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Big Five Personality Traits and Other Predictors of Academic Success in Physician Assistant Students

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Big Five Personality Traits and Other Predictors of Academic Success in Physician Assistant Students

by
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Abstract

The purpose of this study was to examine the relationship between cognitive and noncognitive variables, and academic performance among Physician Assistant (PA) students. Noncognitive variables (i.e. personality traits) were assessed using the Big Five Inventory and the Marlowe Crown Social Desirability Scale. Academic performance outcomes were defined by the participants' preclinical GPA, clinical GPA, PACKRAT score, PANCE score, and PANCE pass/fail. Cognitive variables were assessed using participants' overall preadmission GPA and science GPA. The study followed 146 PA student participants' in seven class cohorts, from matriculation to graduation (first time PANCE). Pearson correlations were computed for each of the cognitive and noncognitive traits' relationship to each of the Big Five personality traits (conscientiousness, agreeableness, neuroticism, openness to experience and extraversion) and academic success variables. Regression analysis was conducted for each of the cognitive and noncognitive traits' relationship to each of the Big Five personality traits and academic success variables. Overall, three of the Big Five personality traits (conscientiousness, agreeableness, and extraversion) positively correlate with one or more academic success variable. Specifically, agreeableness seemed to be the most reliable predictor of academic performance. Cognitive variables (overall preadmission and science GPA) positively correlate with one or more academic success variable. The results of the study suggest physician assistant applicants' prior success and their individual personality traits predict PA school academic performance. Finally, implications, limitations, and cognitive and noncognitive considerations in the admission process are discussed.

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Chapter One: Introduction

Introduction to the Problem

This research, which is propelled by my interest in students' noncognitive personality traits, was designed to identify to what extent these noncognitive traits contribute to Physician Assistant (PA) student academic success. Significant research positively correlates cognitive variables, such as undergraduate GPA, with academic success (Cariaga-Lo, Enarson, Crandall, Zaccaro, & Richards, 1997; Jones, Simpkins, & Hocking, 2014). What is not known is how noncognitive personality traits affect PA student academic achievement. An understanding of these relationships may inform PA programs throughout the student admission and advising processes.

The United States (U.S.) is currently faced with a healthcare provider shortage (Kuehn, 2008). This shortage is in part due to the aging population and the millions of uninsured Americans who now have access to healthcare insurance through the Affordable Care Act (ACA) (Green, Savin, & Lu, 2013). In addition to the ACA, the reasons for a healthcare provider shortage is multifaceted but is in large part driven by factors such as population growth, an aging population, an aging physician workforce, and an increase in physician visits (Salsberg, 2009). Medical schools are expanding but newly admitted medical students are years away from practice and will not meet the demand for years to come (Salsberg, 2009). Current efforts to expand the physician supply through increased enrollment will not sufficiently address the healthcare provider shortage (Kuehn, 2008). The PA profession is expanding and this expansion is seen as a vital part of the healthcare workforce that will be necessary to meet increased demands (Kuehn, 2008). With healthcare reforms such as the ACA, the demand for medical providers will continue to rise into the foreseeable future (Green et al., 2013; Salsberg, 2009). In

light of this demand, the importance of selecting PA students who can succeed academically and professionally is vital to the national healthcare infrastructure.

With the expansion in the PA profession more pre-PA students are applying than available seats in training programs. According to the Physician Assistant Education Association (PAEA), applications have increased each year since 2009, from 2.56 applicants per available seat in the 2009-2010 application cycle to 3.6 applicants per available seat in the 2013-2014 application cycle (Robohm-Leavitt, 2014). With a healthcare provider shortage and an abundance of applicants, PA programs must imperatively select students who exhibit the intellectual and personal qualities desired in a medical provider, as well as the characteristics needed to persist in, and ultimately successfully complete, the PA program and the Physician Assistant National Certification Examination (PANCE). Developing an understanding of the variables that correlate with success in PA education, and how these variables may interact, is a complex task; therefore, understanding what personality traits in addition to GPA differentiate students who struggle from those who excel is important.

Background of the Study

Physician Assistant research has looked at overall preadmission grade point average (GPA), program GPA, select program components, Graduate Record Examinations (GRE), and Physician Assistant Clinical Knowledge Rating and Assessment Tool (PACKRAT) performance to predict PANCE success (Oakes, MacLaren, Gorie, & Funstuen, 1999). Researchers found a correlation between overall preadmission GPA, program GPA, select program components, GRE, and PACKRAT performance with PANCE success, indicating the higher the scores on these cognitive measures the higher the PANCE score (Oakes et al., 1999). McDaniel, Thrasher and Hiatt (2013) identified noncognitive traits that are important to programs, such as

faculty/staff/interviewer interactions, career motivation, student knowledge of the profession, maturity, and professionalism. A lack of research is found in PA education on noncognitive personality variables and their relationship to academic success.

Over the years, a number of studies have been conducted which looked for academic variables that correlate with success in medical schools. For example, research has looked at Medical School Admission Test (MCAT) scores, overall preadmission GPA, and science GPA to predict medical school admission (Cariaga-Lo et al., 1997). Researchers found a correlation between MCAT scores, overall GPA, and science GPA with higher graduation rates (Cariaga-Lo et al., 1997). Other research has studied the relationship between personality variables and academic success in medical school. These studies found positive relationships between select personality variables, mental health, and coping skills with academic success (Cariaga-Lo et al., 1997; Shen & Comrey, 1997; Tyssen et al., 2007). The personality variables found to correlate to medical school academic success include empathy, warm-heartedness, respect for law and others, confidentiality, honesty, perseverance, encouraging behavior, mental toughness, tolerance for ambiguity, compulsiveness, perseverance, and aggressiveness (Lievens, Coetsier, De Fruyt, & De Maeseneer, 2002; Shen & Comrey, 1997; Tyssen & Vaglum, 2002; Tyssen, Vaglum, Gronvold, & Ekeberg, 2001). Hojat (2013) concluded that based on the currently available empirical evidence, conscientiousness should be considered in predicting educational and clinical outcomes. Hojat's finding is consistent with a number of research projects that demonstrate conscientiousness as a significant predictor of academic success (Bore, Munro, & Powis, 2009; Ferguson, James, O'Hehir, Sanders, & McManus, 2003; Haight, Chibnall, Schindler, & Slavin, 2012; Lievens et al., 2002; McAbee & Oswald, 2013; McManus, Keeling, & Paice, 2004; Tyssen et al., 2007).

This study on PA success attempted to determine useful cognitive and noncognitive variables, specifically, the Big Five personality characteristics (conscientiousness, agreeableness, neuroticism, openness to experience and neuroticism). Cognitive traits were examined: overall preadmission GPA and science GPA. The study also examined program cognitive traits: preclinical GPA, clinical GPA, PACKRAT scores, PANCE scores, and PANCE pass/fail. Although program cognitive traits are not predictors of admission, they were shown to be important predictors of academic success in PA education (Higgins et al., 2010). Each of the noncognitive and cognitive variables in this study was examined to determine to what effect they predict academic success in PA school and on the PANCE examination.

Statement of the Problem

For years medical schools have worked to improve the quality of applicants and, ultimately, matriculants (Arawi & Rosoff, 2012). To accomplish this, schools have increased their admission standards (Arawi & Rosoff, 2012). Academic standards, such as higher MCAT scores and science GPAs, were shown to correlate with academic success (Arawi & Rosoff, 2012). Medical schools have achieved a nearly 100% graduation rate by raising academic standard expectations (Arawi & Rosoff, 2012). Yet, while graduation rates are nearly 100%, schools are experiencing unprofessional behaviors in students; for example, inappropriate behavior in small groups, and unprofessionalism ratings by faculty and/or administration. Studies found an association between medical students' unprofessional behavior and subsequent disciplinary action taken by a state medical board (Papadakis, Arnold, Blank, Holmboe, & Lipner, 2008; Papadakis, Hodgson, Teherani, & Kohatsu, 2004; Papadakis, Loeser, & Healy, 2001; Papadakis et al., 2005; Reid, 2010; Yates & James, 2010).

The PA profession identified that students meeting higher academic standards, such as, overall GPA, science GPA, and GRE scores, have higher degrees of academic success (Ennulat, Garrubba, & DeLong, 2011; Higgins et al., 2010). By focusing solely on academic achievement standards, the PA profession is ignoring that the practice of medicine is about the head and the heart (Arawi & Rosoff, 2012). Medical and PA schools serve as the gatekeepers of the profession (Arawi & Rosoff, 2012). Therefore, programs have a responsibility to select students who have the personality traits and the intellectual capability to succeed academically. Research on how PA programs identify individuals with not only the intellectual capability but the personality traits expected in a medical provider is explored here.

Moser and Dereczyk (2012) tested the relationship between personality attributes and professionalism in PA students. This study found that a cluster of healthy personality traits were predictive of many attributes of PA professionalism (Moser & Dereczyk, 2012). While the study was based on a self-reported measure of professionalism, this study suggests methods can be included in the admission process to examine personality attributes.

In an effort to understand what noncognitive variables PA programs desire, McDaniel, Thrasher, and Hiatt (2013) completed a national study. Sixty-one percent of programs surveyed (94 of the 154) returned results, identifying that PA programs are influenced by five noncognitive factors: faculty/staff/interviewer interactions, career motivation, and students' knowledge of profession, maturity and professionalism (McDaniel, Thrasher, & Hiatt, 2013). The research described programs' motivation for using noncognitive variables related to academic and career success (McDaniel et al., 2013). Further research into these noncognitive traits and their relationship to PA program success is lacking. As a result, PA researchers identified the need to study noncognitive variables in PA education (Higgins et al., 2010; Jones

et al., 2014; McDaniel et al., 2013) but have not identified a mechanism to examine these noncognitive variables.

The present research utilizes the Big Five personality traits (conscientiousness, agreeableness, neuroticism, openness to experience, extraversion) as a mechanism to examine noncognitive variables. The Big Five personality traits are related to the noncognitive factors identified by McDaniel, Thrasher, & Hiatt (2013), especially interview interactions, motivation, and maturity. Medical education research has found that the Big Five personality traits are related to academic success (Hojat, Erdmann, & Gonnella, 2013) but researchers have not examined the Big Five personality traits in relation to each other by assessing a population of PA students.

Purpose of the Study

The purpose of this study was to examine the relationship between cognitive and noncognitive variables with academic performance of PA students who were taught in a public higher education institution. Greater understanding of these relationships will assist PA education leaders in developing measures to augment the admission and/or advising process, which will ultimately increase the probability of selecting students who can succeed academically and professionally. The results of this study provide insight on how cognitive and noncognitive variables correlate with PA students' academic success.

Rationale of the Study

As a result of the need to understand what variables are important to PA students' academic success, knowledge of the cognitive and noncognitive factors is beneficial to identify what leads to academic success. The findings of this study have the potential to enhance PA programs' ability to examine noncognitive (i.e. personality) variables in the admission and/or

advising process and should lead to a better understanding of how these variables contribute to academic success. Ultimately, the end result should be an increased awareness by PA programs in order to support the PA admission and advising processes.

A lack of literature exists regarding the examination of personality traits in PA students. Searching the Big Five personality variables in PA education yields no published research specifically around the Big Five personality traits. Medical education research suggests that noncognitive variables may be predictive of academic performance (Haight et al., 2012). McDaniel et al., (2013) identified that noncognitive variables are important to PA programs. Despite the importance to PA programs, only a small number of research articles are peripherally related to personality and/or noncognitive variables (Bourne, Arend, Johnson, Daher, & Martin, 2006; Childers, May, & Ball, 2012; Cohen & Ahmed, 1998; Higgins et al., 2010; Jordan & LaBarbera, 2011; Moser & Dereczyk, 2012; O'Brien, Mathieson, Leafman, & Rice-Spearman, 2012; Opacic, 2003; Schmalz, Rahr, & Allen, 1990; Strand, Price, Scott, & Dieter, 2003).

Research Questions

The dependent variables examined in this dissertation include: program preclinical GPA, clinical phase GPA, PACKRAT score, PANCE score, and PANCE pass/fail.

The independent variables in this examination of PA students' academic success are conscientiousness, agreeableness, neuroticism, openness to experience, extraversion, overall preadmission GPA, and pre-admission science GPA.

The following research questions guided this study:

1. What relationships, if any, do personality traits, as measured by the Big Five Inventory, have with academic success in PA school, as indicated by program preclinical GPA, clinical GPA, PACKRAT score, PANCE score, and PANCE pass/fail?

a. The independent variables were categorized and coded as follows: Conscientiousness, Agreeableness, Neuroticism, Openness to experience, and Extraversion.
b. The dependent variables were categorized as follows: Program preclinical GPA, Clinical phase GPA, PACKRAT score, PANCE score, and PANCE pass (1) / fail (2).

2. What relationships, if any, do preadmission overall and science GPA scores have with academic performance, as indicated by program preclinical GPA, clinical GPA, PACKRAT, PANCE score, and PANCE pass/fail?
    a. Question two was answered with correlational (Pearson's), and regression analyses, including linear and logistic regression. The independent variables were categorized and coded as follows: Overall preadmission GPA, and Science GPA.
    b. The dependent variables were categorized as follows: Program preclinical GPA, clinical GPA, PACKRAT score, PANCE score, and PANCE pass (1) / fail (2).
3. What Big Five Inventory characteristics (conscientiousness, agreeableness, neuroticism, openness to experience, extraversion), preadmission overall GPA and science GPA, predict academic success in PA school (preclinical GPA, clinical phase GPA, PACKRAT, PANCE score, and PANCE pass/fail)?
    a. Question three was answered with regression analysis. The independent variables were categorized and coded as follows: Conscientiousness, Agreeableness, Neuroticism, Openness to experience, Extraversion, Overall preadmission GPA and Science GPA.

b. The dependent variables were categorized as follows: Program preclinical GPA, Clinical phase GPA, PACKRAT score, PANCE score, and PANCE pass (1) / fail (2).

Significance of the Study

The importance of the admission process cannot be understated. Each health related school has an obligation to society to serve as gatekeepers to the profession. The role of gatekeeper demands that schools carefully select the most promising students and then assist them in growing their knowledge, skills, and character (Arawi & Rosoff, 2012). Yet, some students who are admitted to health profession schools should not become practitioners (Arawi & Rosoff, 2012); in other words, some students may have the academic credentials, but lack the professional characteristics important to medical providers.

Definition of Terms

The following terms will be referred to in this study and are defined as follows:

- Academic success: for the purposes of this study academic success is defined by high performance as measured by PA program preclinical GPA, clinical GPA, PACKRAT score, PANCE score, and PANCE pass/fail.
- Overall preadmission GPA: for the purposes of this study overall preadmission GPA is defined by cumulative GPA scores across all universities and courses, and may include any courses from college freshman year to doctoral-level work (CASPA, n.d.).
- Science GPA: CASPA defines science GPA as those courses taken by students in the following course subject areas: Biology/Zoology, Inorganic Chemistry, Biochemistry, Organic Chemistry, Physics, and Other Science (CASPA, n.d.).

- Preclinical: for the purposes of this study the term "preclinical" is defined by all courses taken in the first year of the PA program, i.e., courses prior to clinical courses/rotations.
- Clinical: for the purposes of this study the term "clinical" is defined by those courses/rotations that involve the direct care of patients under medical supervision, i.e., Family Medicine, Pediatrics, Internal Medicine, Obstetrics and Gynecology, Surgery, Behavioral Health, Emergency Medicine and Electives, such as Cardiology, Orthopedics, etc.
- Cognitive variables: for the purposes of this study cognitive variables are defined by those academically related variables related to knowledge, such as, overall preadmission GPA and science GPA.
- Noncognitive variables: for the purposes of this study noncognitive variables refer to the Big Five personality traits: conscientiousness, agreeableness, neuroticism, openness to experience, and extraversion.
- Big Five Inventory (BFI): for the purposes of this study the BFI refers to the Big Five Inventory developed by John and Srivastava (1999). Please note, participants scores on the BFI were adjusted for social desirability using the 10 item Marlowe Crown Social Desirability Scale (M-C (1) 10).

Assumptions

The following are the assumptions identified by the researcher:

- Participants did not feel coerced to take part in this study. They understood that their participation would not influence admission decisions, and they understood that they were free to withdraw from the study at any time.

- Participants' knowledge of the study's purpose will increase their desire to complete the survey instrument.
- The results of this study will provide PA educators with relationships between PA students' academic success, and cognitive and noncognitive traits, which will assist in improving the admission and/or advising processes already in place.
- The survey instrument, which is designed based on the Big Five Inventory and the Marlowe Crown Social Desirability Scale (M-C (1) 10), are psychometrically sound assessment tools for identifying personality traits and social desirability.

Limitations

Although this study has the potential to uncover valuable information about the relationship between cognitive and noncognitive variables to PA student academic success, the researcher identified the following potential limitations of this study:

- This study was conducted at one small, public university in a specified geographic location. Results from this study may be particular to the region in which the study occurred.
- This study included only those students selected for admission to the PA program not all interviewees, or all applicants. Therefore, the study was challenged by this range restriction.
- The survey was a self-reported personality instrument where only quantitative data was generated.
- With the exception of the two classes enrolled at the inception of the study, the instrument was completed during the formal process of being admitted to the program. By asking applicants to complete the survey at the time of admissions they may have

been tempted to respond in a socially desirable manner. Therefore, the researcher incorporated a social desirability scale (M-C (1) 10) into the survey instrument to minimize any social desirability influence.

Nature of the Study

Current PA research focuses primarily on cognitive variables and students' academic success, but little is known about noncognitive variables and PA students' academic success. This study was quantitative in design and examined relationships between cognitive (overall preadmission GPA and science GPA) and noncognitive variables (Big Five personality traits) to PA student academic success endpoints (preclinical GPA, clinical GPA, PACKRAT score, PANCE score, and PANCE pass/fail).

