), are presented in Table 4.

The Math GRE scores were normally distributed. The average Math GRE score for the participants was 568.83 ± 69.18. The lowest Math GRE score was 350 while the highest was 730. All values were within the expected range of Math GRE scores with a possible low of 200 and a possible high of 800. Only one participant had missing data for this variable, indicating that GRE scores were available for analysis for nearly all of the participants.

Like the Math GRE scores, the Verbal GRE scores were normally distributed. The average Verbal GRE score for the participants was 450.91 ± 68.27. The lowest Verbal GRE score was 270 while the highest was 680. All values were within the expected range of GRE scores for this section. Only one participant had missing data for this variable. On average, raw Math GRE scores were over 110 points higher than raw Verbal GRE scores for these participants.

Table 4

Descriptive Statistics for Cognitive and Collegiate Independent Variables

	Mean (s.d.)	Range	Number of Missing Values
Math GRE	568.83 (69.18)	350-730	1
Verbal GRE	450.91 (68.27)	270-680	1
Undergraduate GPA	3.21 (0.33)	2.40-3.98	1
Average SAT of Undergraduate Institution's Freshman Class	1122.74 (112.81)	790-1450	2
Astin Scale of SAT scores	5.03 (1.39)	1-7	2
Princeton Review's Academic Rating	78.46 (7.50)	64-99	42
Prerequisites taken at alma mater	8.42 (3.55)	0-12	2

s.d. – standard deviation

The mean undergraduate cumulative GPA was 3.21 ± 0.33 . The lowest GPA was 2.40 while the highest GPA was 3.98. Only one student had a missing value. The student with a missing value for undergraduate GPA transferred to Elon from another physical therapy program and already had a Master's degree and a PhD in a related field. His GPA from his graduate work was scrutinized by the Admissions Committee in lieu of an inspection of his undergraduate GPA. An inspection of the stem-and-leaf plot presented in Figure 3 indicates that the values for undergraduate GPA were normally distributed.

1997; Dorans 1999). The conversions of ACT scores to SAT scores are presented in Table 5. Data in this table were based on 103,525 test takers who took both the SAT and the ACT between October 1994 and December 1996.

Table 5

Conversions of ACT to SAT Scores for Institutions Reporting only ACT Scores of Entering Students.

ACT Composite Score	SAT Score (Verbal & Math)
36	1600
35	1580
34	1520
33	1470
32	1420
31	1380
30	1340
29	1300
28	1260
27	1220
26	1180
25	1140
24	1110
23	1070

ACT Composite Score	SAT Score (Verbal & Math)
22	1030
21	990
20	950
19	910
18	870
17	830
16	780
15	740
14	680
13	620
12	560
11	500

Average SAT scores for the participants were converted to Astin Cell Scores. In essence, continuous data were converted into ordinal data. The mean Astin score was 5.03 ± 1.39 . The range of Astin Cell scores in this data set was 1 to 7. A score of 1 signified a college or university with an average SAT score of ≤ 854 for its entering students. An Astin score of 7 signified a college or university with an average SAT score of ≥ 1236 for its entering students. Thus the range of Astin scores in the data set was representative of the range of scores for the entire scale. The distribution, however, was skewed toward the smaller values. Thirty-nine participants graduated from colleges with an Astin score of 7 while only three participants graduated from colleges with an Astin score of one. Furthermore, 30 participants graduated from colleges with an Astin score of six, while only four graduated from colleges with an Astin score of two. Thus the Astin Scale exhibited a ceiling effect with this data set. Given the ceiling effect of the Astin Scale and the ordinal nature of the scale, average SAT scores were included in further analyses in lieu of Astin Scale scores which were deleted.

The average Princeton Review Academic Rating for the undergraduate colleges and universities attended by the participants was 78.46 ± 7.50 . For the undergraduate institutions listed in this data set, West Virginia University had the lowest Academic Rating (64) while Duke University had the highest (99). On examination of a stem-and-leaf plot of this variable, as seen in Figure 4, the distribution appeared to be normal except for a somewhat bimodal distribution. The mode for the variable was 77. The tendency toward a bimodal distribution was related to the large number of participants who graduated from the University of North Carolina at Chapel Hill ($n = 18$). UNC –

Thus the quality of the undergraduate experience was not confined to the college or university from which many of these participants graduated. The mean number of prerequisites taken at the alma mater was 8.42 ± 3.55 . This indicates that on average, the participants took over 3 of their 12 prerequisite courses at a community college or at another four-year institution. The range of values encompassed the entire range of possibilities. Some students took no prerequisite courses at their alma mater, while others took all 12 at their alma mater.

The mode for the number of prerequisite courses taken at the alma mater was ten. From inspection of the distribution, one can see that the large majority of participants took most if not all of their prerequisites at their alma maters. Fifty-four participants (27.6% of the total) took all 12 prerequisite courses at their alma mater while 47 participants (24.0%) took all prerequisite courses at the alma mater except for just one or two courses. On the other end of the distribution, only three participants did not take any of their prerequisite courses at their alma mater. Thus the distribution for this variable was skewed toward the lower values. There were only two missing values for this variable.

Question 1

What percentage of matriculating students are successful in completing the physical therapy program at Elon University with the class in which they entered?

Of the 198 participants in this study, 20 of those who matriculated in the physical therapy program at Elon University either dropped out, failed out, or had their graduation delayed for an academic or personal reason. Thus, 10.1% of the participants were placed in the “Attrition” group while the rest were assigned to the “Retention” group.

Question 2

Other than academic reasons, what are the other reasons why students do not successfully complete a physical therapy program with the class in which they entered?

The reason for a participant's leaving the program was determined from documentation in the individual's student file. One reason for leaving was chosen for each participant in the Attrition group from the list of possibilities (Table 6) developed by Gabard and associates (1997).

Students who failed to perform up to departmental expectations on clinical practica were placed in the category of "Failure to Meet Academic Standards" since Gabard and associates (1997) did not develop a separate category for performance in the clinical setting.

From the table, one sees that half of those who failed to graduate with their class did so because of an inability to meet departmental academic standards. However, academic and clinical performance actually account for a larger percentage when part-time programs are taken into account. The two students who were given a part-time program were placed in a part-time program because of academic difficulties encountered in the full-time program. One student quit the program before she was expelled from the program for reasons of academic and clinical performance. Thus 13 of the 20 participants who failed to graduate with their incoming class did so because of unacceptable academic and/or clinical performance. The other seven participants had their graduation denied or delayed for personal reasons (e.g. family obligations, financial hardship, pregnancy, serious illness, or student quit because of a change in career aspirations).

Table 6.

Reasons Why Participants Failed to Complete Program in Timely Manner

Reason for Attrition	Number of Participants in Group
Death of Student	0
Death of Family Member	0
Failure to Meet Academic Standards	10
Family Obligations	1
Financial Hardship	2
Pregnancy	1
Serious Illness	2
Student Quit – Academic Difficulty	1
Student Quit – Career Change	1
Student Expelled	0
Student Given Part-time Program	2
Total	20

Question 3

Is the Princeton Review’s Academic Rating a valid indicator of collegiate quality?

Given that both Academic Rating and an institution’s average SAT score of entering students were to be included in the regression equation in Question 4, the relationship between these two variables needed to be examined beforehand to look for the presence of multicollinearity. The Pearson Product Moment Correlation between an institution’s average SAT score of entering students and that institution’s Princeton

Review Academic Rating is 0.862. This indicates a strong, positive, and significant ($p < 0.0001$) correlation between an institution's average SAT score for its entering students and its Academic Rating. Thus, the Princeton Review's Academic Rating does exhibit concurrent validity of undergraduate institution quality.

However, given that Academic Ratings were not available for the institutions of 42 participants and given the strong relationship between Academic Rating and average SAT score, Academic Rating was deleted from further analyses. The deletion of Academic Rating as a variable acted to minimize the possibility of having multicollinearity between two independent variables with strong linear dependencies. Removing Academic Rating also preserved most of the participants' data for inclusion for the subsequent regression analyses. Keeping Academic Rating in the regression analyses would have meant prohibiting data from 42 participants from contributing to the development of the regression model. Even though Academic Rating may be a valid indicator of undergraduate institution quality, it currently fails to provide scores for the broad spectrum of colleges and universities in the United States.

Question 4

What is the predictive ability of cognitive, collegiate, and demographic variables on success, as defined by attrition (i.e. graduating with the class in which the student entered), in physical therapy education?

Other possibilities of multicollinearity were examined by assessing the Pearson Product Moment Correlations between the continuous independent variables. The independent variables included in the correlations were the continuous cognitive (Math GRE, Verbal GRE, undergraduate GPA), collegiate (average SAT of a college's entering

class), demographic (age, race, gender), and control (number of prerequisites taken at alma mater) variables. Results of the correlations are presented in Table 7.

According to one guide for interpreting the strength of the relationships between two variables (Hatcher and Stepanski 1994), there are no strong correlations noted. This indicates there is no multicollinearity between two or more independent variables. Several statistically significant correlations are noted in Table 7, even though none of the correlations is strong (Hatcher and Stepanksi, 1994). Age was negatively and moderately correlated with Prerequisites ($r = -0.580$; $p < 0.001$). That is, the older students were more likely to take fewer of their prerequisite courses at their alma maters. Also, age was negatively and weakly correlated with undergraduate GPA ($r = -0.265$; $p < 0.001$). There was a slight tendency for older students to have a lower undergraduate GPA than the younger students. Age also was positively and weakly correlated with Verbal GRE score ($r = 0.224$; $p < 0.01$). There was a slight tendency for the older students to have higher scores on the Verbal section of the GRE than the younger students.

The collegiate quality predictor, SAT scores for entering students at a college or university, also correlated with other independent variables. The correlation coefficients, however, were all weak. There was a negative correlation between average SAT scores and undergraduate GPA ($r = -0.267$; $p < 0.001$). Students who attended colleges with high average SAT scores from the student body tended to have lower GPAs. There was a positive correlation between SAT scores and both sections of the GRE, Math ($r = 0.345$; $p < 0.001$) and Verbal ($r = 0.283$; $p < 0.001$). That is, participants who went to more competitive undergraduate institutions tended to have higher GRE scores. Scores on the

two sections of the GRE also were related. Math GRE and Verbal GRE scores were positively yet weakly correlated with each other ($r = 0.407$; $p < 0.001$).

Table 7

Pearson Product Moment Correlation Coefficients between Continuous Variables

	Attrition	Age	SAT	Prereq.	Under. GPA	Math GRE	Verbal GRE
Attrition	1.000						
Age	0.092	1.000					
SAT	-0.122	-0.042	1.000				
Prereq.	-0.044	-0.580***	-0.046	1.000			
Under GPA	-0.057	-0.265***	-0.267***	0.200**	1.000		
Math GRE	-0.022	-0.052	0.345***	-0.040	-0.065	1.000	
Verbal GRE	-0.040	0.224**	0.283***	-0.083	-0.067	0.407***	1.000

Prereq. – Number of prerequisites taken at alma mater

Under. GPA – cumulative undergraduate GPA

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

The number of prerequisites taken at the alma mater was also positively yet weakly correlated with undergraduate GPA ($r = 0.200$; $p < 0.01$). In other words, there was a slight tendency for participants who took most of their prerequisite courses at their alma mater to have higher undergraduate GPAs.

There were no variables that were significantly correlated with the outcome variable, Attrition. The only independent variable that came close to correlating with Attrition was SAT score at the undergraduate institution. The relationship between

Attrition and SAT score was weak, negative ($r = -0.122$) and not significant ($p = 0.090$) given the level of significance chosen for this study. The trend indicates that physical therapy students who graduated from colleges with higher SAT scores were less likely to experience attrition.

Given the lack of significant correlations between the independent variables and the dependent variable, the results of the logistic regression for the prediction of attrition were not surprising. In addition to the continuous independent variables shown in the correlation matrix in Table 7, the two categorical independent variables (Race and Gender) were inserted into the regression analysis. Both of these categorical independent variables were coded as dummy variables. For Race, participants were coded as either a “Zero” (White) or a “One” (Minority). For Gender, participants were coded as either a “Zero” (Male) or a “One” (Female).

The logistic regression model developed for the prediction of attrition did not exhibit problems with separation or multicollinearity. Separation indicates that there is some linear combination of the independent variables that perfectly predicts the dependent variable. Multicollinearity would be demonstrated if the model were significant while none of the individual predictor variables were significant (Allison 1999). The model itself turned out not to be significant, thus eliminating the possibility of multicollinearity. The Chi-Square value for the likelihood ratio of the logistic regression equation was 9.32 ($df = 8$; $p = 0.316$). Thus we failed to reject the null hypothesis that all of the predictor variables had coefficients of zero. The estimates of the individual predictor variables are presented below in Table 8, along with the standard errors and significance levels.

Given the problems with interpreting the coefficient estimates in logistic regression, odds ratios for the estimates of the individual predictor variables are presented in Table 9. The 95% Wald Confidence Intervals are also given for the odds ratio estimates.

Table 8

Estimates, Standard Errors, and Significance Levels of All Predictor Variables in the Logistic Regression Model

Parameter	DF	Estimate	Standard Error	p =
Intercept	1	1.1837	5.9853	0.843
Age	1	0.1223	0.0830	0.141
Race	1	0.3153	0.8854	0.722
Gender	1	0.9018	0.6037	0.135
SAT	1	-0.0052	0.0027	0.054
Prerequisites	1	0.0857	0.0962	0.373
Undergraduate GPA	1	-1.0830	0.9162	0.237
Math GRE	1	0.0031	0.0042	0.465
Verbal GRE	1	-0.0012	0.0042	0.784

DF = degrees of freedom

Table 9

Odds Ratios and Confidence Intervals for All Predictor Variables in the Logistic Regression Model

Effect	Odds Ratio	95% Confidence Intervals
Age	1.130	0.960 – 1.330
Race	1.371	0.242 – 7.772
Gender	2.464	0.755 – 8.045
SAT	0.995	0.990 – 1.000
Prerequisites	1.089	0.902 – 1.316
Undergraduate GPA	0.339	0.056 – 2.040
Math GRE	1.003	0.995 – 1.011
Verbal GRE	0.999	0.991 – 1.007

The confidence intervals include the value of 1.000 for all predictor variables. Thus the odds of experiencing attrition from the physical therapy program do not necessarily change with an increase in the values of the predictor variables. SAT score of the participant's alma mater did come very close to significance, however. The significance level of the prediction of SAT with all other variables held constant was $p = 0.054$. The odds ratio for SAT was 0.995. This odds ratio meant that every increase of one point in SAT score of entering students at a participant's undergraduate institution decreased the odds of being in the Attrition group by 0.5%. Therefore an increase in undergraduate institution SAT score of 10 points would decrease the odds of being placed in the Attrition group by 5%.

Students were placed in the Attrition group for various reasons, some of which were personal in nature and some of which were academic in nature. To examine more closely those participants placed in the Attrition group for academic reasons, participants

who were in the Attrition group for personal reasons were excluded from subsequent analyses. Participants who failed to graduate with the class in which they entered for the following personal reasons were deleted from subsequent analyses: Family obligations (n = 1), Financial hardship (n = 2), Pregnancy (n = 1), Serious illness (n = 2), and Student quit – career change (n = 1). This deletion left 13 participants in the Attrition group, all for academic reasons.

Next, correlation coefficients between independent and dependent variables were calculated, with those in the Attrition group for personal reasons excluded from the data set. These revised correlation coefficients are listed below in Table 10.

Many of the significant correlations noted in Table 7 with all participants included also were present in Table 10 with those who were in the Attrition group for personal reasons excluded from the analysis. Though many correlations were significant, most of the correlations were weak. Only the relationship between Age and Prerequisites was even moderately strong ($r = -0.582$). This relationship indicated that the older the participant, the more likely he or she was to take the prerequisite courses at an institution other than his or her alma mater. Based on the lack of strong associations between variables, the chances of experiencing multicollinearity in the regression equation were minimized.

The second logistic regression model developed for the prediction of attrition did not exhibit problems with separation or multicollinearity. The Chi-Square value for the likelihood ratio of the logistic regression equation was 15.876 (df = 8; $p = 0.044$). Thus we were able to reject the null hypothesis that all of the predictor variables had

coefficients of zero. The estimates of the individual predictor variables are presented below in Table 11, along with the standard errors and significance levels.