Organization of the Study

The remainder of the study was organized into five chapters, references, and appendices in the following manner:

Chapter two presents a review of the related literature (primarily in medical and PA education) on cognitive and noncognitive factors, and academic success.

Chapter three outlines the research design and methodology of the study. The Big Five personality and Social Desirability instruments, the procedures, and sample are described.

Chapter four contains the findings of the study and chapter five provides a summary, conclusion, and recommendations for the study.

Chapter Two: Literature Review

Introduction

Experts have said that prior success predicts future success (Jones et al., 2014) but it is important to understand how students' noncognitive (personality) traits affect academic success. Throughout the medical and PA literature, a wealth of research has examined cognitive variables and student academic achievement (Haight et al., 2012; Higgins et al., 2010; Salvatori, 2001). Cognitive variables include items such as cumulative preadmission GPA, science GPA, and standardized test scores on exams such as the MCAT and GRE. Cognitive variables are extensively used in the admission process for medical and PA school (Haight et al., 2012; Jones et al., 2014) and studies have shown that these variables predict future cognitive performance, that is, success on academic tests (Haight, 2012). Nevertheless, while cognitive variables are good predictors of academic success they are not by themselves perfect measures of future academic success (Koenig, Sireci, & Wiley, 1998). In other words, by itself, high academic achievement does not guarantee a competent and ethical student or future health care provider (Bore et al., 2009).

Interest has grown in examining noncognitive variable relationships with academic success. In 2001, the President/CEO of the American Association of Medical Colleges (AAMC) discouraged the use of overall preadmission GPA and MCAT scores as the primary measures used to select medical students and instead encouraged schools to screen applicants' personal characteristics before utilizing cognitive variables (Albanese, Snow, Skochelak, Huggett, & Farrell, 2003). While this study agrees with the principle, the question remains on how to reliably evaluate the noncognitive variable (i.e., individual personal characteristics) in potential PA student admissions. To date, the majority of medical, physical therapy, and PA schools use

the personal interview as the primary means to evaluate these qualities in addition to personal essays and letters of recommendation (Edwards, Johnson, & Molidor, 1990; Jones et al., 2014; Puryear & Lewis, 1981). Through these avenues, medical and PA schools have begun to examine personality as a potential measure of these important noncognitive qualities (Haight et al., 2012; McDaniel et al., 2013; Moser & Dereczyk, 2012).

The following literature review will summarize the research in medical and PA education related to cognitive and noncognitive qualities and student academic success. While a wealth of research on cognitive variables in medical and PA education can be found, noncognitive values are, in general, under-researched. Medical education, has examined a variety of noncognitive variables (Haight et al., 2012; Lievens et al., 2002; Lievens, Ones, & Dilchert, 2009; Shen & Comrey, 1997) and while PA education has examined some noncognitive variables such as the personal interview, and the personal essay (Forister, Jones, & Mei, 2011), overall personality variable research is lacking. Therefore, the literature review summarizes the medical and PA literature, with the caveat that personality variables are primarily grounded in medical education research. The proceeding section begins with a discussion on admissions in PA and medical schools and is followed by a review of the literature on cognitive and noncognitive variables.

Admissions

Admission procedures are important within medical schools and PA programs around the world for two reasons: more applications are submitted to a school than there are available positions, and, societal and professional expectations demand only those students who will become competent and ethical medical providers be selected (Bore et al., 2009). For all practical purposes, admission committee members tend to select students in one of two ways. There are those that put higher weight on cognitive data, relying on research that has found a significant

relationship between cognitive measures and licensing exam success (Kulatunga-Moruzi, & Norman, 2002). Other admission committee members use cognitive data, such as the GPA and MCAT, as threshold measures that can be complemented by personal characteristics (Kreiter, 2007).

Across the U.S., PA programs generally utilize the following variables to determine admissions: overall GPA, science GPA, healthcare experience, personal statements, recommendation letters, personal interview scores, and standardized test performance, such as the GRE scores (Brown, Imel, Nelson, Hale, & Jansen, 2013). Standardized admission selection criteria have not been established across PA programs (Brown et al., 2013), which is further complicated by a lack of pre-requisite consistency across PA programs (Dehn, 2007; Jones & Miller, 2002). Brown (2013) has suggested that this inconsistency is due to varying program missions. In addition to diverse mission statements, the limited research in identifying selection criteria for PA students that will correlate with student success increases the complication in admissions (Brown et al., 2013; Jones et al., 2014).

Medical school prerequisites, in comparison, are more standardized across the profession yet admission requirements continue to vary from school to school (AAMC, n.d.). Most medical schools require a year of Biology, Physics, English, Inorganic Chemistry, and Organic Chemistry as well as the MCAT exam (AAMC, n.d.). Yet, admission decisions are based on a number of criteria determined by the individual school, and the mission and goals of the institution often drive the formulation of selection criteria (Edwards et al., 1990). Medical schools attempt to select students who exhibit the intellectual and personal qualities desired in physicians, as well as the characteristics needed to persist in, and ultimately complete, the rigid curriculum (Edwards et al., 1990). While medical schools attempt to select the students with these characteristics,

verification of character is relatively nebulous (Arawi & Rosoff, 2012). The personal interview is a tool designed to identify positive and negative personal characteristics, although many unfavorable traits associated with interpersonal problems are difficult to detect in an interview setting (Knights & Kennedy, 2006), and the ability of an interview to reliably assess noncognitive attributes has been questioned (Albanese et al., 2003; Eva, Reiter, Rosenfeld, & Norman, 2004; Eva & Reiter, 2004). As a result, medical schools admissions primarily focus on the applicant's cognitive variables such as the MCAT and overall preadmission GPA (Arawi & Rosoff, 2012; Haight et al., 2012).

Cognitive Variables in Admissions

As the best predictor of future behavior is past behavior, past academic performance is correlated significantly with future academic performance (Kuncel, Hezlett, & Ones, 2001; McManus et al., 2005). For example, cognitive variables, such as MCAT and overall preadmission GPA, seem to predict preclinical success, which is largely driven by academic tests, and yet cognitive variables do not appear to predict clinical success (Haight et al., 2012; Jones et al., 2014; Opacic, 2003; Reede, 1999). The most widely used cognitive variables in the medical and PA admission processes include: cumulative GPA, science GPA, MCAT, and GRE scores (Brown et al., 2013; Jones et al., 2014; Luce, 2011; Kulatunga, et al., 2002). The admission process focuses heavily on cognitive variables (Kulatunga Moruzi & Norman, 2002) on account of prior research identifying a significant relationship between these variables and academic success in medical and PA school (Ferguson, James, & Madeley, 2002; Ferguson et al., 2003; Ferguson, Sanders, O'Hehir, & James, 2000; Haight et al., 2012; Jones et al., 2014; Julian, 2005; Koenig et al., 1998; Kulatunga Moruzi & Norman, 2002; McManus et al., 2005; McManus, Smithers, Partridge, Keeling, & Fleming, 2003; Tyssen et al., 2007). The PA

profession has identified that students meeting higher academic standards such as overall GPA, science GPA, and GRE have higher degrees of academic success (Ennulat, Garrubba, & DeLong, 2011; Higgins et al., 2010; Jones et al., 2014).

Like PA programs, the medical school admission process focuses heavily on cognitive variables, such as cumulative GPA, science GPA, and MCAT scores (Kulatunga Moruzi & Norman, 2002). Prior research has identified a robust relationship between these variables and success in medical school (Ferguson et al., 2003; Haight et al., 2012; Julian, 2005; Koenig et al., 1998; Kulatunga Moruzi & Norman, 2002; McManus et al., 2005; McManus et al., 2003; Tyssen et al., 2007). Researchers found a correlation of MCAT scores, overall GPA, and science GPA to higher graduation rates (Cariaga-Lo et al., 1997). As a tool in determining admissions, the MCAT has allowed for screening out poor academic performers and has resulted in a nearly one-hundred percent graduation rate (Arawi & Rosoff, 2012). Despite these high degree completion rates, stories of practice incompetence and unprofessionalism persist, suggesting a disconnect between graduation rates as a factor determining the success of PA students and actual clinical practice by graduates (Arawi & Rosoff, 2012). This suggests that while these variables are good predictors of success, they are not perfect (Koenig et al., 1998), nor have they been shown to consistently correlate with positive clinical assessments or residency performance (Callahan et al., 2010; Donnon et al., 2007; Shen & Comrey, 1997; Silver & Hodgson, 1997).

Medical College Admission Test

Callaghan, Hojat, Veloski, Endmann, and Gonnella (2010) examined the predictive validity of three MCAT versions to medical school, residency, and licensing exam performance. To be more specific, this longitudinal study examined 7,859 matriculants across 36 classes between 1970 and 2005. To examine academic performance, Callaghan et al., (2010) tested the

predictive validity of the MCAT to academic performance, in this case, the combined GPA across years one and two. In the three MCAT versions, validity coefficients ranged from 0.36 ($p < .01$) to 0.30 ($p < .01$). All three versions of the MCAT were moderately correlated with medical school performance.

To examine the clinical rotation phase, Callaghan, Hojat, Veloski, Endmann, and Gonnella (2010) tested the predictive validity of each of the three MCAT versions against six core rotation written examinations. Between the three MCAT versions, the validity coefficients for the third year, that is, written rotation examinations, ranged from 0.23 ($p < .01$) to 0.31 ($p < .01$). To examine the relationship between MCAT and clinical performance, the Residency Director, or faculty member most familiar with the resident's performance, completed a psychometrically vetted instrument. For clinical performance, the validity coefficients ranged from 0.09 ($p < .01$) to 0.00. Therefore, the validity coefficients were either practically negligible or non-significant (Callahan, Hojat, Veloski, Erdmann, & Gonnella, 2010).

Donnon, Paolucci, and Violato (2007) conducted a meta-analysis of the research to determine the predictive validity of the MCAT for medical school academic performance and on licensing examinations. Eight studies specific to basic science/preclinical performance, with a cumulative sample size of 7,419, were examined. The predictive validity coefficients for these eight studies ranged from 0.21 to 0.54. Donnon et al., (2007) identified a validity coefficient of 0.43. In all, four studies specific to the rotation/clinical years with a cumulative sample size of 6,215 were examined. The predictive validity coefficients of these four studies ranged from 0.29 to 0.39 and had a calculated validity coefficient of 0.39. The Donnon et al., (2007) study demonstrates the MCAT total score has a medium predictive validity coefficient for basic science/preclinical and rotation/clinical performance (Donnon, Paolucci, & Violato, 2007). How

the rotation/clinical performance was measured across the studies is unknown. As a result, it is unclear if the rotation/clinical phase was measured by performance on written exams, preceptor evaluations, assignments, or a combination of each. If the rotation/clinical performance was measured by written examinations, that is to say, the third year, the findings would be consistent with the study performed by Callaghan et al. (2010). As cognitive variables appear to do a good job of predicting how students will perform on exams, they are used as performance variables; yet, these variables do not reliable predict how students will perform in the clinical setting. Indeed, performance in the clinical setting requires a different skill set that is more dependent on personality, that is, noncognitive variables (Haight et al., 2012; Jones et al., 2014; Lee, Vaishnavi, Lau, Andriole, & Jeffe, 2007; Reede, 1999).

Graduate Record Examination

Using the GRE in the admissions process is based on research, which suggests that graduate school success is correlated with GRE performance (Hocking & Piepenbrock, 2010). The GRE research has used cognitive measures such as overall graduate school GPA, end of graduate school year one GPA, and faculty evaluations, as academic success endpoints. Kuncel, Hezlett and Ones (2001) conducted a large meta-analysis on the predictive validity of the GRE for graduate school students in multiple disciplines. Their meta-analysis included 82,659 graduate students from 1,753 independent samples across multiple disciplines. Results showed that the GRE and preadmission GPAs were good predictors of graduate school performance in multiple disciplines (Kuncel et al., 2001). Preadmission GPA and GRE scores correlated positively with GPA at graduation, first year graduate GPA, comprehensive exam scores, successful degree completion, and others (Kuncel et al., 2001). The results indicate that the GRE is a valid measure across disciplines (Kuncel et al., 2001). It is important to note that while

graduate health programs were inlcuded in the meta-analysis, the PA profession was not included in the study.

Physician Assistant literature provides some evidence to corroborate the meta-analysis findings. As previously noted, Higgins (2010) found the GRE (Verbal and Quantitative portions) to correlate with PANCE performance. Additionally, both Parkhurst (2003) and McDaniel et al., (2009) conducted studies that demonstrated the usefulness of the GRE in predicting PANCE performance. Parkhurst (2003) found the combination of preadmission GPAs and GRE scores predictive of PANCE success while McDaniel (2009) found a weak but positive correlation existed among the total GRE and GRE Quantitative score with overall PANCE scores. A significant portion of research on the GRE as a predictive method has shown that the combination of GRE scores and GPA scores predict graduate school success better than the GRE alone (Hocking & Piepenbrock, 2010).

A retrospective study conducted by Luce (2011) analyzed three PA classes examining admission variables (overall preadmission GPA, science GPA, and GRE scores) with the purpose of developing a screening tool that could identify applicants with the highest risk of poor academic performance. Students were placed into one of five quintiles based on admission variables, where a score of 25 was highest performance and five was lowest performance (Luce, 2011). Of the 228 students, 13 had academic difficulties throughout their PA education, and 12 of these had a total quintile score of less than 12 (Luce, 2011). Based on these findings, Luce (2011) concluded that applicant GPA and GRE scores can, at the time of application, be used to determine a threshold which may help identify those applicants at highest risk of poor performance. Yet, various studies found the strength of the correlation and the evidence is less clear on how the GRE predicts areas such as in-field (rotation/internship) performance and board

exam scores (Hocking & Piepenbrock, 2010). The data on the predictive ability of the GRE in health profession programs are mixed (Hocking & Piepenbrock, 2010). The research in PA education does appear to corroborate the meta-analysis of multiple graduate program findings (Kuncel et al., 2001).

Grade Point Average

Overall GPAs were shown to be the most reliable indicator of academic success in the health professions (Salvatori, 2001). Nevertheless, a study by Brown (2013) examined three cohorts of PA students at a single institution and found no correlation between PANCE performance and overall GPAs, science prerequisite GPAs, or health care experience prior to application. In contrast, Higgins, et al., (2010) conducted a study across six U.S. PA programs examining cognitive and noncognitive variables as PANCE predictors. The cognitive variables included undergraduate GPA, graduate GPA, prerequisite grades, GRE-verbal, GRE-quantitative, GRE-combined, and first-year scores on the PACKRAT. The noncognitive variables included interview scores, years of health care experience, age, and gender. Results showed that the noncognitive variables were not significant predictors across programs but in certain institutions did hold significance. Higgins, et al., (2010) identified four significant cognitive predictors of PANCE performance: GPA, GRE (both Verbal and Quantitative), and score obtained on the PACKRAT. Each of the four predictors contributed to a combined regression equation, yet the predictability of the equation was significantly different across schools. In applying the equation, Higgins et al., (2010) found that four of the six schools did notably better on the PANCE than predicted by the equation, while two did worse. When regression was applied to each individual school, the GRE was the only significant predictor of

PANCE success for two of the six programs, while GPA was significant for four of the six programs (Higgins et al., 2010).

A retrospective study including 155 PA students at D'Youville College examined the association between undergraduate course performance (Chemistry I, Pathophysiology, and Biochemistry) and admission GPA to PANCE scores (Andreeff, 2014). Results showed that Pathophysiology grades, Biochemistry grades, and admission GPA had significant positive regression coefficients. This study demonstrated that higher admission GPA and undergraduate course performance predicted higher first-attempt PANCE scores (Andreeff, 2014).

Physician Assistant Clinical Knowledge Rating and Assessment Tool

The PACKRAT is a tool used by students to self-evaluate their strengths and weaknesses while enrolled in a PA program. The PACKRAT is typically given either towards the end of the preclinical phase, clinical phase, or both (Higgins et al., 2010). The interaction between PACKRAT scores and performance on the PANCE has been widely found to correlate positively with PANCE success (Blankenship & Boissonneault, 2006; Cody, Adamson, Parker, & Brakhage, 2004; Ennulat et al., 2011; Higgins et al., 2010; Roscoe & Frosch, 2010). While the results of these studies support the use of the PACKRAT, the timing of the administration of the PACKRAT does not assist programs in selecting students at the time of application.

Noncognitive Variables in Admissions

To date, the majority of correlations identified in PA education have been cognitive variables. A few studies in medical and/or PA literature have examined noncognitive variables. In the subsequent sections, the following noncognitive variables will be discussed: prior healthcare experience, admission interviews, personal statements, and the Big Five personality variables.

Healthcare Experience

Prior healthcare experience was not found to correlate with success (Brown et al., 2013; Higgins et al., 2010). Brown et al., (2013) conducted a retrospective study of 119 PA students at a single program to identify relationships among overall preadmission GPA, preadmission science GPA, program anatomy grades, pharmacology grades, and prior healthcare experience to student academic success (PANCE score, PANCE pass/fail, and program didactic GPA). Results demonstrated no relationship among overall preadmission GPA, science GPA, or prior healthcare experience to student success (PANCE score, PANCE pass/fail, program didactic GPA). Nevertheless, the researchers found a strong relationship existed among program didactic GPA ($r=0.67$) and pharmacology grades ($r=0.68$) with PANCE scores. A moderate association between program anatomy grade ($r=0.41$) and PANCE scores was also identified (Brown et al., 2013).

Higgins, et al., (2010) conducted a retrospective study across six programs to create a model of cognitive and noncognitive variables that could estimate levels of PANCE performance. The noncognitive variables examined included: interview scores, years of healthcare experience, age, and gender. When examining all six programs, the results found that healthcare experience was not a significant predictor of PANCE performance (Higgins et al., 2010). Nevertheless, when examining healthcare experience at individual programs, it was a significant predictor of PANCE scores for two of the six programs studied.