Table 10

Pearson Correlation Coefficients Between Variables with Attrition Group Members for Personal Reasons Excluded

	Attrition	Age	SAT	Prereq.	Under. GPA	Math GRE	Verbal GRE
Attrition	1.000						
Age	0.096	1.000					
SAT	-0.159*	-0.039	1.000				
Prereq.	-0.067	-0.582***	-0.037	1.000			
UnderGPA	-0.120	-0.265***	-0.277***	0.187**	1.000		
Math GRE	-0.006	-0.037	0.332***	-0.035	-0.072	1.000	
Verbal GRE	-0.035	0.232***	0.281***	-0.086	-0.080	0.404***	1.000

Prereq. – Number of prerequisites taken at alma mater

UnderGPA – cumulative undergraduate GPA

* p < 0.05

** p < 0.01

*** p < 0.001

Odds ratios for the estimates of the individual predictor variables are presented in Table 12. The 95% Wald Confidence Intervals are also given for the odds ratio estimates. The confidence intervals include the value of 1.000 for all predictor variables except undergraduate institution’s average SAT score and undergraduate GPA. Odds ratios for these two variables were significantly less than one. This indicates that the odds of experiencing attrition from the physical therapy program decreased with an increase in the values of the SAT variable and undergraduate GPA.

Table 11

Estimates, Standard Errors, and Significance Levels of Predictor Variables in the Logistic Regression Model with Attrition Group Members for Personal Reasons Deleted

Parameter	DF	Estimate	Standard Error	p =
Intercept	1	11.0425	7.694	0.151
Age	1	0.0982	0.0983	0.318
Race	1	0.6345	0.9990	0.525
Gender	1	0.6154	0.7171	0.391
SAT	1	-0.0097	0.0035	0.006
Prerequisites	1	0.1228	0.1242	0.323
Undergraduate GPA	1	-3.2212	1.3532	0.017
Math GRE	1	0.0042	0.0051	0.410
Verbal GRE	1	0.0011	0.0053	0.842

DF = degrees of freedom

Table 12

Odds Ratios and Confidence Intervals for Predictor Variables in the Logistic Regression Model with Attrition Group Members for Personal Reasons Deleted

Effect	Odds Ratio	95% Confidence Intervals
Age	1.103	0.910 – 1.338
Race	1.886	0.266 – 13.365
Gender	1.850	0.454 – 7.544
SAT	0.990	0.984 – 0.997
Prerequisites	1.131	0.886 – 1.442
Undergraduate GPA	0.040	0.003 – 0.566
Math GRE	1.004	0.994 – 1.014
Verbal GRE	1.001	0.991 – 1.011

The significance level of the predictive ability of SAT with all other variables held constant was $p = 0.006$. The odds ratio for SAT was 0.990. This odds ratio meant that every increase of one point in average SAT score of entering students at a participant's undergraduate institution decreased the odds of being in the Attrition group by 1.0%. Therefore an increase in undergraduate institution SAT score of 10 points would decrease the odds of being placed in the Attrition group by 10%. The significance level of the predictive ability of undergraduate GPA with all other variables held constant was $p = 0.017$. The odds ratio for undergraduate GPA was 0.040. Thus every increase of one point in undergraduate GPA decreased the odds of being placed in the Attrition group by 96%. Though the entire regression model was statistically significant, SAT and undergraduate GPA were the only two significant predictor variables when all other variables were held constant.

Another method of interpreting the coefficients obtained using logistic regression is to calculate the predicted probability of attrition when the value of one predictor variable changes while all other predictor variables are kept at a base value (Cheng and Long 2004). For example, the probability of experiencing attrition was determined when the mean institutional SAT score was compared to the institutional SAT score one standard deviation below the mean. Thus, when all other variables were kept at their mean value, the probability of experiencing attrition increased from 0.034 to 0.095 when the participant's alma mater's average SAT score for incoming students decreased from the mean value (1122.74) to the value one standard deviation below the mean (1009.93). In other words, the probability of experiencing attrition increased almost three-fold as the

participant's alma mater's average SAT score for entering students decreased from the mean value to one standard deviation below the mean.

Similarly, the probability of experiencing attrition was determined for the mean value and the value one standard deviation below the mean for the other independently significant variable, undergraduate GPA. When all other variables were kept at their mean value, the probability of experiencing attrition increased from 0.034 to 0.093 when the undergraduate GPA decreased from the mean value (3.20) to the value one standard deviation below the mean (2.87).

Summary of Results

The attrition rate, defined again as those who failed to graduate with the class in which they entered, in the physical therapy program at Elon University was 10.1%. Of those who failed to graduate with the class they entered the program with, 13 had academic reasons and 7 had personal reasons for attrition.

Comparisons of two measures of undergraduate institution quality indicated a strong relationship between average SAT of an undergraduate institution's entering class and the institution's Academic Rating from the Princeton Review ($r = 0.862$). Given the need to minimize multicollinearity with two interdependent variables and given that Academic Ratings were missing for 42 participants, the Academic Rating variable was deleted from the regression analyses.

The model with the eight predictor variables was not able to predict Attrition when all participants were included in the analysis. However, when participants who experienced attrition for personal reasons were excluded from the data set, the model was significant. Furthermore, the average SAT score at the alma mater and undergraduate GPA were

significant and independent predictors of Attrition when all other variables were controlled for. Those who experienced attrition for academic reasons and those who did not experience attrition could be predicted correctly by the model 81.0% of the time when all of the independent variables were included in the model.

Chapter V

Discussion

The purpose of this study was to identify cognitive, collegiate, and demographic predictors of success in physical therapy education for students at Elon University. Attrition in this study was defined as the percentage of participants whose graduation was either delayed or denied. The attrition rate in the graduate physical therapy program at Elon University was 10.1%. Most of those who experienced attrition did so for academic reasons. While the Princeton Review's Academic Rating score exhibits concurrent validity, its utility is limited by the fact that numerous colleges and universities in the United States do not receive Academic Rating scores. When participants who experienced attrition for personal reasons were excluded from the data set, the logistic regression model for the prediction of attrition was significant. Furthermore, the undergraduate institution's average SAT score and undergraduate GPA were significant and independent predictors of Attrition.

Attrition Rate

The attrition rate in this study, including participants whose graduation was delayed but occurred nonetheless, was 10.1%. Only two other studies in physical therapy education have been published reporting an attrition rate. Gabard and associates (1997) surveyed the directors of 43 graduate programs in physical therapy and found that approximately 5% of the physical therapy students who matriculated in one of these programs ended up either failing to graduate or failing to graduate on time.

Thieman and associates (2003) reported an attrition rate of less than one percent in the physical therapy program at the College of St. Catherine in Minnesota, though they did not clarify whether those whose graduation was delayed but not denied were included in their attrition rate. One may infer, however, that based on such a low percentage, the one percent attrition rate only referred to those who either dropped out or failed out of the program.

The attrition rate in the physical therapy program at Elon University appears to be higher than in other physical therapy programs. One reason for this discrepancy may be the fact that the physical therapy program at Elon University is fairly new. Established in 1997, the program was not even accredited by the Commission on Accreditation in Physical Therapy Education until the first class graduated in 2000. Some of these participants may not have been able to get accepted at the more established physical therapy programs. Elon may have “taken a chance” on these students who may not have been as academically prepared for success as students in the more established programs were. Likewise, these participants may have “taken a chance” on Elon by enrolling in an initially unaccredited program.

Even though the attrition rate is higher in the Elon University physical therapy program than it is in other physical therapy programs discussed in the literature, the attrition rate is still lower than it is in most nursing programs. Many nursing programs have an attrition rate greater than 20% (Mashaba and Mhlongo 1995; Dowell 1996; Bolan and Grainger 2003; Shelton 2003). Differences between physical therapy students and nursing students may explain in part the higher attrition rate among nursing students. Most nursing students are educated at the community college level (Briscoe and Anema

1999). Thus a student can become a nurse with as little as two years of post-secondary education. However, a physical therapy student must spend at least six years in post-secondary education, four years as an undergraduate student and two to three years in a graduate physical therapy program. This paradox that students in a longer program experience less attrition may be explained by different commitment levels of the two types of students. The greater length of time required to become a physical therapist may draw only those students to the program who are very committed to the profession. While Tinto's model is longitudinal in nature, the total length of time for degree completion is not a part of the model. The steps are taken to degree completion whether they take one year or ten years to complete. The lack of a time factor in Tinto's model appears appropriate given the differences in time commitments and attrition rates between physical therapy and nursing students. Apparently, the other factors in the model such as Educational and Occupational Commitment influence degree completion more than the total time required for degree completion does.

Similar to the differences in time commitment required for degree completion, the financial burden of attending physical therapy school is greater than the financial burden of attending nursing school. The greater cost in time and financial resources required for a physical therapy education as opposed to a nursing education may act to separate out those who are less committed to the field of physical therapy before they ever enroll.

Differences in academic preparation may play a role in the higher attrition rate among nursing students as compared to physical therapy students. Physical therapy students have college degrees. Many nursing students only have high school degrees.

Physical therapy students in general may be better prepared for success in a professional program than nursing students are.

Several researchers have identified attrition rates in medical school (Fitzpatrick and Wright 1995; Kassebaum and Szenas 1995; Simpson and Budd 1996; James and Chilvers 2001). Only Kassebaum and Szenas (1995), however, examined medical students in the United States and defined attrition similar to the definition of attrition used in this study. They found the percentage of medical students who failed to graduate within the normal allotted time, four years, was a low of 16.7% in 1984 and a high of 18.8% in 1988. Even the lowest percentage, 16.7%, was higher than the attrition rate in the physical therapy program at Elon University. This may be related to differences in educational philosophy. At Elon University, students are accepted into the program with the goal of graduating as many as possible without compromising departmental and professional standards. Currently, the department admits 40 students per year with the hope that at least 36 (90%) of them will persevere to graduate with their entering classmates. The physical therapy faculty at Elon, with assistance from tutors and counselors, strive to give students whatever resources they need in order to be successful in the program. Some medical schools, especially those that are more competitive and less nurturing, may actually admit students into their program with the idea that a certain percentage of students will need to either fail out, drop out, or go on a part-time program. Attrition of incoming students may be a goal for some medical schools while it is not preferred or desired in the physical therapy program at Elon University. Thus the Institutional Experience and Academic Integration in Tinto's model may differ between physical therapy education and medical education in ways that influence degree

completion. The lower attrition rate in physical therapy compared to medicine probably should not be attributed to better academic preparation of physical therapy students. Academic preparation between the two groups is not considered a likely possibility given that students in both programs have undergraduate degrees. In addition, the prerequisites for acceptance into medical school may be more rigorous than the prerequisites for physical therapy. For example, at both the University of North Carolina at Chapel Hill and Duke University medical schools, applicants are required to take and pass two courses in organic chemistry. Most physical therapy programs, including the one at Elon University, do not require any coursework in organic chemistry. In reference to Tinto's model, the Educational Experiences prior to admission differ between physical therapy and medical education.

The element of the length of the time commitment required in physical therapy, nursing, and medical education may not adversely affect attrition. A nursing degree generally requires the student to spend two to four years in post-secondary education. A physical therapy degree requires at least six to seven years in post-secondary education. A medical degree has the greatest time commitment; a medical student spends a minimum of eight years in post-secondary education not including internships, residencies, and fellowships. Despite the longer time commitments, medical and physical therapy education programs experience less student attrition than nursing programs do. Tinto's model of doctoral persistence, while chronological in nature, does not put limits on the total time to degree completion. Other Attributes in Tinto's model may influence degree completion more than the time requirements do. Nursing students, for example, may experience greater attrition because they have more concerns with Educational

Experiences or Student Background despite the fact that the length of their program is shorter than it is for medical and physical therapy students. Nursing students in general may have less academic preparation (Educational Experiences) and less encouragement and support from family members for degree completion (Student Background) than medical or physical therapy students have. These types of factors may have a stronger influence on attrition than the time commitment required for degree completion does.

Just as time commitment does not appear to adversely influence attrition in medicine, nursing, and physical therapy, the financial cost of pursuing a degree in a healthcare field may not significantly affect attrition. Most nursing education occurs at the community college or undergraduate level while medical and physical therapy education occur at the graduate level. Thus the financial cost of obtaining a nursing degree is generally lower than for medical or physical therapy education. Nevertheless, the attrition rate is still highest among nursing students. This indicates that at least for these three health care fields, Financial Resources may not influence degree completion as much as Student Background, Educational Experiences, and Student Attributes do.

The attrition rate in the physical therapy program at Elon University is higher than it is for other physical therapy programs with published attrition rates. However, this attrition rate is still lower than it is in most medical schools and it is certainly lower than the attrition rate in most nursing programs. Elon University's attrition rate, while somewhat higher than those published in other PT programs, is closer to the only published study using the same definition of attrition than it is to the published attrition rates in either medical or nursing school.

Reasons for Attrition

Gabard and associates (1997) are the only investigators who have examined the reasons why physical therapy students experience attrition. According to Gabard and associates, “the most common reason given for why students did not graduate on time was that students went on an extended or part-time program for academic reasons. The top three reasons for leaving programs were academic difficulty, failure to meet academic standards, and being expelled from the program” (1997, p. 142) , including being expelled for unprofessional behavior. Like Gabard and associates’ study, the most common reason for experiencing attrition for physical therapy students at Elon University was failure to meet academic standards, which included departmental expectations for performance in the clinical setting (n = 10; 5.0% of all participants). Three other reasons were tied for second place in regards to their frequency. Two students (1.0% of all participants) were put in a part-time program because of an inability to experience academic success in the typical full-time program. Unlike the results by Gabard and associates (1997), two of these three reasons—financial hardship and serious illness—were personal in nature. Two students experienced attrition because of a financial hardship (1.0% of all participants). Both students later enrolled in physical therapy programs in public universities. Given that Elon is a private university where tuition for the physical therapy program was more costly than at public universities, the loss of two students because of financial hardship is not unexpected. Two other participants in the Attrition group had serious illnesses (1.0% of all participants).

The results of this study mirror the results of the study by Gabard and associates (1997) in that even though the attrition rate was higher in the current study, most of those

experienced attrition for academic reasons. There were at few students at Elon, however, who experienced attrition for personal reasons, mainly related to their financial resources and their personal health.

Indicators of Collegiate Quality

The Princeton Review's Academic Rating was examined as an indicator of undergraduate institution quality along with the more commonly utilized average SAT score of an institution's entering class. The Princeton Review's Academic Rating may have better face validity than the average SAT score of an institution's entering class as an indicator of undergraduate institution quality. The average SAT score of an institution's entering class may indicate the caliber of student admitted to the institution. However, average SAT score does not necessarily reflect the quality of the educational experience received. The Princeton Review's Academic Rating is more reflective of the quality of the educational experience obtained at an undergraduate institution. The Academic Rating is based on current students' impressions of the academic experience at their undergraduate institution.

Despite the greater face validity of the Princeton Review's Academic Rating, there are significant limitations of the Academic Rating that impact its utility when one makes comparisons among undergraduate institutions regarding the quality of the education provided to students. The correlation coefficient between average SAT score and Academic Rating was positive and very strong ($r = 0.862$; $p < 0.001$). The higher the average SAT score of an institution's entering class, the greater the Academic Rating. For example, the average SAT score of entering students at Duke University was very high (i.e. 1415); the Academic Rating for Duke also was very high (i.e. 99). Similarly, the

average SAT score of entering students at Radford University was low (i.e. 991); the Academic Rating for Radford also was low (i.e. 68). Average SAT score for entering students and Academic Rating are highly interdependent.

Thus while Academic Rating exhibits concurrent validity with institutional SAT score, an Academic Rating is not provided for many smaller or less prestigious colleges or universities. In this study, 42 of the 198 participants graduated from institutions that did not have Academic Ratings. Only one of the 198 participants did not graduate from an institution that did not report an average SAT score or its corresponding ACT score. That institution without a reported SAT or ACT score was California State University at Los Angeles, a small university not to be confused with the renowned University of California at Los Angeles. Given the large number of institutions that are not provided with Academic Rating scores and given the strong relationship between average SAT and Academic Rating, one may conclude that Academic Rating is not a more applicable indicator of undergraduate institution quality than average SAT score is.

Others have developed and implemented other measures of undergraduate institution quality. For example, the National Survey of Student Engagement (NSSE) surveys thousands of students in over 350 colleges and universities per year (Kuh 2003). The purpose of the survey is to “assess the extent to which students engage in a variety of good educational practices. The NSSE project is grounded in the proposition that the frequency with which students engage in activities that represent effective educational practice is a good proxy for collegiate quality” (Kuh 2003). However, there are close to 2000 four-year colleges and universities in the United States, according to The Princeton Review (2003). Thus instruments like the NSSE, while well-intentioned, suffer the same

problem as the Academic Rating score; they are not comprehensive in the ratings they provide. Many colleges and universities do not participate in the NSSE. Thus the NSSE and similar instruments do not allow for comparisons of undergraduate academic quality among the gamut of colleges and universities in the United States. Even though Astin (1985) contends that a single measure is typically not the best means of determining the quality of the education obtained at an institution of higher education, the reality is that average SAT score, along with its equivalent ACT score, is the only measure that is used universally in higher education in the United States. All other measures may have greater legitimacy as indicators of academic quality but they lack wide applicability. Thus we still have only one useable indicator of undergraduate institution quality, the average SAT score.