An unpublished study by Roscoe and Frosh (2010) analyzed an individual program, examining cognitive and noncognitive variables. As it relates to noncognitive variables, the results found healthcare experience to be a negative predictor of PANCE score, meaning the higher the healthcare experience hours the lower the PANCE score (Roscoe & Frosch, 2010).

Keene, Petrusa, Carter, and Schmidt (2000) conducted a study that examined their current applicant screening process (with objective and subjective variable ratings) to determine the impact that subjective variables had on candidates who were invited to a pre-admissions interview. Subjective variables in the screening process were noncognitive traits: healthcare experience, motivation/maturity, academic potential, and written expression [as evaluated by the personal essays]. Results showed that of the 111 students interviewed 36 (32%) applicants would not have been invited to an interview had subjective variables not been included in the applicant screening process. Seventeen of these 36 applicants (46%) were ultimately admitted to the program (Keene, Petrusa, Carter, & Schmidt, 2000). Consequently, the results of this study support the use of subjective variables, namely noncognitive variables, in the application/admission processes (Keene et al., 2000). Faculty members' judgment of the applicant's healthcare experience, motivation/maturity, academic potential, and written expression significantly influenced the interview selection process (Keene et al., 2000); the more academic potential, motivation/maturity, healthcare experience, and ability to express oneself in the written form, the greater the odds of being accepted. The study did not inform programs of the academic success of the students who were selected based on noncognitive variables. Nevertheless, if subjective (noncognitive) variables were not included in the admission process a number of applicants would have been otherwise precluded from the opportunity to interview and be accepted to a PA program.

Opacic (2003) studied 290 clinical phase students across 14 PA programs in Pennsylvania to examine the relationship between clinical performance and student self-efficacy, beliefs, achievement expectations, and personal outcome values. The study was conducted to investigate whether cognitive variables (preclinical year GPA) and noncognitive variables

(through survey instruments and health care experience) could predict clinical performance. Results showed that beliefs, achievement expectations, personal outcomes, and preclinical year GPA were not significant predictors of clinical performance. Neither did any correlation between student clinical performance exist in relation to previous preclinical GPA or healthcare experience. A significant correlation was present between student self-efficacy and clinical performance (r=0.16) (Opacic, 2003). The results of this study suggest that clinical performance is measured, at least in part, by noncognitive skills such as self-efficacy. Given the strength of the correlation and the fact that 95% of the variance was not explained, the researcher was cautious in her recommendation (Opacic, 2003).

Interview

Historically, the interview has been utilized to capture personal characteristics (Albanese et al., 2003). The interview serves four main purposes: information gathering, verification, recruitment, and decision making about applicants (Edwards et al., 1990). Through a survey delivered to medical schools, Puryear and Lewis (1981) identified that of all the data collected through the admission process, the majority of medical school admission committee members valued the information collected from the interview above all other data. Edwards et al., (1990) argued that the most important purpose of the interview is to collect noncognitive information about applicants that would be exceedingly difficult to obtain by other means. Clearly, information collected from the admission interview can have a significant impact on admission decisions (Albanese et al., 2003).

The personal interview is a tool designed to identify positive and negative personal characteristics, although many unfavorable traits associated with interpersonal problems are difficult to detect in an interview setting (Knights & Kennedy, 2006), and the ability of an

interview to reliably assess noncognitive attributes has been questioned (Albanese et al., 2003; Eva, Reiter, Rosenfeld, & Norman, 2004; Eva & Reiter, 2004). The evidence that traditional measures such as the personal interview can accurately identify those applicants with noncognitive strengths is at best equivocal (Dawes, Faust, & Meehl, 1989; Eva et al., 2004; Shulruf, Poole, Wang, Rudland, & Wilkinson, 2012). This should not come as a surprise given actuarial methods, such as psychological measures, are superior to human judgment in predicting outcomes of interest (Eva & Reiter, 2004). In support of this, Dawes (1989) pointed to nearly 100 comparative studies that have demonstrated actuarial methods are equal to or superior to human judgment.

Big Five Personality Variables

The primary interest of this study was the correlation between the Big Five personality variables and PA students' academic success. In medical education, personality has been defined as a set of characteristics and behavioral tendencies that make up an individual's personal features (Hojat, Erdmann, & Gonnella, 2013). These unique characteristics and behavioral tendencies are based on a number of interacting factors such as individual predisposition, childhood upbringing, social and cultural lived experiences, life events, and education (Hojat et al., 2013). The Big Five personality variables include: conscientiousness, agreeableness, neuroticism, openness to experience, and extraversion. These traits are easily misunderstood; therefore, definitions of the Big Five personality variables are provided in the following sections.

Conscientiousness

Conscientiousness describes task and goal orientation behavior. More specifically, conscientiousness refers to the following: deferred gratification, thinking before acting, plan

making, and task prioritization (John & Srivastava, 1999). Other descriptive trait adjectives include: organized, efficient, thorough, deliberate, self-disciplined, persistent, dependable, and careful (John & Srivastava, 1999; Lievens et al., 2002; Lievens et al., 2009). An individual with lower levels of conscientiousness indicates someone who is disorganized, unreliable, distractible, careless, and apathetic towards goals (Chibnall, Blaskiewicz, & Detrick, 2009). In contrast, an individual with higher conscientiousness indicates someone who is more capable, organized, efficient, self-disciplined, circumspect, adherent to principles, and a high achiever (Chibnall et al., 2009; Lievens et al., 2009). Conscientiousness is considered a motivational trait. Indeed, those who are high in conscientiousness strive to excel, yet they do not give up when faced with adversity (Lievens et al., 2009).

A dearth of PA literature exists on conscientiousness and PA student success. Nevertheless, based on the following medical literature, medical students with higher levels of conscientiousness achieve higher levels of academic success than students with lower levels of conscientiousness (Doherty & Nugent, 2011; Ferguson et al., 2003; Grehan, Flanagan, & Malgady, 2011; Haight et al., 2012; Hojat et al., 2013; Lievens et al., 2002; Lievens et al., 2009; McAbee & Oswald, 2013; Moser & Dereczyk, 2012; Tyssen et al., 2007). Based on the evidence, conscientiousness is recognized as a crucial predictor of occupational performance in medicine and the link between conscientiousness scores and performance measures in preclinical and clinical phases of medical education is empirically supported (Doherty & Nugent, 2011; Hojat et al., 2013). In fact, of the Big Five personality variables, conscientiousness has been found most consistently to predict preclinical and clinical academic success in medical education. Conscientiousness is conceptually more applicable to the performance of clinically active physicians and medical students (Hojat et al., 2013).

Agreeableness

Agreeableness describes the propensity to help others and behave in a pro-social way (Lievens et al., 2009). As such, agreeableness describes an orientation towards others and includes such traits as altruism, modesty, and tenderheartedness (John & Srivastava, 1999). John and Srivastava (1999) described this trait with words such as forgiving, undemanding, warm, modest, and sympathetic. An individual lower in agreeableness indicates someone who is more skeptical, cynical, competitive, uncooperative, unfriendly, selfish, detached, and egocentric (Chibnall et al., 2009; Lievens et al., 2009). Conversely, an individual with higher levels of agreeableness indicates someone who is more trusting of others, displays humility, is empathic, nurturing, affectionate, sensitive, straightforward, and cooperative (Chibnall et al., 2009; Lievens et al., 2002; Lievens et al., 2009).

A lack of PA literature on agreeableness and PA student success has been published. Magalhaes, Costa, and Costa (2012) have demonstrated that medical students with higher levels of agreeableness have higher levels of empathy, an important trait in the patient-provider relationship. In addition, physician empathy is positively associated with clinical outcomes (Magalhães, Costa, & Costa, 2012). Therefore, researchers have suggested that medical students higher in agreeableness would outperform students lower in agreeableness during the clinical phase (Hojat et al., 2013).

Neuroticism

Neuroticism describes an individual's predilection towards becoming emotionally upset (Lievens et al., 2009). Neuroticism therefore refers to negative emotionality and includes such traits as anxiety, nervousness, tension, and sadness (John & Srivastava, 1999). Other researchers have described this trait with words such as irritable, worrier, angry, discontented, moody, and

impulsive (John & Srivastava, 1999; Lievens et al., 2002; Lievens et al., 2009). An individual lower in neuroticism indicates someone who has more emotional control while under stress and is less impulsive (Chibnall et al., 2009). In comparison, an individual higher in neuroticism indicates someone who is vulnerable under stress, impulsive, self-conscious, and exhibits low self-esteem (Chibnall et al., 2009; Lievens et al., 2009). Individuals high in neuroticism tend to give up easily, have problems approaching difficult tasks, and employ poor coping strategies to deal with stressful situations (Lievens et al., 2009).

The PA literature is lacking in regard to neuroticism and PA student success. Nevertheless, in an educational setting, one would expect neuroticism to be negatively related to academic success and positively related to student attrition (Lievens et al., 2009). Students with higher levels of neuroticism are susceptible to anxiety (McManus et al., 2004; Tyssen et al., 2007), are more likely to perform poorly on academic tests, and are vulnerable to test anxiety (Hojat et al., 2013). Therefore, students with high levels of neuroticism will likely achieve lower levels of academic success than students with lower levels of neuroticism. In a study of college students at the University of Seville, researchers identified that students failing in their coursework scored higher in neuroses than the non-failing students (Sánchez, Rejano, & Rodríguez, 2001).

Openness to Experience

Openness, or open-mindedness, describes an individual's complex intellectual and observed life experiences, their originality, complexity, depth, and breadth (John & Srivastava, 1999). Other researchers have described this trait with words such as curious, imaginative, artistic, unconventional, excitable, broad minded, and original (John & Srivastava, 1999; Lievens et al., 2002; Lievens et al., 2009). An individual who is lower in openness indicates someone

with a blunted affect, that is conventional and accepting of authority, yet has a narrower task orientation (Chibnall et al., 2009). In contrast, an individual who is higher in openness includes someone that has a preference for variety, pays attention to inner emotions, has intellectual curiosity, is imaginative, and has aesthetic sensitivity (Chibnall et al., 2009; Lievens et al., 2009).

A paucity in PA literature is evident on openness to experience as openness relates to PA student success. Nevertheless, based on the following medical literature, students with higher levels of openness to experience will achieve higher levels of academic success than students with lower levels of openness to experience, especially in the clinical phase (Lievens et al., 2002; Lievens et al., 2009). Openness to experience is positively associated with empathy, which is crucial to the patient-provider relationship (Magalhães et al., 2012). Interestingly, physician assistant research has shown that empathy actually declines during PA training (Mandel & Schweinle, 2012). The primary focus of this research is on the relationship, if any, with noncognitive and cognitive traits and PA student academic success.

Extraversion

Extraversion is best defined as an individual's capacity for joy and the propensity toward interpersonal stimulation (Lievens et al., 2009). Extraversion can be described as an energetic approach to the world and includes such traits as confidence, assertiveness, and sociability (John & Srivastava, 1999). Other researchers have described this trait with words such as gregarious, energetic, talkative, persuasive, positive, enthusiastic, warm, and outgoing (John & Srivastava, 1999; Lievens et al., 2002; Lievens et al., 2009). Extraverts are often more distractible, impulsive, and sociable (Lievens et al., 2009). An individual with low extraversion includes a more reserved, socially introverted, formal individual with emotional composure (Chibnall et al., 2009). Conversely, an individual with higher extraversion indicates a friendly, socially assertive,

positive individual with a tendency toward group affiliation as well as excitement seeking (Chibnall et al., 2009). Although extraverts tend to receive lower grades than introverts, evidence exists showing that extraverts do better in environments requiring interpersonal interaction such as seminar classes (Lievens et al., 2009).

While a lack of PA literature on extraversion to PA student academic success exists, the medical literature demonstrates that students with higher levels of extraversion will achieve higher levels of academic success in clinical performance (Davis & Banken, 2005), than students with lower levels of extraversion. Specifically, extraversion appears to more consistently predict clinical performance (Davis & Banken, 2005; Ferguson et al., 2003; Haight et al., 2012; Hojat, Callahan, & Gonnella, 2004; Knights & Kennedy, 2007; McManus et al., 2004; Tyssen et al., 2007).

Personality Variables and Academic Success

Personality is an important noncognitive variable that plays a significant role in academic and professional performance (Hojat et al., 2013). As stated previously, the most common mechanism to measure noncognitive variables is through the admissions interview, letters of recommendation, and personal statements and essays. Yet, the results of these mechanisms are at best equivocal due to the fact that reliability and validity evidence is inadequate (Dawes et al., 1989; Eva et al., 2004; Hojat et al., 2013; Shulruf et al., 2012).

In PA education, Opacic (2003) studied 290 students across all PA programs in Pennsylvania to examine the relationship between PA student clinical performance and student self-efficacy, beliefs, achievement expectations, and personal outcome values. The study was conducted to investigate whether cognitive variables (preclinical year GPA) and noncognitive variables (assessed through survey instruments and health care experience) could predict clinical

performance. Results showed self-efficacy (personality) was a significant predictor of student clinical performance. Based on the findings, Opacic (2003) suggested that clinical performance is associated more with noncognitive variables than with cognitive variables. Self-efficacy measures have the potential to predict clinical performance and may have implications in the selection and instruction of PA students (Opacic, 2003).

A study examined personality attributes and professionalism of PA students (Moser & Dereczyk, 2012). Eighty-two students from one private midwest university participated in the study. Personality traits were measured through the Million College Counseling Inventory (MCCI), while professionalism was measured through a developed scale based on the American Board of Internal Medicine (ABIM) conceptual professionalism parameters. The MCCI measures 11 personality variables: introverted, inhibited, dejected, needy, sociable, confident, unruly, conscientious, oppositional, denigrated, and borderline. The professionalism scale measures the following items: taking responsibility for one's actions, giving time in service of others, importance of lifelong learning, belief in equal treatment for all patients, honesty and trustworthiness, open-mindedness, professional dress, punctuality, maintaining confidentiality, participating in class discussions, ability to give and receive criticism, and seeking out new challenges. The professionalism scale is a Likert-type instrument completed by the student. Cluster analysis was conducted on the MCCI results where three natural clusters were identified: healthy personality clusters, unhealthy personality clusters, and radical, unruly, oppositional clusters. Each of the clusters was then examined for a relationship with each of the fifteen professionalism traits. Results from this study showed the healthy personality group significantly and positively predicted taking full responsibility for self, volunteering for others, professional dress, punctuality, class participation, ability to give and receive criticism, and the

desire to seek out new challenges. The unhealthy cluster was significantly and negatively associated with taking full responsibility, volunteerism, trustworthiness, professional dress, punctuality, giving and receiving criticism, and taking on new challenges. The radical, unruly, oppositional group was significantly and negatively associated with taking full responsibility. In summary, Moser and Dereczyk (2012) found personality traits predicted levels of self-reported professionalism.

McDaniel, Thrasher, and Hiatt (2013) completed a program-wide survey in an effort to understand the noncognitive variables that PA programs desire. This study identified that programs are most influenced by five noncognitive factors: faculty/staff/interviewer interactions, career motivation, knowledge of profession, maturity, and professionalism (McDaniel et al., 2013). Physician Assistant programs are motivated to use noncognitive variables in admissions processes; McDaniel et al's., (2013) research revealed that the most common motivators for including noncognitive variables are academic and career success. In summary, McDaniel, et al. (2013) identified variables important to programs and the motivation for identifying these traits. The research into these noncognitive traits and their relationship to PA program success is lacking. As a result, PA researchers have identified the need to study noncognitive variables in PA education (Higgins et al., 2010; McDaniel et al., 2013).

Personality Variables and Medical Education

A number of personality instruments have been used across medical education, compounding the difficulty in identifying specific personality attributes that favorably predict performance (Hojat et al., 2013). For example, some studies have used instruments that measure the Big Five factors of personality while others have used the 16 Personality Factors Instrument, the California Personality Inventory, or the Myers-Briggs Type Indicator. Each of these

instruments uses variations in terms, which make it challenging to compare across instruments. The following section will review studies conducted using various personality instruments and their findings.

Big Five Factors of Personality

Lievens, Coetsier, De Fruyt, and De Maeseneer (2002) examined medical student personality traits as compared to other college majors to determine if personality traits predicted preclinical performance. Medical students across five Flemish Universities completed the NEO-PI-R, five-factor model of personality, and were followed from admission to completion of the three preclinical years (Lievens et al., 2002). At the same time, students across seven majors (engineering, philosophy, languages and history, law, sciences, economics, psychology and pedagogical sciences, political and social sciences) at one university completed the NEO-PI-R, and results showed that there are differences in personalities across academic majors (Lievens et al., 2002). Compared to other majors, medical students scored highest in extraversion and agreeableness but students from other majors shared similar high scores. Outside of scoring highest in extraversion and agreeableness, medical students did not have unique personality traits that distinguished them from students in other academic majors. Extraversion and agreeableness are two factors that also define interpersonal skills. Therefore, identifying students with higher scores in extraversion and agreeableness may be beneficial for medical providers' communication and collaboration skills in practice (Lievens et al., 2002).

The personality variable conscientiousness significantly predicted final scores, which were calculated by a series of exams across a number of courses in each preclinical year. Indeed, conscientiousness was a strong and continuous predictor where those higher in conscientiousness are more likely to succeed academically than those lower in conscientiousness (Lievens et al.,

2002). Extraversion was a significant variable in year one of medical school, yet it was a negative predictor, meaning students high in extraversion obtained lower scores. Openness was a significant variable on final scores in year three. Medical students low in conscientiousness and high in the extraversion facets of gregariousness and excitement seeking were significantly less likely to successfully complete the preclinical years. Lievens et al. (2002) were cautious about this finding as the statistical analysis utilized t-tests across multiple comparisons, increasing the risk of type-1 error. Because conscientiousness affects academic results and can be assessed at admissions, the authors recommended personality assessment as a potential tool for student counseling (Lievens et al., 2002).