In the field of medical education, the form of SAT average used to indicate undergraduate institution quality is Astin cell scores (Evans 1975; Clapp 1976; Hall 1992). Again, Astin cell scores are simply undergraduate institution average SAT scores converted to an ordinal scale. An Astin cell score of “One” indicates a college or university where the average SAT for the student body is ≤ 854 . On the other end of the scale, an Astin cell score of “Seven” indicates an institution where the average SAT for the student body is ≥ 1236 . The problem with using the Astin scale in this study was that, while average SAT scores for the undergraduate institutions represented in this study were normally distributed, the corresponding Astin scale scores were skewed toward the lower values. There were many more higher Astin cell scores than there were lower scores. Thus the Astin cell scores displayed a ceiling effect for the range of institutions in this data set. Previous investigators who used Astin cell scores in their studies of medical

students did not report whether or not the Astin cell scores in their studies were normally distributed (Evans 1975; Clapp 1976; Hall 1992).

This ceiling effect may occur because students who go on to graduate school, like the participants in this study, are more likely to attend institutions with higher academic quality. Some may argue that the ceiling effect occurs because since the Astin scale was developed over 30 years ago, average SAT scores may have crept higher overall for all undergraduate institutions. This explanation is unlikely, however, given that the Educational Testing Service periodically re-centers SAT scores so that the average score remains close to 1000 (2004). The average SAT score for the undergraduate institutions represented in this data set was 1122.74. Another more likely reason for the skewed distribution of Astin cell scores is the possible inflation of reported average SAT scores among colleges and universities (Schackner 2002). Schackner reported that at the University of Pittsburgh, administrators exclude “special access” students when they report the average SAT score for their student body. “Special access” students are those students who are admitted to the university despite low high school GPAs and/or low SAT scores. Even though none of the participants in this study was a graduate of the University of Pittsburgh, other institutions may similarly exclude the scores of certain students so as to make the average SAT scores for their institutions as a whole appear higher than they actually are.

Undergraduate institution Academic Ratings were not available for many participants in this study, thus creating a problem with the number of subjects available for the subsequent regression analyses. Ordinal Astin cell scores of average SAT scores from the undergraduate institutions were not normally distributed. Neither Academic

Rating nor Astin cell score was as useful an indicator of undergraduate institution quality as the institution's average SAT score of entering students. Therefore, Academic Rating and Astin cell score were variables deleted from the subsequent regression analyses. The lone remaining indicator of undergraduate institution quality utilized in this study was average SAT of an institution's entering class.

Relationships Between Remaining Independent Variables

The significant correlations found between the independent variables remaining in the data set were generally not surprising. The strongest relationship noted in the correlation matrix was between the variables Age and Prerequisites ($r = -0.580$; $p < 0.001$). The older the student, the less the number of prerequisite courses that student took at his or her alma mater. Some participants were in their 30s and 40s and went back to school in physical therapy as a second career. Many of these older students chose majors like Business or Communications at their alma maters, majors that did not require many science courses. By the time these students were in their 30s or 40s, they may certainly have moved far away from their undergraduate institutions and taken many of the prerequisite courses for physical therapy school as part-time students close to where they lived.

Similar to the relationship with Prerequisites, Age also was negatively and significantly correlated with Undergraduate GPA, albeit weakly ($r = -0.265$; $p < 0.001$). The older the participant in this study, the lower his or her Undergraduate GPA tended to be. One possible explanation for this admittedly weak negative relationship between Age and Undergraduate GPA is that perhaps the younger students in the physical therapy program were more goal-oriented and thus more driven to succeed academically in their

undergraduate years. The older participants in this sample may have been more directionless in their undergraduate days, as evidenced by their desire to change careers to physical therapy a few years after graduation.

Undergraduate GPA was positively and significantly but weakly correlated with Prerequisites ($r = 0.200$; $p < 0.01$). That is, those with a higher undergraduate GPA tended to take more of their prerequisite courses for physical therapy school at their alma maters. Age may be a confounding variable when considering the relationship between Undergraduate GPA and Prerequisites. As mentioned earlier, Age was negatively correlated with both Undergraduate GPA and Prerequisites. The relationship between Undergraduate GPA and Prerequisites may be influenced by the fact that older participants tended to have lower undergraduate GPAs and they also took fewer of their prerequisites at their alma maters. Of course, another possible explanation for this relationship is that the student who takes most of his coursework at one institution may be a more stable and even a better student academically than the student who transfers from one institution to another.

In addition to Prerequisites and Undergraduate GPA, Age was correlated with one other variable in this study. The correlation coefficient between Age and Verbal GRE was 0.224 ($p < 0.01$). Thus, the older participants tended to have higher Verbal GRE scores. These results agree with the results obtained in a study of individuals who repeated taking the GRE five years or more after taking it previously (Wilson 1988). Based on his analysis of 3,614 individuals who re-took the GRE after five or more years, Wilson found that Verbal GRE scores increased as people became older. Similar to the results of this study, Wilson also found that Math GRE scores did not increase as the test

taker became older. Wilson concluded from his study that as people age, their command of the language strengthens but unless they use mathematical computations extensively as part of their vocation (e.g. engineering), their mathematical skills do not improve with age. As young adults move into their late 20s, 30s, and 40s they may obtain better verbal skills and maintain their mathematical skills simply because of the process of maturation.

In addition to the correlation between age and Verbal GRE, Verbal GRE was positively yet weakly correlated with Math GRE ($r = 0.407$; $p < 0.001$) in this study. The higher a participant's Verbal GRE score, the higher the participant's Math GRE score tended to be. This positive relationship was expected and should not be surprising, given that these two variables represent two standardized, multiple-choice sections of the same test of cognitive abilities taken on the same day in the same place.

In addition to its positive relationship with Age and Math GRE, Verbal GRE was also positively and significantly but weakly correlated with institutional SAT ($r = 0.283$; $p < 0.001$). Those who scored higher on the Verbal section of the GRE were more likely to have graduated from an institution with a higher average SAT score for its entering students. The same was true for the Math GRE; those who scored higher on the Math section of the GRE were more likely to have graduated from an institution with a higher average SAT score for its entering students. This relationship between GRE scores and undergraduate institution quality is consistent with Astin's previous work. According to his research (Astin 1993), the research orientation of an undergraduate institution is a strong predictor of Verbal GRE score. Universities with a strong research orientation often attract students with high SAT scores, the indicator of undergraduate quality used in this study. One reason for the relationship between Verbal GRE and undergraduate

institution quality may lie in the fact that the most selective schools spend three times as much money on a student as the least selective schools (Astin 1993), money that may be spent preparing them for success with tests of language skills. While the individual SAT scores of the participants in the current study were not known, students from higher quality institutions may have performed better on the GRE because they had higher SAT scores than the other participants. Verbal SAT score is a strong predictor of Verbal GRE score; likewise, Math SAT score is the strongest predictor of Math GRE score, according to Astin (1993). Performance on standardized tests before entering college predicts performance on standardized tests after the completion of college. Therefore, participants from higher quality undergraduate institutions may have had higher GRE scores because they demonstrated an ability to do well on standardized tests, as evidenced by their SAT scores, and they obtained educations that prepared them more for success on the GRE.

While the participants from higher quality institutions had higher GRE scores, these participants also had lower undergraduate GPAs ($r = -0.267$; $p < 0.001$). Once again, these results are not surprising, given work conducted earlier by Astin. He found that undergraduate GPA is reduced by attending a highly selective institution (Astin 1978). Highly selective institutions (i.e. institutions with high SAT scores for entering students) may not experience problems with grade inflation to the degree less selective institutions do. Also, if professors use norm-referenced grading, a student who is the best student at a lower quality institution may be an average student at a high quality institution. Thus the student may make an “A” at a lower quality institution but a “B” or an even lower grade at a higher quality institution simply because of the academic caliber of his or her peers. Despite the fact that a student’s GPA may be lower at a higher quality

undergraduate institution than at a lower quality institution, attending a higher quality college or university may slightly increase a student's aspirations for pursuing and enrolling in a graduate or professional program (Astin 1978).

Despite the significance of the previously discussed correlations, only one of them exhibited more than a weak relationship. The strongest relationship was between Age and Prerequisites, indicating that older participants were less likely to have taken many of their prerequisite courses for physical therapy school at their alma maters.