In a subsequent longitudinal study, Lievens, Ones, and Dilchert (2009) examined the Big Five personality variables over seven years to investigate whether personality scale validities increased over time. Results showed that over time, extraversion, openness, and conscientiousness scores increased in operational validity for predicting GPAs. While being extraverted and open may not be important in early academic performance, they become increasingly important as the curriculum progresses into applied practice such as patient care (Lievens et al., 2009). This finding is consistent with other research (Kleshinski, Shriner, & Khuder, 2008; Tyssen et al., 2007), and a literature review (Doherty & Nugent, 2011) demonstrated extraversion as a predictor of performance in the clinical phase of training (Kleshinski et al., 2008; Tyssen et al., 2007). Perhaps more than any other variable, conscientiousness appears to be an increasingly important resource for medical students (Lievens et al., 2009). The importance of conscientiousness is echoed by other research (Ferguson et al., 2003; Haight et al., 2012; Hojat et al., 2013; O'Connor & Paunonen, 2007).

16 Personality Factor Questionnaire (16 PF)

The 16 PF instrument measures the following variables: warmth, reasoning, emotional stability, dominance, liveliness, rule-consciousness, social boldness, sensitivity, vigilance, abstractedness, privateness, apprehension, openness to change, self-reliance, perfectionism, and tension (Manuel, Borges, & Gerzina, 2005). Manuel, Borges, and Gerzina (2005) conducted a study looking for correlations between the 16 PF and a clinical skills assessment. In all, 206 medical students who had matriculated at the University of Cincinnati School of Medicine between 1999-2002 completed the 16 PF and the clinical skills assessment. The clinical skills assessment is based on one standardized patient case where students have one hour to complete a history and physical, a case presentation, and feedback (Manuel et al., 2005). The student evaluation is an equally weighted score on the following skills: physical exam, communication skills, data gathering, and case presentation (Manuel et al., 2005). Results of the study revealed a positive correlation with the 16 PF variable of warmth with overall clinical skills. Conversely, abstractedness and privateness negatively correlated with overall clinical skills. Warmth, emotional stability, and perfectionism were positively associated with communication skills while privateness was negatively associated with communication skills; whereas warmth and abstractedness were positively correlated with data gathering. Finally, the results from the physical exam and case presentation portion of the assessment had no significant correlation. Based on these findings, the authors suggested that a relationship may be present between personality traits, that is noncognitive variables, and clinical skills (Manuel et al., 2005).

A study in Malaysia examined 101 medical students' personality traits through the 16 PF and their academic success at the end of the second preclinical year looking for relationships between personality variables and academic success (Peng, Khaw & Edariah, 1995). In this

study, students initially completed the 16 PF at matriculation and repeated the test at the end of the second year. Results showed positive correlation with academic success and the 16 PF traits of enthusiastic, venturesome, imaginative, and experimenting. Conversely, a negative correlation was found between academic success and the 16 PF trait of being self-assured (Peng et al., 1995). Peng, et al., (1995) also found that students in academic trouble were more likely to be more apprehensive, less emotionally stable, and more reserved than others. Based on the findings, the authors suggested that the 16 PF could make a distinction between students not at risk of academic failure and those who are (Peng et al., 1995).

In contrast to the findings by Peng et al., (1995) and Manuel et al., (2005) Green, Peters, and Webster (1991) conducted a study of 129 University of Wales College of Medicine students to identify relationships between the 16 PF and medical school performance as well as subsequent academic success. Results found no relationship between the 16 PF personality variables and medical school academic success (Green, Peters, & Webster, 1991). The researchers conducted a follow-up study of 146 additional medical students from the University of Wales and again found no relationship between the 16 PF personality variables and medical school academic success (Green, Peters, & Webster, 1993).

California Psychological Inventory (CPI)

The CPI is a 434-item instrument designed to understand prior actions and to predict future behavior; its purpose is to measure an individual's psychological qualities and behavior adaptation. The psychological variables include responsibility, socialization, self-control, communality, well-being, and rule-respecting. Hodgson, Teherani, Gough, Bradley, and Papadakis (2007) conducted a case-controlled, descriptive, designed study examining the correlation between the CPI assessment variables and unprofessional behavior during medical school. Results showed that physicians who demonstrated unprofessional behavior during

medical school scored significantly lower on responsibility, communality, well-being, and rule-respecting than those who did not demonstrate unprofessional behavior. The CPI factors responsibility, communality, well-being, and rule-respecting were significantly associated with higher levels of professionalism (Hodgson et al., 2007). Specifically, the lower the scores in responsibility, communality, well-being, and rule-respecting, the greater the unprofessional behavior in medical school. Based on the findings, the authors concluded that CPI results differed by level of unprofessional behavior and thus suggested the potential use of personality instruments in the admissions process (Hodgson et al., 2007).

These results are consistent with a case-controlled study conducted by Papadakis et al., (2005), which examined the files of 704 medical students across three medical schools: University of Michigan Medical School in Ann Arbor, Jefferson Medical College of Thomas Jefferson University in Philadelphia, and University of California, San Francisco (UCSF) School of Medicine. The files were examined for unprofessional behavior during medical school and categorized into eight categories: irresponsibility; diminished capacity for self-improvement; immaturity; poor initiative; impaired relationships with students, residents, or faculty; impaired relationships with nurses; impaired relationships with patients and families; and unprofessional behavior associated with anxiety, insecurity, or nervousness. The unprofessional behaviors were then compared to disciplinary action by any state medical board in the United States between 1990 and 2003. The researchers examined other predictor variables: age; sex; undergraduate science GPA; MCAT scores; medical school course and clerkship grades; and scores on the examination of the National Board of Medical Examiners (NBME), Part I; or on the U.S. Medical Licensing Examination (USMLE), Step 1 (Papadakis et al., 2005). Results showed that of the 704 medical students, a medical board had disciplined 235. Specifically, the

unprofessional categories of irresponsibility and lack of self-improvement were primarily associated with medical board discipline. Low MCAT scores and poor grades in the first two years of medical school were associated with disciplinary action by a medical board. Based on the findings, the authors concluded that unprofessional behavior in medical school is strongly associated with disciplinary action by a medical board, and students with the strongest association were those described as irresponsible or having diminished ability to improve their behavior (Papadakis et al., 2005).

Myers-Briggs Type Indicator (MBTI)

Cohen and Ahmed (1998) examined the Myers-Briggs profiles of health professions students at Nova Southeastern University in PA, Medical, Occupational Therapy (OT), Physical Therapy (PT) and Pharmacy programs. Results showed PA and medical students were similar in personality profiles. That is, they were primary thinkers and primary sensors. As opposed to the PA, medical, and pharmacy students, OT and PT students were primary feelers. Whereas pharmacy students were found to be primary sensors and more introverted than other professions (Cohen & Ahmed, 1998).

A study of 64 medical students during a rotation in obstetrics/gynecology examined the correlation between MBTI personality and performance as measured by the clinical evaluations (Davis & Banken, 2005). Results showed a positive correlation between extraversion and performance on the clinical evaluation but no significant correlation between National Board of Medical Examiners (NBME) subject scores and clinical evaluations (Davis & Banken, 2005). A study of 263 osteopathic students who had all completed the MBTI found no correlation between personality types and high or low MCAT performance, but a correlation did exist between the

intuitive-feeling personality and performance on the Comprehensive Osteopathic Medical Licensing Exam (COMPLEX-USA, Level 1) (Sefcik, Prerost, & Arbet, 2009).

Neuroticism Extroversion Openness – Five Factor Inventory (NEO-FFI)

Given the length of the Neuroticism, Extraversion, Openness Personality Inventory-Revised (NEO PI-R), researchers developed an abbreviated five-factor personality instrument based on the original (John & Srivastava, 1999). Researchers developed the NEO-FFI by examining the items that loaded most highly on each of the original NEO PI-R five personality factors. In doing so, 12 item scales were included in the NEO-FFI. Costa and McCrae (1995) reported reliabilities of the NEO-FFI with a mean of 0.78 across the five personality factors. Based on the findings, the NEO-FFI is substantially correlated with the NEO PI-R. The results suggest that the NEO-FFI inherits a substantial portion of the validity of the NEO PI-R (John & Srivastava, 1999).

Trait Descriptive Adjectives (TDA)

Goldberg (1992) created the Trait Descriptive Adjectives (TDA) by condensing his thorough taxonomic data into a number of reported adjective lists and conducting factor analysis to develop an instrument that would be an optimal representation of the Big Five personality traits. To conduct the analysis, Goldberg (1992) first selected only those adjectives that uniquely described each Big Five personality trait so that the TDA's design would assess the variety of traits defined by the Big Five personality traits. The TDA instrument consists of 100 trait descriptive adjectives where participants are asked to rate how accurately each descriptor portrays themselves on a nine point Likert scale: 1 = extremely inaccurate, 5 = neither accurate nor inaccurate and 9 = extremely accurate. The TDA scales have remarkably high internal consistency (John & Srivastava, 1999).

Other Personality Instruments

Knights and Kennedy (2006) studied 159 Australian medical students to assess the incidence and type of dysfunctional personality characteristics that exist in medical students who were selected through the admission process, which included an interview, written application, and assessment of prior academic performance. The study utilized the Hogan Development Survey (HDS) which is a 168-question dichotomous survey designed to measure dysfunctional personality characteristics that impact working relationships with others where the higher the score equals the higher the dysfunction. The instrument includes 11 scales and each has 14 items. The scales excitable, skeptical, cautious, reserved, and leisurely are classified as "moving away from people". The scales bold, mischievous, colorful, and imaginative are classified as "moving against people". The scales dutiful and diligent are classified as "moving towards people" (Knights & Kennedy, 2006). Results showed that the majority of the admitted medical students had elevated to high scores indicating dysfunctional traits. The admissions interview is designed to assess positive and negative characteristics, yet negative characteristics are difficult to detect in an interview setting. Based on the findings, the authors suggested that the HDS is an effective tool in identifying dysfunctional personality traits and could be used as an effective adjunct to the admissions process (Knights & Kennedy, 2006).

Knights and Kennedy (2007) conducted a follow-up study that examined the correlation between HDS scores and academic success in each of the three years of medical education. Moving away scales were negatively correlated with academic performance in years two and three as well as in performance overall. Moving against scales were negatively associated with academic performance in year three and in overall performance while diligence, a component of the moving toward scales, was positively correlated to academic performance in all years. Based

on the results, Knights and Kennedy (2007) suggested that the HDS has value in the admissions process with the potential to predict academic performance.

Big Five Inventory (BFI)

The first known research on the Big Five personality traits dates back to the 1930s (Hogan, 1997). A host of researchers have examined the Big Five dimensions and, while interruptions have occurred through the years, the work appears to reflect a working consensus on the importance of these five personality traits: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (Hogan, 1997). McCrae and John (1992) sate "Research using both natural language adjectives and theoretically based personality questionnaires supports the comprehensiveness of the model and its applicability across observers and cultures" (p. 175); this is supported by other research (Benet-Martínez & John, 1998).

A number of questionnaires to measure personality traits exist, such as, Neuroticism, Extraversion, Openness Personality Inventory-Revised (NEO PI-R), Edwards Personal Preference Schedule (EPPS), California Personality Instrument (CPI), Guilford-Zimmerman Temperament Inventory, Trait Descriptive Adjectives (TDA), and Myers-Briggs Type Indicator (Hogan, 1997). The variety of personality trait instruments is part of what has challenged researchers. Despite the variety in questionnaires, McCrae (1990) has systematically shown that virtually every major instrument measures some or all of the Big Five traits (McCrae & John, 1992). The five personality traits can confidently be considered as the full range of personality traits. Therefore, the five-factor model provides a framework for integrating personality research (Hogan, 1997). Research has shown that the Big Five model is stable across age groups; it

performs equally well on school children, college students, and adults (Hogan, 1997). Digman (1990) states:

> At a minimum, research on the five-factor model has given us a useful set of very broad dimensions that characterize individual differences. These dimensions can be measured with high reliability and impressive validity. Taken together, they provide a good answer to the question of personality structure (p. 436).

The Big Five Inventory (BFI) utilized in the current research is an instrument designed by John (n.d.) and it is available free for researchers to use for non-commercial purposes. The BFI was created to address the need for a brief yet reliable instrument that would allow for efficient and flexible assessment of the Big Five personality traits (John & Srivastava, 1999). The BFI requires survey takers to respond to each of the 44 questions on a five-point Likert scale: disagree strongly, disagree a little, neither agree nor disagree, agree a little, and/or agree strongly (John & Srivastava, 1999), where disagree stongly is given a score of 1 and agree strongly is given a score of 5.

Instead of using single trait adjectives, as in other personality instruments, the BFI employs short phrases based on prototypical markers of the Big Five personality traits, such as, I see myself as someone who "is talkative", "is full of energy". Single adjectives such as "original" become "is original, comes up with new ideas" in the BFI. The short phrases reduce the propensity for confusion that may arise with ambiguous adjective, and/or those with multiple meanings (John, Naumann, & Soto, 2008). Single adjective surveys are answered less consistently than surveys accompanied by definitions or elaborations, such as the short phrases provided in the BFI (John et al., 2008). The BFI has been shown to have greater inter-rater agreement than single adjective personality instruments (John et al., 2008). While the instrument

is shorter than others, for example the NEO PI-R, it does not sacrifice content coverage or good psychometric properties (John et al., 2008). John, et al., (2008) have also reported the BFI's validity evidence with peer ratings and other Big Five instruments. John, et al., (2008) reported BFI scale alpha reliabilities from 0.75 to 0.90 and average above 0.80. Three month test-retest reliabilities range from 0.80 to 0.90, with a mean of 0.85 (John et al., 2008).

In the current research, personality data was obtained during the personal interview, thus time was a limiting factor in deciding which personality survey to employ. On the whole, the BFI is a shorter instrument that has good inter-rater agreement, covers the Big Five personality variables well, has good psychometric properties, and has good reliability and validity evidence. Thus, the BFI was chosen as the personality instrument for the current research.

Marlowe Crown Social Desirability Scale (M-C (1) 10)

The personal interview day is a high-stakes event for interviewees. Given these high-stakes, applicants may "fake good" on the personality inventory. "Faking good" has been found to reduce the predictive validity of the instrument only minimally (Ones, Dilchert, Viswesvaran, & Judge, 2007). While "faking good" has been found to only minimally reduce the predictive validity, the advice of Bore and Munro (2009) was followed and the social desirability scale was incorporated to counter this effect. The social desirability questions incorporated into the BFI for this study is a question set based on the work of Crowne and Marlowe (1960). The original Marlowe Crowne instrument is a 33-question survey that had wide use following its development (Strahan & Gerbasi, 1972). Data demonstrated that several of the original items contributed relatively little to the overall measure (Strahan & Gerbasi, 1972), and therefore Strahan and Garbasi (1972) studied various short forms developed from the original Marlowe and Crowne instrument and found that one short form in particular was superior—the Marlowe

Crown Social Desirability Scale; M-C (1) 10 (Strahan & Gerbasi, 1972). As social desirability response bias needs to be controlled because without such control, research results can often be misleading (Saunders, 1991), the question set for this study includes the 10-question set from the Marlowe Crowne instrument (M-C (1) 10). This question set allows for statistical control for individuals that may be "faking good" based on analysis of the response set (Saunders, 1991; Strahan & Gerbasi, 1972).

Summary

Physician Assistant education has identified a number of cognitive variables that predict success throughout PA education. These cognitive variables in PA education are consistent with medical education research (Ferguson et al., 2003; Koenig et al., 1998; Kulatunga Moruzi & Norman, 2002; McManus et al., 2005; McManus et al., 2003). A lack of PA specific research exists regarding noncognitive variables exists, with the exception of research on demographics and previous healthcare experience to academic success. Therefore, this study is informed by a number of noncognitive variables identified by medical education (Bore et al., 2009; Ferguson et al., 2003; Haight et al., 2012; Hojat et al., 2013; Knights & Kennedy, 2007; Lievens et al., 2002; Magalhães et al., 2012; McAbee & Oswald, 2013; Urlings-Strop et al., 2009)

Medical education has examined both cognitive and noncognitive variables. While the general consensus is that noncognitive variables are valuable in the admission process, significant difficulty still exists in measuring these variables in valid and reliable ways (Kulatunga Moruzi & Norman, 2002). The use of personality variables in the admissions process continues to be debated, in part, due to the challenge in making generalizable conclusions across studies that have used a variety of personality instruments (Lievens et al., 2002). Regardless, based on an extensive literature review, Hojat, et al. (2013) concluded

conscientiousness should be considered in predicting positive educational and clinical achievements. Conscientiousness could potentially be used as a mechanism to break a tie when applicants have similar academic qualifications (Hojat et al., 2013). These recommendations are consistent with a number of research projects that demonstrate conscientiousness as a significant predictor of academic success (Bore et al., 2009; Davis & Banken, 2005; Ferguson et al., 2003; Haight et al., 2012; Lievens et al., 2002; McAbee & Oswald, 2013; McManus et al., 2004; Tyssen et al., 2007). Hojat et al., (2013) concluded that any "lingering doubts about the role of personality in the performance of physicians-in-training and in-practice results is a futile and never-ending search for additional evidence, which would be counterproductive, because waiting for certainty is waiting for eternity" (p.1268).