Predictors of Attrition

Whether or not a participant experienced attrition, defined again as whether the student's graduation was either delayed or denied, was not predicted by the entire regression model including the eight predictor variables of Math GRE, Verbal GRE, undergraduate GPA, SAT of the undergraduate institution's entering class, Age, Race, Gender, and Prerequisites taken at the alma mater. However, given that many of the predictor variables were cognitive in nature, those who experienced attrition for non-academic reasons were deleted from further analyses. For the remaining participants, the eight independent variables formed a predictive model of attrition. Two of those predictor variables, undergraduate GPA and SAT of an institution's entering class, were significant, independent predictors of attrition after controlling for the other independent variables.

Neither Math nor Verbal GRE scores were significant, independent predictors of attrition. These findings contradict the findings of Kirchner and associates (1994) who found that GRE scores were significant predictors of both physical therapy GPA and written examination scores. In addition, Thieman and associates (2003) found that GRE

scores were predictive of physical therapy GPA and licensure exam score. However, only five percent of the variance in physical therapy GPA was explained by GRE scores alone. In addition, the outcome variable in this study, attrition, differed from the ones used in the studies by Kirchner and associates (1994) and Thieman and associates (2003). This may help explain the differences in results noted between this and previous studies. Also, the controlling variables entered in the predictive equations differed between studies. For instance, in this study, undergraduate institution quality was considered but it was not addressed in the previous studies. Thieman and associates considered other factors such as the strength of required letters of recommendation, factors that were not included in this study. Thus the influence of GRE scores on “success” in the physical therapy program may have been influenced by the different controlling factors utilized in the three studies.

The results of the current study indicate that undergraduate GPA was an independently significant predictor of attrition. This finding is in agreement with the findings of many other studies in physical therapy education (McGinnis 1984; Balogun, Karacoloff et al. 1986; Day 1986; Levine, Knecht et al. 1986; Balogun 1988; Roehrig 1990; Kirchner, Holm et al. 1994; Templeton, Burcham et al. 1994; Hayes, Fiebert et al. 1997; Dockter 2001; Thieman, Weddle et al. 2003), even though these other studies defined success in other ways besides attrition. This study is the first to identify undergraduate GPA as a predictor of attrition in physical therapy education, thus adding more breadth to the importance of undergraduate GPA as a predictor of different types of success in physical therapy education.

The current study also is the first to identify undergraduate institution quality as a significant, independent predictor of attrition in physical therapy education. Heretofore, undergraduate institution quality was identified as an independent predictor of different forms of educational success in medical (Evans 1975; Clapp 1976; Sarnacki 1982; Strayhorn and Frierson 1989; Hall 1992; Mitchell, Haynes et al. 1994; Reede 1999) and nursing education (Griffiths, Bevil et al. 1995; Lewis and Lewis 2000). Neither of the studies in nursing school settings defined undergraduate institution quality by the institution's average SAT score, as was the case in the current study. However, many of the medical school studies did define undergraduate institution quality by the average SAT score of the institution's student body (Evans 1975; Clapp 1976; Sarnacki 1982; Strayhorn and Frierson 1989; Hall 1992; Mitchell, Haynes et al. 1994; Reede 1999). Each of these medical school studies examined the influence of undergraduate institution quality on medical school GPA, National Board of Medical Examiners score, or both. Each set of investigators found that the quality of the medical student's undergraduate institution was a consistent predictor of the outcome variable. Knowing the medical student's undergraduate GPA was an important but not sufficient consideration. An undergraduate GPA of 3.30 was not as predictive of "success" in medical school as knowing that that 3.30 GPA was obtained from Yale University as opposed to a less selective university, for example. Similarly, in this study, while undergraduate GPA was in and of itself a significant predictor of attrition in physical therapy school, knowing the quality of the institution from which that GPA was obtained enhanced the predictive ability of attrition. The physical therapy student whose graduation was either delayed or

denied for academic reasons was more likely to have graduated from a lower quality college or university with a lower undergraduate GPA.

Once again, none of these studies conducted in medical school settings examined the influence of undergraduate institution quality on attrition. Based on the results of this current study, knowledge of undergraduate institution quality may have broader implications for success besides professional school GPA and performance on licensure and other standardized tests.

While a part of the overall significant model to predict attrition for academic reasons, neither age nor any of the other demographic variables was an independent, significant predictor of attrition in this study. Of the eight studies reviewed that address the ability of age to predict academic success in physical therapy education, all of them defined “success” as course grades or overall professional GPA (Peat, Woodbury et al. 1982; Hahn 1984; Williams 1984; Rikard-Bell, Marshall et al. 1991; Amosun, Balogun et al. 1996; Hayes, Fiebert et al. 1997; Dockter 2001; Thieman, Weddle et al. 2003). Four of the groups of investigators found that age was a significant predictor of physical therapy course grade or overall GPA (Peat, Woodbury et al. 1982; Amosun, Balogun et al. 1996; Dockter 2001; Thieman, Weddle et al. 2003). Younger students performed better academically than older students did. The four other studies did not find age to be a significant predictor of grade or GPA (Hahn 1984; Rikard-Bell, Marshall et al. 1991; Hayes, Fiebert et al. 1997; Thieman, Weddle et al. 2003).

Unlike these other studies examining the predictive ability of age, the current study did not define success by the student’s GPA in the professional program. Even though attrition is related in part to GPA given that those whose GPA falls too low will

fail out of the program and thus experience attrition, some who experience attrition may have a relatively high GPA and vice versa. Those who experience attrition for personal reasons may have high GPAs in the program when they do drop out.

Another difference between these earlier studies and the current study is that all of these studies examined only graduates of physical therapy programs. Therefore, those who dropped out of the program were not included in the predictive equations of physical therapy grade or GPA. This current study was more inclusive in its analyses since graduates as well as those who failed to graduate were included. The samples were different; this study included those who dropped out while the previous investigators did not. This sample difference may affect the comparability between the results of this study and previous investigations.

The results of this study also contribute to our understanding of the influence of other demographic factors on academic success in physical therapy education. In this study race was not a significant predictor of attrition. Despite using different outcome measures, the finding of this study concurs with the results obtained by El Ansari (2003) who found no difference in physical therapy GPA between students of different races. This similarity holds, despite the different geographic and cultural locations of the studies. The current study analyzed students at Elon University in the United States while El Ansari conducted his study at a university in England. El Ansari's lack of significance for race may have been related to the fact that only 2.4% of his participants were of a minority race. Nonetheless, the results of the current study also found no difference in attrition between students of different races even though a greater percentage of the participants in this study (10%) were of a minority race.

Interestingly, in a 1986 study conducted in the United States, Day found race to be a significant predictor of physical therapy GPA. Again, the participants in the two studies attended different physical therapy schools, even though they were all located in the United States. In addition, the outcome variables differed between the two studies; Day used physical therapy GPA as her outcome variable while attrition was the outcome variable in the current study. Thus, different results regarding the predictability of race between the current study and the study by Day may be related in part to differences between the participants and the physical therapy programs they attended as well as the different outcome measures used.

The gender of the participant was another demographic variable that did not independently predict attrition in the current study. This adds to the previous studies which have addressed the predictive ability of gender on “success” in physical therapy education (Day 1986; Rikard-Bell, Marshall et al. 1991; Payton 1997; El Ansari 2003). Given the contradictory findings of these previous studies, consideration of the results of the current study is important. The results of this study concur with the findings of Rikard-Bell and associates (1991) and Payton (1997) who did not find gender to be a predictor of academic success in physical therapy education. Day (1986) also found that gender was not a significant predictor of physical therapy GPA except in one of the four programs surveyed. In a more recent study, however, El Ansari (2003) found that the overall grade in a physical therapy program in England was significantly higher for women than it was for men. Clearly this issue requires further investigation, even though it currently appears that gender may not be a predictor of academic success in physical therapy education.

The entire regression model did not predict attrition in this study except when participants who experienced attrition for personal reasons were excluded from the analysis. When limited to those in the attrition group who experienced only academic problems, the model with eight predictive variables was significant. Of those eight predictor variables, only undergraduate institution quality and undergraduate GPA were independent, significant predictors of attrition. While numerous other studies in physical therapy education have identified undergraduate GPA as a significant predictor of academic success, the current study is the first to investigate and identify undergraduate institution quality as a significant predictor. Knowing an applicant's undergraduate GPA is important in determining whether or not that student will become a "successful" physical therapy student. However, the addition of the quality of the undergraduate institution from which that GPA was earned may add more precision to the estimation of whether or not that applicant will experience attrition or retention.

Connections to Tinto's Model of Doctoral Persistence

The results of this study support the framework of Tinto's longitudinal model of doctoral persistence, once participants who experienced attrition for personal or family reasons were deleted from the analysis. When all participants were entered into the analysis, the Attributes (independent variables) used in this study were not predictive of whether or not the participant graduated with the class he or she entered with. Too many of the other portions of Tinto's model not assessed in this study apparently were more influential on degree completion. Specifically, Financial Resources may have been a limiting factor that was not included in the prediction equation since two of the participants dropped out of the program for financial reasons. Also, External

Commitments were not specifically addressed in this study, though it turned out that some of the participants were placed in the Attrition group for personal and family reasons. For example, one student had her graduation delayed because she became pregnant and delivered her baby while she was enrolled in the program. Becoming pregnant and having a baby would come under Tinto's category of External Commitments. In this participant's case, External Commitments caused her delay in graduation; none of the Attributes examined in this study caused her attrition.

When the participants who experienced attrition for personal and family reasons were deleted from the regression analysis, the Attributes examined in this study became influential on timely completion of the physical therapy program. With the independent variables utilized in this study, Educational Experiences (as measured by undergraduate institution quality) and Student Background (as measured by undergraduate GPA) were more predictive of attrition than Student Attributes (as measured by age, race, and gender) were. Figure 5 provides a revised representation of the portion of Tinto's model addressed in this study with the most predictive Attributes in bold print.

Given that most of the predictor variables utilized in this study were cognitive and academic in nature, the Attributes examined in this study became significant once those who experienced attrition for personal and family reasons were deleted from the analysis. Thus the results from this study support Tinto's model of doctoral persistence. Attributes can have an influence on degree completion, despite the fact that several other steps must take place in order for the student to reach the goal of graduation.

The current study is the first to examine attrition in physical therapy education using Tinto's model of doctoral persistence. Based on this research, Tinto's model does

appear to be appropriate for use when examining physical therapy education, even though Tinto's model outlines the steps toward an academic doctoral degree while participants in this professional physical therapy program were Master's degree students at the time of the study.

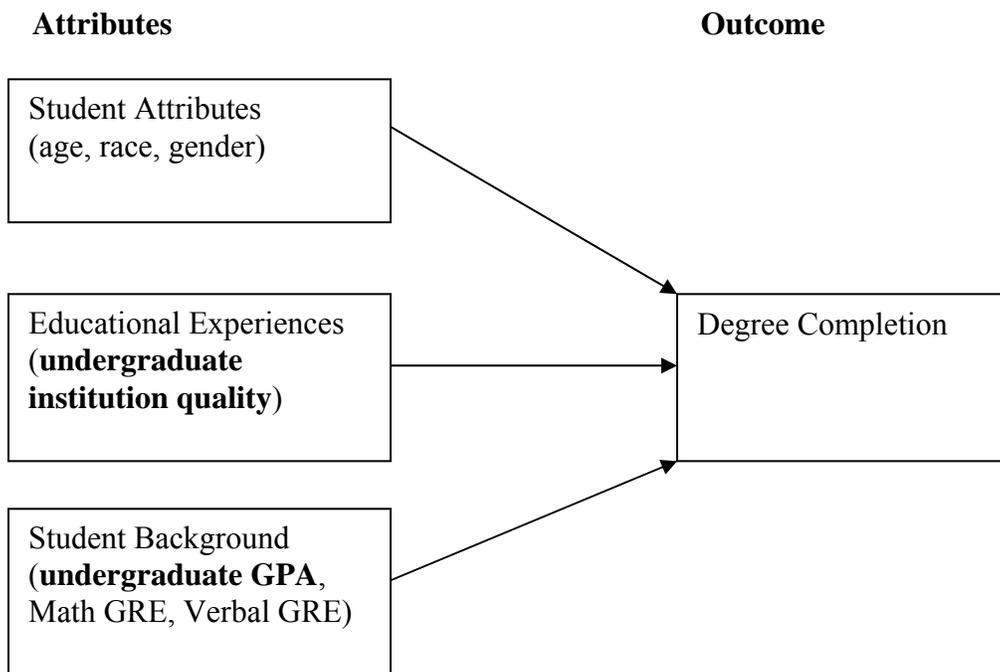


Figure 5. Revised portion of Tinto's model with significant, independent predictors of attrition for academic reasons in bold print.

Limitations

Other variables not used in this study may better represent the different Attributes in Tinto's model. For instance, a student's commitment to the profession may be a better predictor of attrition than the Student Attributes used in this study (age, race, and gender).

The ability of Attributes to predict Degree Completion is based on the variables chosen to represent the Attributes.

This study also may have limited generalizability to other physical therapy educational programs. Academic programs and institutions all have unique programmatic and philosophical differences. Results obtained from a school like Elon may not be applicable to schools in other parts of the country or in public universities or in programs with different educational philosophies.

Nevertheless, the students who comprised the participants in this study were similar in certain respects to physical therapists and physical therapy students in other educational programs. The demographic characteristics of physical therapists in the United States were collected via surveys conducted by the American Physical Therapy Association (2003). The racial make-up of the participants in this study was similar to the racial representation of physical therapists in the United States. The percentages of each racial group represented in the participants and in physical therapists nationwide are presented below in Table 13.

The racial profile of the participants in this study reflects the racial profile of the practicing physical therapists. There was, however, a greater percentage of African-Americans in this study than in the profession overall (4.5% versus 1.1%). This difference may reflect the location of Elon University in a Southern state, the preponderance of students coming into the program from colleges in Southern states, and the greater representation of African-Americans in the South.

Table 13

Racial Representation of Participants and Physical Therapists in the United States

Race	Participants (%)	Physical Therapists (%)
American Indian	0.5	0.3
Asian or Pacific Islander	2.0	2.7
African-American or Black	4.5	1.1
White	90.4	93.2
Hispanic/Latino	2.0	1.7

In the profession of physical therapy, most recent statistics indicate that 69.0% of therapists in the United States are female while 31.0% are male (American Physical Therapy Association 2003). For the participants in this study, in comparison to national statistics, a slightly greater percentage of participants was male (37.9% of participants) while slightly fewer were female (62.1%).

In addition to demographic similarities to the population, GRE scores for the participants also were comparable to GRE scores of all who took the exam (Educational Testing Service 2004). This organization published the GRE scores for those who chose Health and Medical Sciences as their intended field of graduate study. Results were presented from those who took the GRE between July 1, 2000 and June 30, 2003. Over 60,400 people took the GRE as prospective Health and Medical Science students during this time period. Their average (s.d.) Math GRE score was 548 (116); their average (s.d.) Verbal GRE score was 448 (89). In comparison, for the participants in this study, the average (s.d.) Math GRE score was 569 (69); the average (s.d.) Verbal GRE score was

451 (68). Thus the GRE scores for the participants in this study were slightly higher than the average GRE scores for all prospective Health and Medical Sciences students.

Even though the participants in this study all attended one university, they appeared to be quite similar to their current and future peers, at least in regards to their racial make-up, gender distribution, Math GRE scores, and Verbal GRE scores. This provides an argument for an increased ability to generalize the results of this study to other physical therapy programs.

Another limitation of this study is that, while the overall number of participants was adequate for regression analysis ($n = 198$), the number of participants who were in the Attrition group was low ($n = 20$). If the distribution between the Attrition group and the Retention group had been more of a 50-50 split, then the standard errors for the coefficients would not have been as high (Allison 1999). With the inherent instability of the regression model, the greatest risk was of possibly committing a Type II error. If the distribution had been more even, other variables besides undergraduate institution average SAT score and undergraduate GPA may have been independent, significant predictors of attrition. However, the possibility of a Type II error is lessened by the fact that the level of significance for age, race, gender, number of prerequisites, Math GRE, or Verbal GRE was not very close to 0.05 in either of the regression analyses. As students continue to matriculate in the program over the next few years, the number of participants in the Attrition group should grow, thus providing for a more stable model.

Another possible limitation of this study is that, while the participants in this study had graduated from college prior to 2002, Academic Rating and average SAT score of an institution's entering class were obtained from the 2004 version of The Princeton

Review. While the average SAT score of entering students at an undergraduate institution does not change much from year to year, the average SAT score may change appreciably over a longer period of time. For instance, ten years ago, the average SAT score of entering students at Elon was 1040. Now the most recent documented average SAT score of entering students at Elon University is 1145, an increase of 105 points in the last decade. Other colleges and universities may have experienced a similar change in average SAT score over that time span. Several of the older participants in this study graduated from college more than ten years ago. Thus the average SAT scores at their undergraduate institutions may not have accurately reflected the average SAT scores at their schools when the participants were actually enrolled in college. Despite this limitation, the current average SAT scores used in this study were still independently and significantly predictive of attrition.