The Big Five model enjoys considerable support and has become the most widely used and researched framework (Gosling, Rentfrow, & Swann, 2003). The BFI is a frequently used instrument covering the Big Five in research where the survey-takers' time is at a premium (John & Srivastava, 1999). Ultimately, the BFI is a reliable and valid instrument that can be completed in the time available at PA program interviews. Importantly, Lievens, Coetsier, De Fruyt and De Maeseneer (2002), suggest that the five-factor model "may serve as a uniform, comprehensive and robust framework for describing medical students' personality characteristics and for substantially advancing our understanding of whether these traits relate to academic success" (p. 1051). As previously noted, social desirability response needs to be corrected. The M-C (1) 10 was selected based on acceptable reliabilities and its indication for use when administration time is limited (Strahan & Gerbasi, 1972).

Chapter Three: Methodology

Introduction

The purpose of this study was to examine the relationship between cognitive and noncognitive variables with academic performance of PA students who were taught in a public higher education institution. The following research questions guided this study:

1. What relationships do personality traits, as measured by the Big Five Inventory, have with academic success, as indicated by program preclinical GPA, clinical GPA, PACKRAT, PANCE score, and PANCE pass/fail?
2. What relationships, if any, do preadmission overall and science GPA scores have with academic performance, as indicated by program preclinical GPA, clinical GPA, PACKRAT, PANCE score, and PANCE pass/fail?
3. What Big Five Inventory characteristics (conscientiousness, agreeableness, neuroticism, openness to experience, extraversion), preadmission overall GPA and science GPA predict academic success in PA school (preclinical GPA, clinical phase GPA, PACKRAT, PANCE score, and PANCE pass/fail)?

The following sections in this chapter provide a summary of the research method and design, sample, setting, instrumentation and measures, reliability and validity, data collection, data analysis, as well as limitations, delimitations, and ethical considerations.

Research Method and Design

The method and design of this study was a retrospective data analysis created from a quantitative survey and already existing program data. Specifically, the BFI and the M-C (1) 10 were used at the time of admission interviews to evaluate physician assistant students' personality traits while combating social desirability. Research questions address the

relationship between cognitive variables (academic predictors) and noncognitive variables (Big Five personality traits) with academic success (preclinical GPA, clinical GPA, PACKRAT, PANCE score, and PANCE pass/fail) in a PA program. The statistical analysis is correlational in nature.

Sample

The population under study was 146 students (41 men and 105 women) at a midwest university PA program during the years of 2009 through 2015, that is, 146 students in seven class cohorts in a 24-28 month program. Therefore, the class cohort of 2009 matriculated in 2007, the class of 2010 matriculated in 2008, class of 2011 matriculated in 2009, and so on.

During the admission process, students applied to the program through the Centralized Application Service for Physician Assistants (CASPA). A number of variables were collected and calculated by CASPA and were tracked from matriculation to graduation. The preadmission cognitive variables tracked included preadmission cumulative GPA and science GPA.

All applications were reviewed by the midwest PA program faculty with attention to a number of variables: overall preadmission GPA, science GPA, prior healthcare experience hours, program mission (educational or economically disadvantaged applicant, community size, expressed interest in primary care, service to the underserved, research experience), and letters of recommendation. Based on this application review, the program selected students to invite to campus for a personal interview. The personal interview experience consisted of an interview with two committee members, submission of a writing sample, and time to meet with the program director in small groups. At the conclusion of the program director meeting, each applicant was asked to participate in the study. Institution Review Board approval (see Appendix A) was explained and a consent form was distributed, signed and collected, and a copy

of the consent form was provided for each applicant (see Appendix B). Thereafter, each applicant completed the BFI and M-C (1) 10 to capture social desirability and the Big Five personality traits: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (see Appendix C).

Following the personal interview, the program selected 20-25 students per year to matriculate into the PA program. The Big Five and M-C (1) 10 instrument data was transferred to a secure database for those students who enrolled in the PA program. Therefore, all students invited for a personal interview were invited to participate in the study but only those students ultimately accepted and matriculated were included in the present sample. A second informed consent was requested allowing permission to track PA students' academic progress: course and rotation grades, PACKRAT score, and PANCE score and pass/fail (see Appendix D).

Setting

Upon matriculation, the program had gathered PA students overall preadmission GPA, science GPA, and the Big Five personality traits as measured by the Big Five Inventory. As students progressed through the program, the preclinical and clinical GPAs were tracked. In year two, approximately three months prior to graduation, students sat for the PACKRAT (Physician Assistant Clinical Knowledge Rating Assessment Tool). The PACKRAT is a 225-question exam developed annually by the Physician Assistant Education Association (PAEA), which allows for student self-assessment prior to sitting for the PANCE (Physician Assistant National Certification Examination). The program had access to year two PACKRAT scores, which were tracked for comparison as a predictor of academic success. Finally, to practice and gain licensure, all students must successfully complete an accredited PA program and pass the

PANCE. The PANCE is a secure 300-question exam developed by the National Commission on the Certification of Physician Assistants (NCCPA).

The PANCE is evaluated using the Rasch Model where a scaled score is calculated, allowing for results to be compared over time and among different groups of examinees. The NCCPA (n.d.) states "The scale is based on the performance of a reference group whose scores were scaled so that the average proficiency measure was assigned a scaled score of 500 and the standard deviation was established at 100". The minimum reported score is 200, and the maximum reported score is 800. PANCE data was available to the program and were tracked (total score and pass/fail) for comparison as a predictor of academic success.

Instrumentation and Measures

To carry out a study exploring the relationship between personality traits (noncognitive) and PA program academic success (cognitive), the Big Five Inventory (BFI) was utilized. Incorporated into the BFI was a social desirability scale—the M-C (1) 10—that was used to adjust for social desirability. The following sections discuss the reliability and validity of these instruments. For purposes of this study, academic success was defined by the students preclinical GPA, clinical GPA, PACKRAT score, PANCE score, and PANCE pass/fail.

Reliability and Validity

The BFI and M-C (1) 10 have been examined for their reliability and validity. With respect to reliability and validity for the BFI, John and Srivastava (1999) conducted an analysis comparing three Big Five personality instruments: TDA, NEO-FFI, and the BFI. A large data set on all three measures was utilized for comparison. The analysis consisted of 462 undergraduate students at the University of California, Berkeley who had completed the TDA, the NEO-FFI, and the BFI. The results showed impressive reliability for each of the three instruments. The

longer TDA instrument had a mean alpha of 0.89 while the BFI had a mean alpha of 0.83 and the NEO-FFI had a mean alpha of 0.79 (see Table 1). To determine the extent to which the correlations reflected the reliability of the instruments rather than the differences among the instruments, the researchers computed corrected validity correlations. The corrected validity correlations averaged 0.91 (see Table 2). John and Srivastava (1999) concluded that, "Together the findings show that the Big Five are fairly independent dimensions that can be measured with convergent and discriminant validity" (p. 26).

Table 1

Reliabilities: BFI and Other Instruments (TDA and NEO)

	Conscientiousness	Agreeableness	Neuroticism	Openness	Extraversion	Mean
BFI	0.82	0.79	0.84	0.81	0.88	0.83
TDA	0.9	0.9	0.85	0.88	0.92	0.89
NEO	0.83	0.78	0.85	0.7	0.78	0.79
Mean	0.85	0.83	0.85	0.81	0.87	0.84

Note. Adapted from John and Srivastava (1999), Table 3, p. 62

Table 2

Validity: Corrected Pairwise Convergent Validities

	Conscientiousness	Agreeableness	Neuroticism	Openness	Extraversion	Mean
BFI – TDA	0.99	0.93	0.95	0.9	0.89	0.95
BFI – NEO	0.83	0.97	0.96	0.9	0.85	0.92
TDA-NEO	0.79	0.81	0.89	0.82	0.71	0.81
Mean	0.93	0.92	0.94	0.88	0.83	0.91

Note. Adapted from John and Srivastava (1999), Table 3, p. 62

The Big Five framework enjoys considerable support and has become the most widely used and researched (Gosling, Rentfrow, & Swann, 2003). The BFI is a frequently used instrument in research where the survey-takers' time is at a premium (John & Srivastava, 1999).

Ultimately, the BFI is a reliable and valid instrument that can be completed in the time available at PA program interviews. The BFI instrument has been adapted to multiple languages, including Chinese, Dutch, English, Hebrew, Spanish, Italian, Lithuanian, Portuguese, and Swedish (Benet-Martínez & John, 1998; John, n.d.). Therefore for this study, the BFI was used, not the TDA or NEO-FFI.

Concerning the Marlowe Crown Social Desirability scale (M-C (1) 10), Strahan and Gerbasi (1972) conducted a study on the original 33-item Marlowe-Crown Social Desirability Scale (M-C SDS). Previous data showed that several items on the original scale contributed little to the overall measure (Strahan & Gerbasi, 1972). With this finding in mind, and the interest in a shorter social desirability scale, the researchers had 272 introductory psychology students at two institutions (one private university and one all-girls private catholic college) complete the original 33-item M-C SDS. From the survey data, the researchers conducted a principal component analysis to form three short scales: the M-C (1) 10, M-C (2) 10, and the M-C 20. Results showed correlations between the short scales and the M-C SDS in the 0.80s or 0.90s (Strahan & Gerbasi, 1972). The M-C SDS reported reliability coefficients of 0.83 for university males, 0.87 for university females, and 0.73 for college females (private catholic college). In comparison, the M-C (1) 10 had reliability coefficients of 0.70 for university males, 0.66 for university females, and 0.61 for college females. The M-C (2) 10 had reliability coefficients of 0.62 for university males, 0.75 for university females, and 0.49 for college females. Finally, the M-C 20 had reliability coefficients of 0.78 for university males, 0.83 for university females, and 0.73 for college females. Table 3 summarizes the reliability coefficients for each instrument. Based on these findings, Strahan and Gerbasi (1972) concluded that the M-C 20 is as internally consistent as the M-C SDS and that the two 10-question items are parallel with the M-C (1) 10

being slightly superior. While the shorter 10-item response sets lose some reliability, when administration time is limited the drop in reliability is tolerable (Strahan & Gerbasi, 1972). The M-C (1) 10 is commonly used, as can be noted by the number of times the scale has been cited, purported to be 1,269 times in Google Scholar. Finally, as social desirability is not the primary interest of the study, the benefits of brevity outweigh the acceptable loss of reliability. Therefore for purposes of this study and with time limitations, the M-C (1) 10 was used in combination with the BFI.

Table 3

Reliability Coefficients (M-C SDS, M-C (1) 10, M-C (2) 10, M-C 20)

	University Males (n=64)	University Females (n=34)	College Females (n=130)
M-C (1) 10	0.7	0.66	0.61
M-C (2) 10	0.62	0.75	0.49
M-C 20	0.78	0.83	0.73
M-C SDS	0.83	0.87	0.73

Note. Adapted from Strahan and Gerbasi (1972), p. 192

Data Collection

The aim of the present study was to identify attributes of successful PA students that may be discernable and useful for those making admissions decisions for PA educational programs. The primary aim of the study was to examine the usefulness of adding noncognitive variables to traditional predictors, that is, in addition to cognitive variables of academic success. The sample included 146 PA students from seven class cohorts, 2009 through 2015.

The cognitive predictor variables include overall preadmission GPA and science GPA. The CASPA service verifies participants' transcripts and calculates an overall preadmission GPA and a science GPA (CASPA, n.d.). The overall preadmission GPA calculated by CASPA includes all university courses from freshman level to doctorate level work (CASPA, n.d.). The

science GPA is calculated by verification of science courses taken prior to application. Science courses are those courses in Biology/Zoology, Inorganic Chemistry, Biochemistry, Organic Chemistry, Physics, and other science (CASPA, n.d.). The noncognitive predictor variables include the Big Five personality variables (conscientiousness, agreeableness, neuroticism, openness to experience, and extraversion). The M-C (1) 10 was used to correct the Big Five personality traits for social desirability bias as the M-C (1) 10 question set measures social desirability; that is, the tendency of participants to answer questions that will be viewed more favorably by the admission committee.

Each of these cognitive and noncognitive variables was examined as predictors of PA education academic success. The dependent academic success variables include: PA program preclinical GPA and clinical GPA, PACKRAT score, PANCE score, and PANCE pass/fail. The preclinical GPA includes grades from all courses preceding the clinical year training, such as, basic science courses, Pharmacology, and Medicine courses. The academic success variables remained consistent throughout the study, however preclinical courses were altered over time. For example, the embryology course was replaced with a new course entitled Introduction to Clinical Basic Sciences. There was restructuring of content within preclinical courses. For example, the Research Perspectives course was moved from the second semester to the first semester. The grading scales for all courses remained consistent throughout the study.

The clinical GPA includes grades from each supervised clinical practice experience (rotation), such as, Family Medicine, General Surgery, and Internal Medicine. Clinical rotation grades are calculated through student performance on a multiple choice end-of-rotation examination, the clinical faculty end-of-rotation evaluation, and assignments, such as, history and physical case studies. The clinical GPA is specific to clinical phase performance, as

measured by clinical faculty evaluations, exams and assignments, and does not include grades from preclinical coursework. During the course of the study, the clinical rotation length was adjusted slightly, reducing rotation length by five days. Otherwise, the clinical rotations (core and electives) and rotation grading criteria remained consistent throughout the study. Table 4 summarizes the components used in calculating the preclinical and clinical GPA, and the timeframe that the variables were measured.

Table 4

Description of the Elements Included in the Calculation of the Preclinical and Clinical GPA

Variable	Timeline	Components of Grade
Preclinical GPA	End of course performance in first half of program.	• Gross Anatomy • Embryology • Physiology • Professional Practice 1 • Introduction to Clinical Basic Sciences • Research Perspectives • Medicine 1 • Professional Practice 2 • Pharmacology • Masters Project • Medicine 2 • Professional Practice 3
Clinical GPA	End-of-rotation performance in final half of program.	Each supervised clinical practice/rotation grade is calculated from student performance on an end-of-rotation examination, clinical faculty evaluation of student and assignments. The rotations include: • Family Medicine • Rural/Underserved Family Medicine • Internal Medicine • Pediatrics • OB/GYN • Behavioral Health • Emergency Medicine • Surgery • Elective 1 • Elective 2

The variables were collected from the participants' application to the program through graduation and were collected in two stages.

Stage one: At the time of application, the participants' overall preadmission GPA and science GPA were collected from the CASPA application. Following faculty review of the participants' applications, the PA program invited approximately 80 candidates to a personal interview. During the personal interview, students were invited to complete the BFI and M-C (1) 10. Those class cohorts that were enrolled in the program at the inception of the study, class cohorts 2009 and 2010, were invited to participate during the course of their enrollment. The researcher provided written information introducing the study and an informed consent form was distributed to the participants (see Appendix B). Students who agreed to participate were asked to complete the personality instrument. All students invited to participate in the study completed the personality instrument. Therefore, all students who were ultimately accepted into the program participated in the current research. The personality instrument is a 54-item question set based on the Big Five Inventory (BFI) and the Marlowe Crowne ten item social desirability scale (M-C (1) 10) (see Appendix C). Following the personal interview, candidates were selected to enter the PA program. As previously stated, the class cohorts enrolled at the inception of the study, class cohorts 2009 and 2010, participated during their enrollment. Over the course of the study two students matriculated into the program but did not graduate.

Stage 2: When students matriculated into the PA program, the researcher provided written information to introduce the study and an informed consent form was distributed (see Appendix D). The second informed consent asked for permission to utilize the participants' academic success variables along with their personality instrument and preadmission variables. As previously, the informed consent form provided brief background information on the study, the procedures for participation, and a discussion of confidentiality and the voluntary nature of the study. All matriculates agreed to participate in the current research. The researcher provided

a copy of the informed consent to each participant so that additional questions about the study could be directed to the researcher and/or the University of South Dakota IRB. Therefore, two informed consents were requested and obtained, one at the time of the personal interview (Appendix B), which gave consent for the personality instrument and preadmission variables, and one at matriculation into the PA program (Appendix D), which gave consent for collection of academic success variables along with the personality instrument. The two class cohorts that were enrolled at the inception of the study, class cohorts 2009 and 2010, gave consent following enrollment using the enrolled student consent (Appendix D).

As previously stated, the variables were collected from the initial application through the students' education and graduation (PANCE). Initially, the preadmission GPA and science GPA were collected from the students' CASPA application. During the personal interview, students' were asked to complete the personality survey (Appendix C), which was then manually entered into a database. As the students' progressed through the curriculum, the preclinical and clinical grades were tracked and recorded in a database. At the end of the didactic phase of the program, the overall preclinical GPA was calculated from course performance in each of the didactic courses. The clinical GPA was calculated from rotation performance as measured by: preceptor/clinical faculty evaluation of student performance, end-of-rotation examination, and assignments. Each of these components was used in calculating the rotation performance and corresponding letter grade. The clinical GPA then was calculated from rotation performance throughout the students' clinical experiences at the end of the clinical phase. Approximately three months prior to graduation, students' sit for the PACKRAT. The results were made available to the program electronically and then recorded and tracked in a database. Finally, following graduation, students are eligible to sit for the PANCE. These results are available to

the program electronically both as a graduate score and pass/fail, which were then recorded and tracked in a database. Table 5 summarizes each of the dependent and independent variables included in the study, the timeframe the variable was collected, and the means by which the variable was collected.

Table 5

Illustration of the Data Collection Procedure; Variables, and Where the Data is Collected

Variables	Time of Collection	How Collected
Overall preadmission GPA	Collected at time of Application.	Extracted from the students application; CASPA.
Science GPA	Collected at time of Application.	Extracted from the students application; CASPA.
Personality Instrument - Conscientiousness - Agreeableness - Openness to experience - Extraversion - Social desirability	Collected at the personal interview for PA school.	54 item survey instrument; including the 44 BFI and 10 M-C (1) 10 question sets.
Program Preclinical GPA	Collected at the end of the preclinical phase.	Extracted from the students' PA Program academic record.
Clinical GPA	Collected at the end of the clinical phase.	Extracted from the students' PA Program academic record.
PACKRAT	Collected during the clinical phase; approximately 3 months prior to graduation.	Results extracted from the PACKRAT testing portal.
PANCE score	Collected following graduation.	Results extracted from the NCCPA program portal.
PANCE pass/fail	Collected following graduation.	Results extracted from the NCCPA program portal.

Data Analysis

Analyses include descriptive statistics for the dependent variables (program preclinical GPA, clinical phase GPA, PACKRAT, PANCE score, and PANCE pass/fail) and independent variables (openness to experience, conscientiousness, extraversion, agreeableness, neuroticism, overall preadmission GPA, and science GPA). These variables were reviewed for normality. The collected data was analyzed using Statistical Analysis System (SAS) 9.4.

The research questions were answered with correlational (Pearson's), and regression analyses, including linear and logistic regression. Pearson's allowed for examination of the relationship between two score sets (Patten, 2012), such as conscientiousness and PANCE score.

Regression analysis asks the question: "How much better can I predict… a dependent variable (Y) if I know an independent variable" (X) (Vogt, 2007), (p. 146). For example, is one better able to predict the PANCE score (Y) when the researcher knows the student's level of conscientiousness (X), or is the researcher better able to predict the PANCE score (Y) when the researcher know the student's overall preadmission GPA (X)?

Linear regression assumes that a linear relation, either positive or negative, exists between the dependent variable (Y) and the independent variable (X) being evaluated (Worster, Fan, & Ismaila, 2007). The resulting line, often displayed by a scatter plot, describes the relation (Worster, Fan, & Ismaila, 2007). For example, linear regression asks if a relationship between PANCE score (Y) and overall preadmission GPA (X) exists, is the linear relationship positive, negative, or does none exist? In other words, is the relationship such that the higher the overall preadmission GPA then the higher the resulting PANCE score; the higher the overall preadmission GPA then the lower resulting PANCE score; the lower the overall preadmission GPA then the higher resulting PANCE score; the lower the overall preadmission GPA then the

lower resulting PANCE score; or, is there no linear relationship at all between preadmission GPA and resulting PANCE score?

In addition to linear regression, Logistic regression, a method of analyzing data where the dependent variable (Y) is dichotomous or categorical, among other possibilities, is used. Logistic regression is conducted to find the best fitting relationship between the dependent variable (Y) and the independent variables (X) ("Logistic regression," n.d.). For example, what is the relationship between conscientiousness, overall preadmission GPA, and PANCE pass (scored as 1)/fail (scored as 2)?

Sequential multiple regression was conducted. Sequential multiple regression allows for examination of an additive effect—does the independent variable (X) add "to the equation at its point of entry" (Tabachnick & Fidell, 2007) (p. 138)? For example, if the overall preadmission GPA is a statistically significant predictor of PANCE scores, will including extraversion scores add to the predictive ability?

Limitations

Although this study has the potential to uncover valuable cognitive and noncognitive traits to predict PA student academic success in the admissions process, the reader is cautioned that the study findings have limitations. The following limitations should be considered when interpreting the conclusions suggested by the researcher:

- All participants in this study were students in an individual PA program and therefore the generalizability of study is limited. The study could be replicated in any PA program.
- The participants involved in this study were a sample of convenience; only those students that matriculated into the PA program were ultimately examined. Students

not selected for an interview or not selected for matriculation into the PA program were not included in the study.

- As previously described, a number of variables were reviewed during the admissions process but GPA was a significant component to admissions. The program had a limited number of available seats annually and more applicants than seats. For example, for the 2014-2015 admission process there were 348 qualified applications for 25 available seats. In total, the program interviewed approximately 80 potential students. By the time applicants were invited for an interview, little variation was found in the quality of the applicants. That is to say, the applicants invited for an interview were well-matched in areas such as GPAs and health care experience hours. This leads to the challenge of range restriction which may impact score validity and reliability and statistical power (Weber, 2001). According to Weber (2001) "When the range of values of one or both variables being correlated is curtailed then the resulting Pearson r may be larger, smaller, or equal to the Pearson r of the complete data set" (p. 4).
- At implementation of the data collection the two classes enrolled in the PA program completed the personality instrument while the remaining classes took the instrument at the time of the personal interview. The 2009 class cohort completed the survey at the end of the clinical phase, prior to graduation, while the 2010 class cohort completed the survey at the end of the preclinical phase, prior to commencing the clinical phase.
- The instrument included the M-C (1) 10 which allowed for correction of social desirability, that is, "faking good". According to Ones, et al., (2007) "faking good"

reduces the predictive validity only minimally. The possibility exists that the environmental difference, having the opportunity to complete the survey outside of admissions, may have impacted the personality instrument results. The researcher informed the participants by way of the consent form that their participation was voluntary and that the survey would not be utilized in the admissions process. Nevertheless, given the survey was completed during interviews, participants may have felt pressured to complete the survey for fear of not being accepted should they have chosen not to participate.

Delimitations

In order to focus the study the researcher knowingly established delimitations. The following delimitations should be considered when interpreting the conclusions suggested by the study findings:

- The focus of this study was on PA students at one university.
- A more extensive personality and social desirability instrument, for example the TDA, may have produced greater validity. The selection of personality (BFI) and social desirability scales (M-C (1) 10) was based on time constraints that occur during the interview day. The chosen instruments were reliable and valid and a more extensive scale may have altered the findings either positively or negatively. Delivering a more extensive instrument would have required more time than was currently available during the interview day. The personal interview day was designed to select the best possible students to matriculate and delivering an extensive instrument would have distracted from the interview itself.

Ethical Considerations

Due to the nature of the study, no reasonable expectation existed for any type of harm to come upon any participant, including physical or psychological harm. All participants were made fully aware of the purpose of the study prior to the commencement of the study. While student names were available to the researcher on the initial survey instrument, following admission, the selected students' data was moved to a database and coded such that personal identifiers were not identifiable. All data were stored securely with the researcher. Following completion of the study the data will be stored with the researcher on a secure server.

The decision to participate or decline to participate in this study did not affect admissions decisions. The consent form and the researcher informed the participants that their participation was voluntary and that the survey would not be utilized in the admissions process. Nevertheless, given the survey was completed during interviews, participants may have felt pressure to complete the survey for fear of not being accepted should they choose to not participate.

Chapter Four: Results

The purpose of this study was to examine the relationships between cognitive and noncognitive variables with academic performance of PA students attending a midwestern state university. As noted in Chapter 1, a healthcare provider shortage exists in spite of an abundance of applications. While there are an abundance of applications, programs are only able to fill the number of seats approved by the accrediting body. Thus, the selection and admission of students who possess the intellectual and personal qualities desired in a medical provider is imperative.

A survey was administered to interviewees at their admissions interview to gather noncognitive quantitative data. The survey (John & Srivastava, 1999; Strahan & Gerbasi, 1972) was designed to measure the Big Five personality traits as well as the social desirability of the participants by employing the M-C (1) 10. The survey included other measures to examine learning motivation that were part of a larger ongoing study and those will not be discussed here.

This study was designed to answer the following research questions: (1) What relationships do personality traits, as measured by the Big Five Inventory, have with academic performance, as indicated by program preclinical GPA, clinical GPA, PACKRAT, PANCE score, and PANCE pass/fail? (2) What relationships, if any, do preadmission overall and science GPA scores have with PA program academic performance, as indicated by program preclinical GPA, clinical GPA, PACKRAT, PANCE score, and PANCE pass/fail? (3) What Big Five Inventory characteristics (conscientiousness, agreeableness, neuroticism, openness to experience, extraversion), preadmission overall GPA and science GPA predict academic success in PA school (preclinical GPA, clinical phase GPA, PACKRAT, PANCE score, and PANCE pass/fail)?

The chapter is organized by way of the above research questions. Included in this chapter are descriptive statistics covering participant demographics, Cronbach's alpha for the survey measures, Kolmogorov-Smirov tests for normality, Pearson correlations, and linear and logistic regression results related to the three research questions. Statistics included in this study were estimated using SAS 9.4.

Data Analysis Procedures

The present sample included all 146 students across seven class cohorts (graduating classes of: 2009, 2010, 2011, 2012, 2013, 2014, and 2015), who graduated from one midwest university PA Program. The survey data was entered in a Microsoft Excel spreadsheet and imported in SAS® (version 9.4) for analyses, including estimating Cronbach's alpha coefficients to determine internal reliability of the instrument and Kolmogorov-Smirnov tests for normality. To describe the results descriptive statistics, such as frequencies, means, and standard deviations were also computed. Pearson's correlations were calculated between each of the Big Five personality traits and the M-C (1) 10, and thereafter, the Big Five personality traits were adjusted for social desirability as described by Saunders (1991). Pearson correlations were calculated between preadmission GPAs (overall and science GPA) and the academic success variables. Linear and logistic regression were used to fit predictive models in which Big Five personality traits and preadmission overall GPA predict PA program academic performance variables. The SAS log file is included for review in Appendix E.

Cronbach's Alpha Coefficient for Internal Reliability

Cronbach's alpha is a measure of scale reliability: as the Cronbach's alpha approaches 1.0 the more reliable it is. In the present study, Cronbach's alpha was estimated for each of the Big Five personality trait subscales and the M-C (1) 10 (see Table 6). In social science research

a reliability coefficient of 0.70 is considered acceptable (Institute for Digital Research and Education, 2016).

Table 6

Cronbach's Alpha Coefficients of the Big Five Personality Traits and M-C (1) 10

Variable	Cronbach Alpha
Conscientiousness	0.821
Agreeableness	0.784
Neuroticism	0.75
Openness	0.749
Extraversion	0.862
M-C (1) 10	0.706

As previously discussed, the BFI and the M-C (1) 10 are well-vetted instruments, and the Cronbach alphas computed in the present study are consistent with reliabilities reported by John and Srivastava (1999) and Strahan and Gerbasi (1972) (see Chapter 3).

Kolmogorov-Smirnov

The Kolmogorov-Smirnov tests whether a given dataset is distributed differently from normal where a p value of < 0.05 indicates non-normality. In this case, the question is: do the Big Five personality traits and academic performance variables fit a normal distribution? The Kolmogorov-Smirnov test was used to assess the normality of the variables investigated here, including each of the Big Five personality traits as well as the academic performance variables (see Table 7).

Table 7

Kolmogorov-Smirnov for Big Five Personality Traits and Academic Success Variables

Variable	N	Mean	Std Dev	Kolmogorov-Smirnov test (*p*)
Conscientiousness (adjusted)	146	2.88	0.411	<0.0100
Agreeableness (adjusted)	146	2.45	0.354	<0.0100
Neuroticism (adjusted)	146	4.21	0.529	>0.1500
Openness (adjusted)	146	2.84	0.521	0.0354
Extraversion (adjusted)	146	3.69	0.697	>0.1500
Preclinical GPA	146	3.57	0.281	0.1383
Clinical GPA	146	3.63	0.216	<0.0100
PACKRAT Score	146	140.16	15.59	>0.1500
PANCE Score	146	487.34	107.46	>0.1500

The Kolmogorov-Smirnov values indicate that some variables deviate from normality. Given the large sample and given that the Kolmogorov-Smirnov is a powerful test these low p-values are to be expected. Histograms were created to demonstrate the relative symmetry of the variables. This symmetry was particularly true when examining the adjusted Big Five personality traits (see Figures 1-9). While some variables deviate from normality, histograms demonstrate the relative similarity of the variables relative to normal distribution.