In addition to the potential problem of using an undergraduate institution's current SAT averages when the participants themselves graduated years earlier, some may contend that average SAT score is not the best indicator of undergraduate institution quality. The Princeton Review's Academic Rating was chosen for this study as a potential improved indicator of undergraduate institution quality. However, too many institutions did not have Academic Ratings, thus making it difficult to use this variable to make comparisons between institutions.

Average SAT score is a good proxy for many other indicators of undergraduate institution quality (Astin 1985). According to Astin, who has conducted much of the foundational research addressing the issue of undergraduate institution quality, average SAT score of entering students is a strong indicator of the reputation of the institution;

the higher the average SAT score, the greater the reputation (1985). Also, Astin found that the more selective the institution, as measured by SAT of the entering class, the greater the per-pupil expenditure. Selective institutions spend more than three times as much money on their students' education as less selective institutions do (Astin 1993). Thus average SAT score is a good indicator of a college or university's reputation as well as its allocation of resources for students.

In addition to the reputation of a college or university and the resources it spends on its students, undergraduate institution quality also may be judged by the student outcomes attained after graduation, the content of what is taught to students, or the development of student talent while in college (Astin 1985). Astin notes that colleges and universities have assessed student outcomes in the following ways: the graduation rates of undergraduates, the proportion of college graduates who obtain graduate degrees, alumni earnings, and students and alumni ratings of the undergraduate experience. The National Survey of Student Engagement (Kuh 2003) is one such instrument that obtains student opinion regarding the undergraduate experience.

Astin admits that quantifying what is taught to students is problematic. He does note, however, that the most selective colleges and universities award most of their degrees in the liberal arts and sciences while the most selective technological universities award most of their degrees in engineering.

Astin also admits that quantifying the intellectual and personal talent developed by students while in college is problematic. Assessing intellectual and personal development would require administering pre-tests at matriculation and post-tests at graduation, tasks undergraduate institutions typically do not undertake (Astin 1985).

While these alternative methods of determining undergraduate institution quality may exhibit more face validity, these methods are not consistently utilized by all colleges and universities. If one wants to make comparisons between all colleges and universities in the United States, the average SAT score for entering students continues to be the most appropriate method.

One final limitation of this study is that some may argue with the outcome variable used in this study. They may contend that licensure exam scores or clinical competence at employment are better indicators of success in physical therapy education than attrition. Even if this proves to be so, one must successfully complete the educational program before taking the licensure exam or practicing as a physical therapist. One cannot even take the licensure exam or practice as a clinician for even a day unless one first completes the educational program. In addition, there is no consensus as to what defines clinical competence, at least in the field of physical therapy. Does clinical competence mean that patients experience a better outcome? Does clinical competence mean that patient satisfaction questionnaires are superb? Does it mean that the clinician is engaged in professional development activities? Lastly, one may surmise from the research literature that even though attrition in physical therapy education has significant individual and societal implications, this issue has not been investigated much at all.

Recommendations

Based on the results of this study, the admissions committee members in the physical therapy program at Elon University should continue to consider cognitive factors in determining the ability of an applicant to successfully complete the program in

a timely manner. Specifically, undergraduate GPA should continue to weigh heavily in the decision process. In addition, the admissions committee should begin to consider the quality of the undergraduate institution from which the applicant graduated. The quality of the undergraduate institution attended appears to enhance the interpretation of the undergraduate GPA. For example, a student with a 3.0 GPA from a high quality college or university is not similar to the student with a 3.0 GPA from a lower quality institution; the student from the higher quality college or university may be less likely to experience attrition in the physical therapy program at Elon.

Other physical therapy programs may want to note the results of this study. While the scope of this study was limited to students in the Elon University physical therapy program, these participants are similar in several respects to students in other physical therapy programs. Based on the results of this study, other institutions may want to examine their current and former students to see if undergraduate institution quality can enhance the prediction of a successful outcome in their academic programs. Replication of this research, especially if conducted in collaboration with other physical therapy programs, will be required before these results can be generalized to other programs.

Recommendations for Future Research

The possibilities for research into attrition and other forms of success in physical therapy education are numerous, given the limited research that has been conducted in the field. A few considerations for future research are presented below.

The results of this study may be able to be generalized to physical therapy programs in other small, private universities, though they may not be as applicable to physical therapy programs in large, public universities. Future researchers may want to

work collaboratively with faculty members in other physical therapy programs. Inter-institutional collaboration may allow researchers to differentiate causes and predictors of attrition between public and private universities. For example, while attrition because of financial hardship was a problem for two students in this study, there may be even fewer students in publicly-supported universities who experience attrition because of financial hardship.

The results of this research, if applied universally, may have a negative influence on the admission of disadvantaged and minority students. As noted earlier in the Discussion section, only 1.1% of all physical therapists in the United States are African-American (American Physical Therapy Association 2003). Given that many historically black colleges and universities have low average SAT scores for their entering students, using undergraduate institution average SAT score in determining the admissibility of an applicant may exclude some African-American students based on the quality of their undergraduate institution. Future researchers should determine if factoring in undergraduate institution quality does indeed limit the already small number of African-American and other minority applicants to physical therapy educational programs. If so, then the recruitment and retention efforts suggested by Haskins and Rose-St. Prix (1994) should be implemented by academic institutions that consider undergraduate institution quality in their admissions decisions.

Another recommendation for future research endeavors involves the outcome variable “clinical competence upon entering the practice of physical therapy.” Clinical competence after graduation is one outcome that has not been addressed at all in the research literature. Future researchers should operationally define clinical competence

upon entering practice. Then these researchers could see if there are any cognitive, collegiate, demographic, or even personality predictors of clinical competence.

The database used in this study will need to expand beyond 198 participants and this study will need to be replicated in other settings before the following conclusions can be generalized to other physical therapy programs.

Conclusions

From the results of this study, one can reasonably make the conclusions listed below: The attrition rate in the physical therapy program at Elon University is 10%. This attrition rate, while higher than the attrition rates published from other physical therapy programs, is lower than the attrition rates in nursing education and in medical education. Most students in the Elon physical therapy program experienced attrition for academic reasons.

The Princeton Review's Academic Rating is positively and strongly correlated with average SAT score of a college or university's entering class. Nevertheless, average SAT score of the entering class is still the best universally-applied indicator of the quality of a college or university's undergraduate experience.

Attrition in the Elon physical therapy program was not predicted by the regression model including the following independent variables: age, race, gender, number of prerequisite courses taken at the undergraduate institution, average SAT of an undergraduate institution's entering class, undergraduate GPA, Math GRE score, and Verbal GRE score. However, once those who experienced attrition for personal reasons were excluded, the regression model including the eight predictor variables did predict those who experienced attrition for academic reasons. Lastly, once the other predictor

variables were controlled for, average SAT of a college or university's entering class and undergraduate GPA were able to independently predict attrition for academic reasons.

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Appendix

ELON UNIVERSITY
Department of Physical Therapy Education
ADMISSIONS WORKSHEET

Name: _____ Class of 20

Major: _____ Degree Conferred by: _____ Year _____

I PRE-INTERVIEW INFORMATION

A GPA
 (Admissions Office) Cumulative undergraduate GPA _____ X 15 = _____
 Overall Science GPA _____ X 15 = _____
Weighted GPA _____ pts.
(minimum 90/120 maximum possible)

B Letters of Recommendation
 (Admissions Office) Score 5 points for "outstanding", 3 points for "recommend", 1 point for "recommend with reservation"; and 0 points for "do not recommend". Automatic rejection if applicant gets a "0" or less than "7" score.
 Letter Number 1 PT _____ Points
 Letter Number 2 Academic _____ Points
 Letter Number 3 Other _____ Point **Letters of Recommendation** _____ pts.
 Weighted Letters of Rec. (Students Score) X 10 = _____ X .15
Weighted Letter Score _____
(minimum 10.5/22.50 maximum possible)

C Graduate Record Examination - No scores less than 500 (maximum score - 800)
 (Admissions Office) Verbal _____
 Quantitative _____ Writing Assessment _____ (Max Score 6.0)
 Analytical _____
 Total _____ X .15 = _____
2 scores divided by 2 for Weighted GRE _____
3 scores divided by 3 for Weighted GRE _____
(minimum 75/120 maximum possible)

D Personal Statement
 (PT Faculty) Satisfactory _____ Unsatisfactory _____

E Volunteer Experience
 (PT Faculty) Complete In Progress
 100 hours total _____
 20 hours Acute _____
Subtotal _____ pts.
(minimum 175.5/262.50 maximum possible)