Figure 1

Kolmogorov-Smirnov Data Plot: Conscientiousness

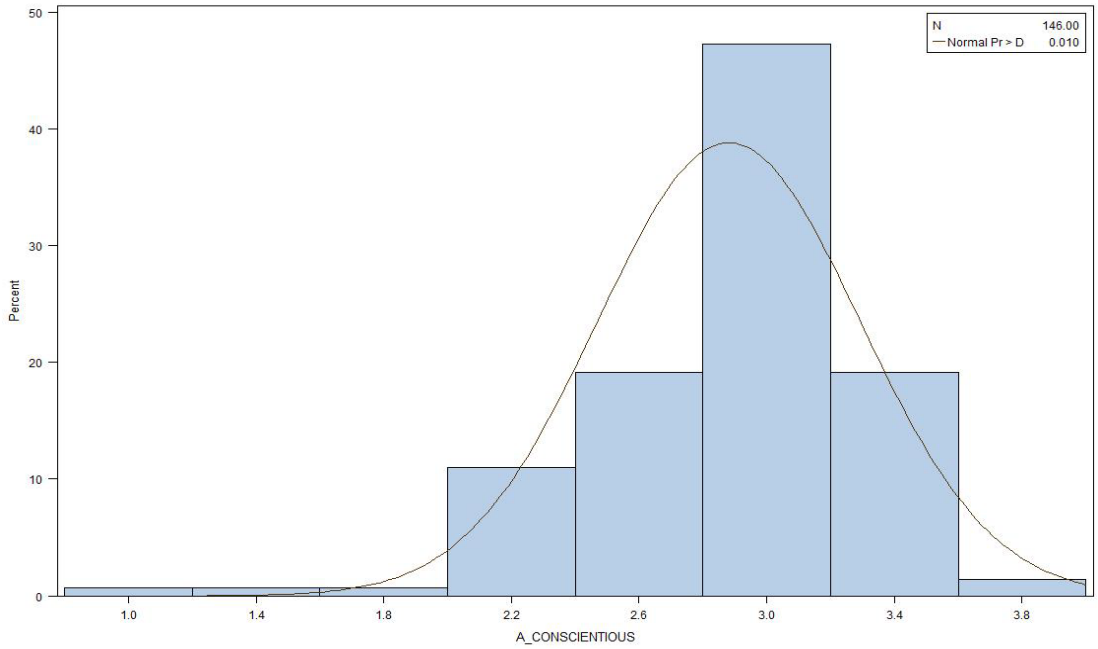


Figure 2

Kolmogorov-Smirnov Data Plot: Agreeableness

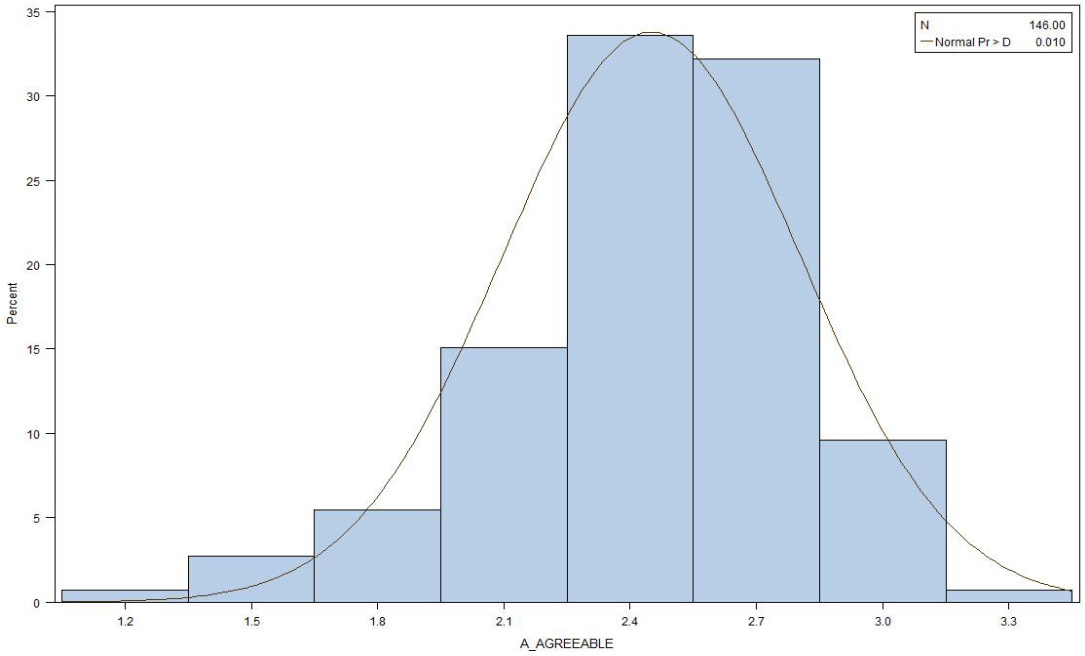


Figure 3

Kolmogorov-Smirnov Data Plot: Neuroticism

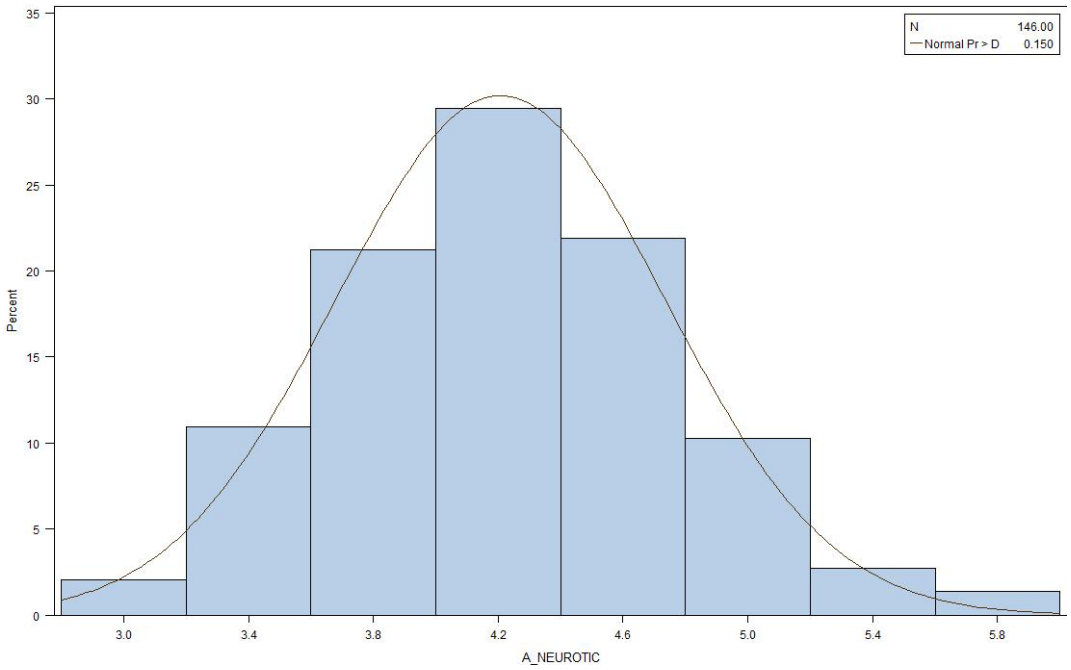


Figure 4

Kolmogorov-Smirnov Data Plot: Openness

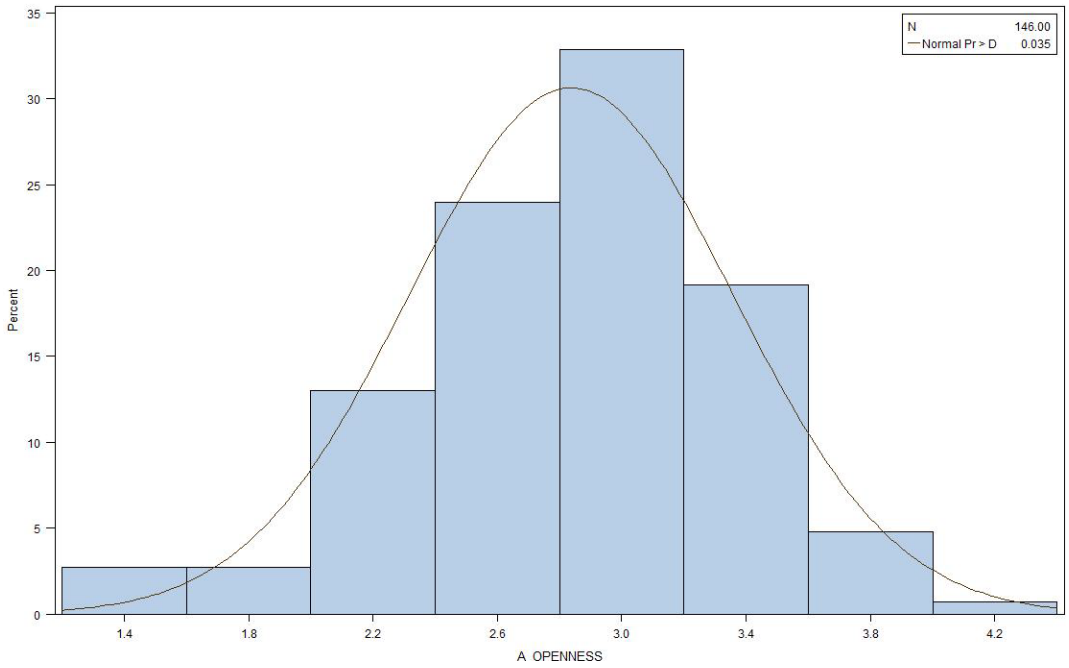


Figure 5

Kolmogorov-Smirnov Data Plot: Extraversion

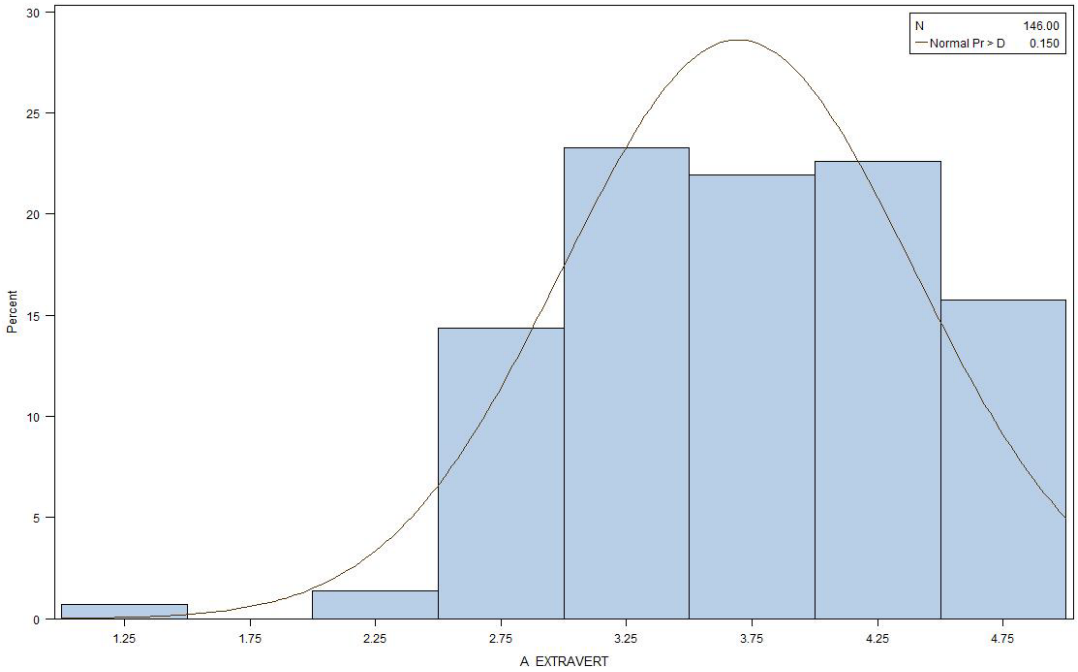


Figure 6

Kolmogorov-Smirnov Data Plot: Preclinical GPA

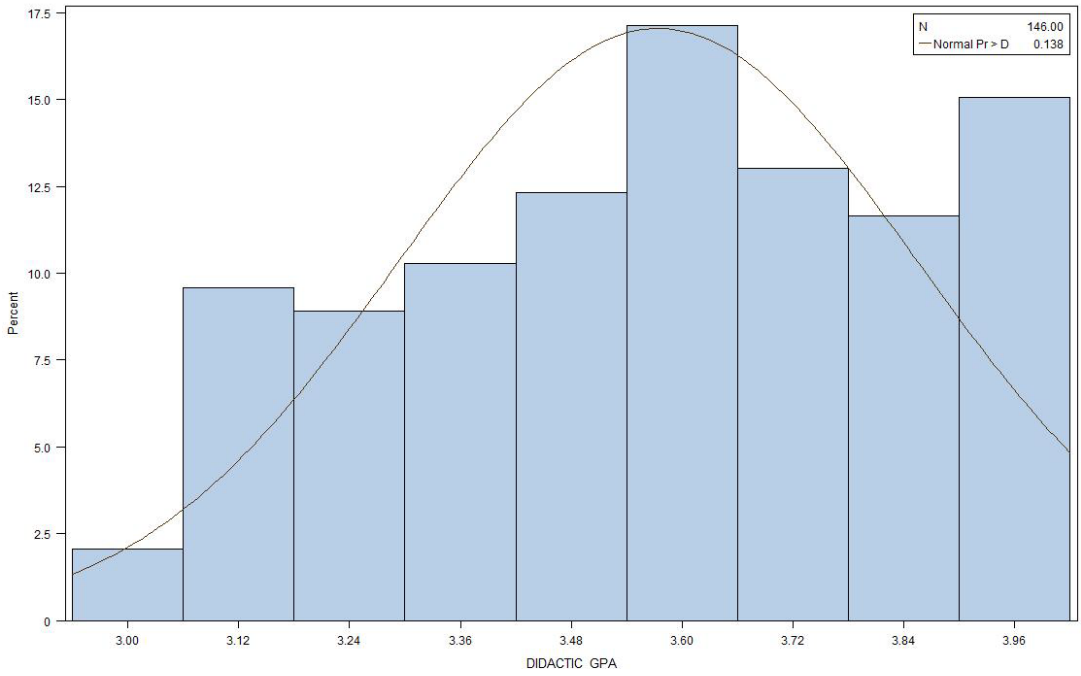


Figure 7

Kolmogorov-Smirnov Data Plot: Clinical GPA

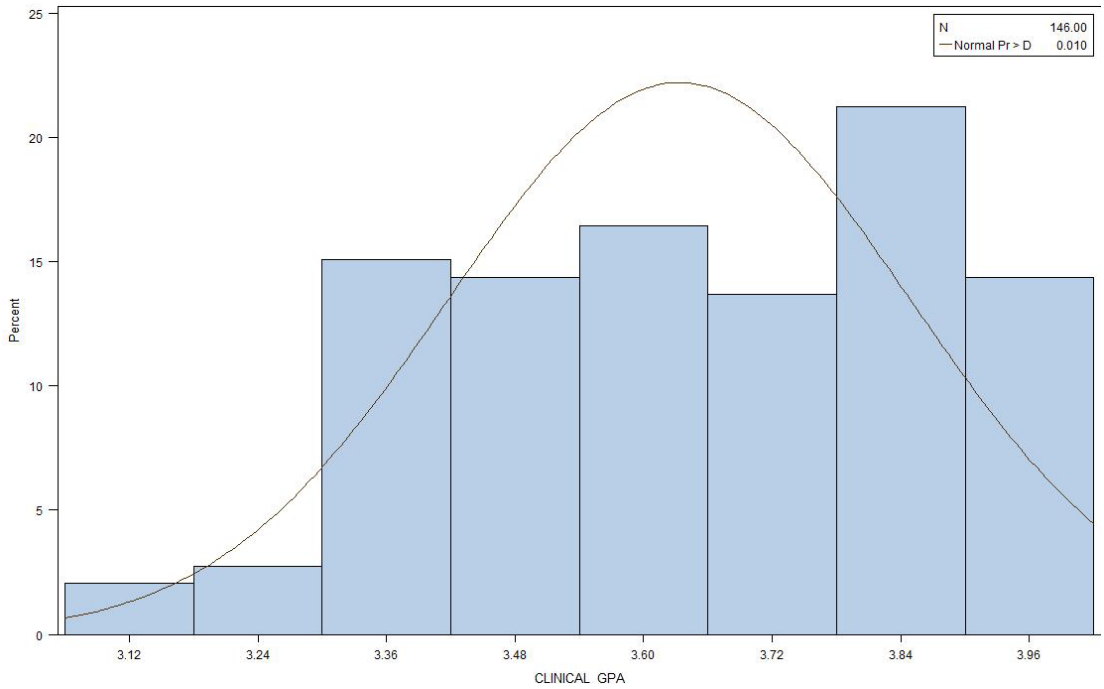


Figure 8

Kolmogorov-Smirnov Data Plot: PACKRAT Score

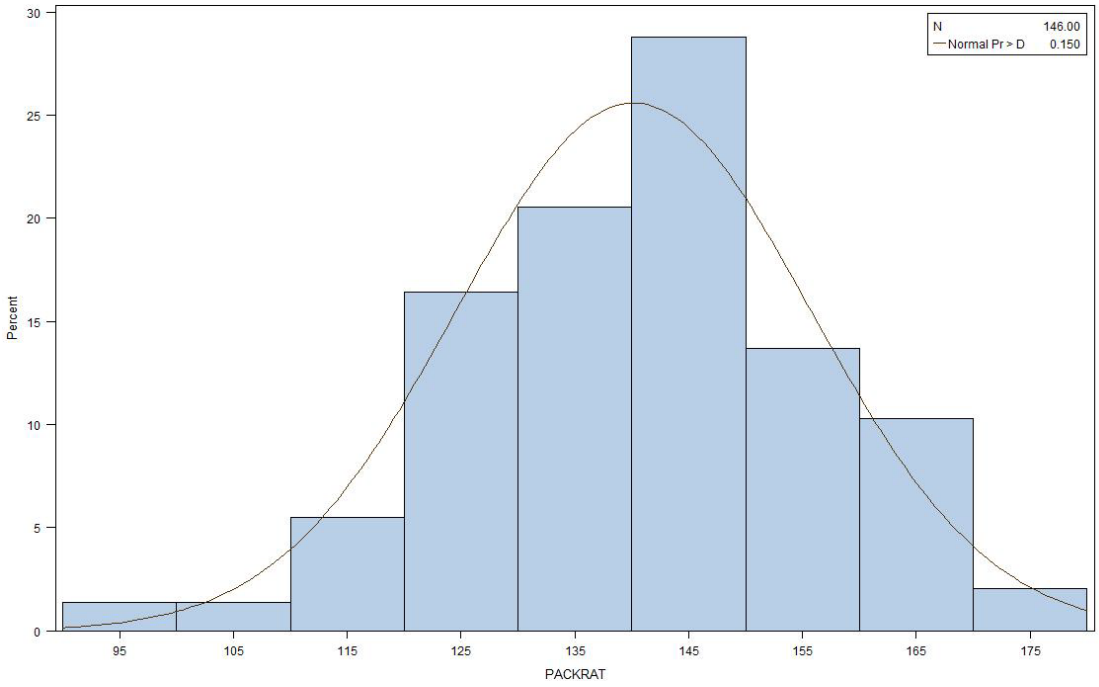
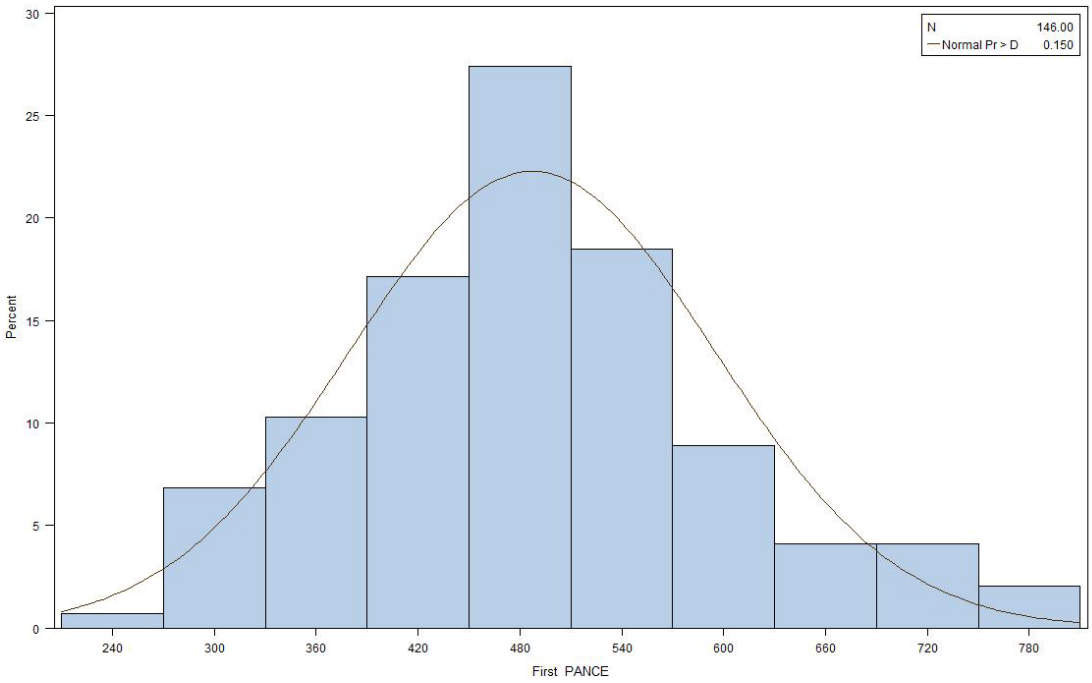


Figure 9

Kolmogorov-Smirnov Data Plot: PANCE Score



Participant Demographics

The 146 participants in this study represent all program graduates across seven PA class cohorts (graduating classes of: 2009, 2010, 2011, 2012, 2013, 2014, and 2015). Forty-one (28.1%) were male and 105 (71.9%) were female. The sample participants can be described as 96.6% Caucasian (n = 141), 2.1% Asians (n = 3), 0.7% Native Americans (n = 1) and 0.7% Hispanics (n =1). The majority of participants were younger than 25 years of age (n = 71, 48.6%), 46 (31.5%) were between the ages of 25-29, 15 were between the ages of 30-34 (10.3%), 10 were between the ages of 35-41 (6.8%), and four (2.7%) were between the ages of 42-48. Table 8 summarizes participant demographics.

Table 8

Descriptive Statistics on Demographics

Variable	N	Percent
Sex		
Male	41	28.1%
Female	105	71.9%
Race		
White/Caucasian	141	96.6%
Asian	3	2.1%
Native American	1	0.7%
Hispanic	1	0.7%
Age		
<25	71	48.6%
25-29	46	31.5%
30-34	15	10.3%
35-41	10	6.8%
42-48	4	2.7%

Note: n= 146

Research Question Results

The following section of this chapter describes the results relevant to each of the three research questions: (1) What relationships do personality traits, as measured by the Big Five Inventory, have with PA program academic performance, as indicated by program preclinical GPA, clinical GPA, PACKRAT, PANCE score, and PANCE pass/fail? (2) What relationships, if any, do preadmission overall and science GPA scores have with academic performance, as indicated by program preclinical GPA, clinical GPA, PACKRAT, PANCE score, and PANCE pass/fail? (3) What combination of Big Five Inventory characteristics (conscientiousness, agreeableness, neuroticism, openness to experience, extraversion), preadmission overall GPA and science GPA predict academic success in PA school (preclinical GPA, clinical phase GPA, PACKRAT, PANCE score, and PANCE pass/fail).

Controlling for Social Desirability

To answer the three research questions it was important first to know if participants responded to the survey in a socially desirable manner. In other words, were participants answering questions in a manner that they assumed would be viewed more favorably by the admissions committee? To determine if the Big Five personality traits should be corrected for social desirability a Pearson correlation was completed. Initial Pearson correlation coefficients identified a significant correlation between the M-C (1) 10 and four of the five Big Five personality variables (see Table 9), specifically, conscientiousness and M-C (1) 10 ($p < 0.0001$), agreeableness and M-C (1) 10 ($p < 0.0001$), neuroticism and M-C (1) 10 ($p < 0.0001$), and openness to experience and M-C (1) 10 ($p = 0.0008$). No significant correlation exists between extraversion ($p = 0.8119$) and M-C (1) 10 scores. These results imply that participants responded in a socially desirable manner for four of the five personality variables. With no correlation between age and the M-C (1) 10 ($p = 0.8434$), these results suggest that regardless of age, participants completed the survey in a socially desirable manner. The above results support the researcher's decision to collect M-C (1) 10 scores from participants. Participants completed the survey instrument during the admissions process, and one can reason that during an admissions interview they were attempting to respond in a biased (i.e. socially desirable) manner. Table 9 represents the initial Pearson correlation between the M-C (1) 10 the Big Five personality variables and age.

Table 9

Pearson Correlations with M-C (1) 10 the Big Five Personality Variables and Age

	N	r	*p*
Conscientiousness	146	0.48031	< 0.0001*
Agreeableness	146	0.62408	< 0.0001*
Neuroticism	146	-0.45659	< 0.0001*
Openness	146	0.27438	0.0008*
Extraversion	146	0.01986	0.8119
Age	146	0.01649	0.8434

*indicates results are significant

Therefore, to address the confound that participants responded in a socially desirable manner the Big Five personality scores were adjusted for social desirability. Adjusting for social desirability was accomplished by the regression method described by Saunders (1991).

Research Question One

This question asked whether the Big Five personality variables are related to academic success (preclinical GPA, clinical GPA, PACKRAT score, PANCE score). Pearson correlations were estimated to determine the relationships between each of the Big Five personality traits to preclinical GPA, clinical GPA, PACKRAT, and PANCE score. As PANCE pass/fail is a dichotomous variable it was analyzed as a dependent variable with logistic regression. Scores from the Big Five personality traits (conscientiousness, agreeableness, neuroticism, openness to experience, extraversion) are measures on a five point Likert scale, where 1 represents disagree strongly and 5 represents agree strongly. Preclinical and clinical GPA scores range from 0 to 4.0. PACKRAT scores range from 0 to 225. Finally, PANCE scores range from 0 to 800. Table 10 represents the results of the descriptive statistics for the variables of interest.

Table 10

Descriptive Statistics for the Big Five Personality Traits and Academic Success Variables

	N	Mean	Std Dev
Conscientiousness (Adjusted)	146	2.88	0.411
Agreeableness (Adjusted)	146	2.45	0.354
Neuroticism (Adjusted)	146	4.21	0.529
Openness (Adjusted)	146	2.84	0.521
Extraversion (Adjusted)	146	3.69	0.697
Preclinical GPA	146	3.57	0.281
Clinical GPA	146	3.63	0.216
PACKRAT Score	146	140.16	15.59
PANCE Score	146	487.34	107.46

Table 11 (below) presents the Pearson correlations between each of the adjusted Big Five personality variables and academic success (preclinical GPA, clinical GPA, PACKRAT score, PANCE score and PANCE pass/fail). The significance level was set at the standard $p < 0.05$. Effect sizes were considered for their practical implication in PA school admissions decisions.

Table 11

Predicting Academic Success with the Big Five Personality Traits

r (*p*)	Conscientiousness	Agreeableness	Neuroticism	Openness	Extraversion
Preclinical GPA	0.19404 (0.0189*)	0.19067 (0.0212*)	-0.05633 (0.4995)	-0.03075 (0.7125)	0.03460 (0.6784)
Clinical GPA	0.19206 (0.0214*)	0.12490 (0.1331)	-0.13176 (0.1129)	0.12687 (0.1270)	0.19892 (0.0161*)
PACKRAT Score	0.10820 (0.1936)	0.16796 (0.0427*)	-0.09534 (0.2523)	0.05057 (0.5444)	0.05943 (0.4761)
PANCE Score	0.06456 (0.4388)	0.15737 (0.0578)	-0.01601 (0.8479)	-0.08277 (0.3206)	0.05688 (0.4953)

*indicates results are significant

Significant correlations exist between conscientiousness and preclinical GPA (p = 0.0189) and clinical GPA (p = 0.0214). No correlation was identified between conscientiousness and PACKRAT and PANCE scores.

Significant correlations exist between agreeableness and preclinical GPA (p = 0.0212) and PACKRAT (p = 0.0427). No correlation was identified between agreeableness and clinical GPA, or PANCE score. While no significant correlation existed between agreeableness and PANCE score, it was approaching significance (p = 0.0578).

No significant correlations exist between neuroticism and preclinical GPA, clinical GPA, PACKRAT, and PANCE score.

No significant correlations exist between openness to experience and preclinical GPA, clinical GPA, PACKRAT, and PANCE score.

Finally, significant correlations exist between extraversion and clinical GPA (p = 0.0161). No correlation exists between extraversion and preclinical GPA, PACKRAT, and PANCE score.

Predicting PANCE pass/fail with the Big Five Personality Traits

As previously discussed, PANCE pass/fail is dichotomous and therefore logistic regression was used to predict this outcome. Regression analysis yielded a significant relationship between PANCE pass/fail and agreeableness ($p = 0.023$). Regression analysis identified no relationship between PANCE pass/fail and conscientiousness, neuroticism, openness to experience, and extraversion. Table 12 represents the logistic correlations between PANCE pass/fail and each of the Big Five personality traits. The significance level was set at the standard $p < 0.05$.

Table 12

Predicting PANCE pass/fail with the Big Five Personality Traits

	N	*p*
Conscientiousness	146	0.5016
Agreeableness	146	0.0230*
Neuroticism	146	0.3414
Openness	146	0.0884
Extraversion	146	0.3764

*indicates results are significant

Research Question Two

This question asked whether preadmission cognitive variables (overall preadmission GPA and science GPA) are related to academic success (preclinical GPA, clinical GPA, PACKRAT score, PANCE score). To answer this question a Pearson correlation was conducted to describe the relationship between overall preadmission and science GPA to preclinical GPA, clinical GPA, PACKRAT, PANCE score, and PANCE pass/fail. As with question one, PANCE pass/fail is dichotomous it will therefore be predicted using logistic regression. To put the academic success variables into context, the preclinical and clinical GPA scores range from 0 to 4.0. PACKRAT scores range from 0 to 225. Finally, PANCE scores range from 0 to 800. Table

13 represents the results of the descriptive statistics for overall preadmission GPA, science GPA, and academic success variables.

Table 13

Descriptive Statistics: Overall Preadmission GPA, Science GPA and Academic Success Variables

	N	Mean	Std Dev
Overall Preadmission GPA	146	3.52	0.303
Preadmission Science GPA	146	3.42	0.354
Preclinical GPA	146	3.57	0.281
Clinical GPA	146	3.63	0.216
PACKRAT Score	146	140.16	15.59
PANCE Score	146	487.34	107.46

A significant correlation exists between overall preadmission GPA and preclinical GPA ($p < 0.0001$), clinical GPA ($p = 0.0279$), PACKRAT score ($p = 0.0158$), and PANCE score ($p = 0.0001$). Table 14 lists the Pearson correlations between the overall preadmission GPA and the academic success variables.

Table 14

Predicting Academic Success with the Preadmission Overall GPA

	N	R	*p*
Preclinical GPA	146	0.42673	< 0.0001*
Clinical GPA	146	0.18198	0.0279*
PACKRAT Score	146	0.19942	0.0158*
PANCE Score	146	0.31149	0.0001*

*indicates results are significant

Significant correlations exist for preadmission science GPA with preclinical GPA ($p < 0.0001$), clinical GPA ($p = 0.0355$), and PANCE score ($p = 0.0053$). No correlation exists between preadmission science GPA and PACKRAT score. Table 15 presents the Pearson correlations between the overall preadmission science GPA and the academic success variables.

Table 15

Predicting Academic Success with the Preadmission Science GPA

	N	R	*P*
Preclinical GPA	146	0.35268	< 0.0001*
Clinical GPA	146	0.17419	0.0355*
PACKRAT Score	146	0.13892	0.0945
PANCE Score	146	0.22952	0.0053*

*indicates results are significant

As previously discussed, PANCE pass/fail is dichotomous and therefore logistic regression was used to predict this outcome. Interestingly, there was no relationship between PANCE pass/fail and overall preadmission GPA or preadmission science GPA. Table 16 represents the logistic regression results.

Table 16

Predicting PANCE pass/fail with overall Preadmission GPA and Science GPA

	N	*p*
Preadmission Overall GPA	146	0.4337
Preadmission Science GPA	146	0.9408

Research Question Three

This question asked which noncognitive (Big Five personality traits) and cognitive traits (overall preadmission GPA and science GPA) can together predict academic success (preclinical GPA, clinical GPA, PACKRAT score, PANCE score). To answer this question two statistical methods were used: linear and logistic regressions.

Recall that preadmission overall GPA significantly predicted preclinical GPA ($p < 0.0001$), clinical GPA ($p = 0.0355$), and PANCE score ($p = 0.0053$), while no correlation existed between preadmission science GPA and PACKRAT score ($p = 0.0945$), see Table 15. As Table 14 demonstrates, the correlations for overall preadmission GPA were stronger than those for

preadmission science GPA for each outcome variable: preclinical GPA, clinical GPA, PACKRAT score,) and PANCE score. Including both science GPA and overall GPA in the multivariate prediction models would confound the results with collinearity. For these reasons the following analyses use only overall preadmission GPA as a predictor.

Predicting Preclinical GPA with the Big Five Personality Traits and Overall Preadmission GPA

Conscientiousness is not a significant predictor of preclinical GPA when included in a model with overall preadmission GPA also as a predictor. But, it did approach significance ($p = 0.0827$). Preadmission overall GPA alone predicted preclinical GPA with a significant R^2 of 0.1821. Adding conscientiousness improved that R^2 to 0.1992, i.e., a 0.0171 improvement in R^2 ($p = 0.0827$).

Agreeableness is a significant predictor of preclinical GPA when included in a model with overall preadmission GPA also as a predictor ($p = 0.0154$). Preadmission overall GPA alone predicted preclinical GPA with a significant R^2 of 0.1821. Adding agreeableness improved that to 0.2151, i.e., a 0.0330 improvement in R^2 ($p = 0.0154$).

Neuroticism is not a significant predictor of preclinical GPA when included in a model with overall preadmission GPA also as a predictor. Preadmission overall GPA alone predicted preclinical GPA with a significant R^2 of 0.1821. Adding neuroticism improved that to 0.1909, i.e., a 0.0088 improvement in R^2 ($p = 0.2144$).

Openness is not a significant predictor of preclinical GPA when included in a model with overall preadmission GPA also as a predictor. Preadmission overall GPA alone predicted preclinical GPA with a significant R^2 of 0.1821. There was no improvement in R^2 when openness is added ($p = 1.0$).

Extraversion is not a significant predictor of preclinical GPA when included in a model with overall preadmission GPA also as a predictor. Preadmission overall GPA alone predicted preclinical GPA with a significant R^2 of 0.1821. Adding extraversion improved that to 0.1824, i.e., a 0.0003 improvement in R^2. (p = 0.8191).

Table 17 represents the inferential tests of difference models to predict preclinical GPA. Model 1 predicts preclinical GPA using preadmission overall GPA alone. Models 2 through 6 add each of the Big Five personality predictors to preadmission overall GPA to predict preclinical GPA.

Table 17

Inferential Tests for Predicting Preclinical GPA with Preadmission Overall GPA and the Big Five Personality Traits

	Predictors	R^2	*p* – value	ΔR^2	p (ΔR^2)
Model 1	Preadmission overall GPA	0.1821	<0.0001		
Model 2	Preadmission overall GPA Conscientiousness	.0.1992	<0.0001	0.0171	0.0827
Model 3	Overall Preadmission GPA Agreeableness	0.2151	<0.0001	0.033	0.0154*
Model 4	Overall Preadmission GPA Neuroticism	0.1909	<0.0001	0.0088	0.2144
Model 5	Overall Preadmission GPA Openness	0.1821	<0.0001	0	1
Model 6	Overall Preadmission GPA Extraversion	0.1824	<0.0001	0.0003	0.8191

*indicates results are significant

Predicting Clinical GPA with the Big Five Personality Traits and Preadmission Overall GPA

Conscientiousness is a significant predictor of clinical GPA when included in a model with overall preadmission GPA ($p = 0.0441$) also as a predictor. Preadmission overall GPA alone predicted clinical GPA with a significant R^2 of 0.0331. Adding conscientiousness improved that to 0.0602, i.e., a 0.0271 improvement in R^2 ($p = 0441$).

Agreeableness is not a significant predictor of clinical GPA when included in a model with overall preadmission GPA also as a predictor. Preadmission overall GPA alone predicted clinical GPA with a significant R^2 of 0.0331. Adding agreeableness improved that to 0.0478, i.e., a 0.0147 improvement in R^2 ($p = 0.1395$).

Neuroticism is not a significant predictor of clinical GPA when included in a model with preadmission overall GPA also as a predictor. However, it did approach significance ($p = 0.0701$). Preadmission overall GPA alone predicted clinical GPA with a significant R^2 of 0.0331. Adding neuroticism improved that to 0.0551, i.e., a 0.022 improvement in R^2 ($p = 0.0279$).

Openness is not a significant predictor of clinical GPA when included in a model with preadmission overall GPA also as a predictor. Preadmission overall GPA alone predicted clinical GPA with a significant R^2 of 0.0331. Adding openness improved that to 0.0523, i.e., a 0.0192 improvement in R^2 ($p = 0.0909$).

Extraversion is a significant predictor of clinical GPA when included in a model with preadmission overall GPA ($p = 0.0184$) also as a predictor. Preadmission overall GPA alone predicted clinical GPA with a significant R^2 of 0.0331. Adding extraversion improved that to 0.0701, i.e., a 0.0370 improvement in R^2 ($p = 0.0184$).

Table 18 represents the inferential tests of difference models to predict clinical GPA. Model 1 predicts clinical GPA using preadmission overall GPA. Models 2 through 6 add each of the Big Five personality predictors to preadmission overall GPA to predict clinical GPA.

Table 18

Inferential Tests for Predicting Clinical GPA with Preadmission Overall GPA and the Big Five Personality Traits

	Predictors	R^2	*p* – value	ΔR^2	p (ΔR^2)
Model 1	Preadmission overall GPA	0.0331	0.0279		
Model 2	Preadmission overall GPA Conscientiousness	0.0602	0.0118	0.0271	0.0441*
Model 3	Preadmission overall GPA Agreeableness	0.0478	0.302	0.0147	0.1395
Model 4	Preadmission overall GPA Neuroticism	0.0551	0.0174	0.022	0.0701
Model 5	Preadmission overall GPA Openness	0.0523	0.0214	0.0192	0.0909
Model 6	Preadmission overall GPA Extraversion	0.0701	0.0055	0.037	0.0184*

*indicates results are significant

Predicting PACKRAT Score with the Big Five Personality Traits and Preadmission Overall GPA

Conscientiousness is not a significant predictor of PACKRAT score when included in a model with preadmission overall GPA also as a predictor. Preadmission overall GPA alone predicted PACKRAT score with a significant R^2 of 0.0398. Adding conscientiousness improved that to 0.0460, i.e., a 0.0062 improvement in R^2 ($p = 0.3367$).

Agreeableness is a significant predictor of PACKRAT score when included in a model with overall preadmission GPA ($p = 0.0446$) also as a predictor. Preadmission overall GPA

alone predicted PACKRAT score with a significant R^2 of 0.0398. Adding agreeableness improved that to 0.0666, i.e., a 0.0268 improvement in R^2 ($p = 0.0446$).

Neuroticism is not a significant predictor of PACKRAT score when included in a model with overall preadmission GPA also as a predictor. Preadmission overall GPA alone predicted PACKRAT score with a significant R^2 of 0.0398. Adding neuroticism improved that to 0.0526, i.e., a 0.0128 improvement in R^2 ($p = 0.1667$).

Openness is not a significant predictor of PACKRAT score when included in a model with overall preadmission GPA also as a predictor. Preadmission overall GPA alone predicted PACKRAT score with a significant R^2 of 0.0398. Adding openness improved that to 0.0438 i.e., a 0.004 improvement in R^2 ($p = 0.4405$).

Extraversion is not a significant predictor of PACKRAT score when included in a model with overall preadmission GPA also as a predictor. Preadmission overall GPA alone predicted PACKRAT score with a significant R^2 of 0.0398. Adding extraversion improved that to 0.0425, i.e., a 0.0027 improvement in R^2 ($p = 0.5264$).

Table 19 represents the inferential tests of difference models to predict PACKKRAT score. Model 1 predicts PACKRAT score using preadmission overall GPA. Models 2 through 6 add each of the Big Five personality variables to the preadmission overall GPA to predict PACKRAT score.

Table 19

Inferential Test for Predicting the PACKRAT Score with the Preadmission Overall GPA and the Big Five Personality Traits

	Predictors	R^2	*p* – value	ΔR^2	p (ΔR^2)
Model 1	Preadmission Overall GPA	0.0398	0.0158		
Model 2	Preadmission Overall GPA Conscientiousness	0.046	0.0345	0.0062	0.3367
Model 3	Preadmission Overall GPA Agreeableness	0.0666	0.0072	0.0268	0.0446*
Model 4	Preadmission Overall GPA Neuroticism	0.0526	0.0211	0.0128	0.1667
Model 5	Preadmission Overall GPA Openness	0.0438	0.0408	0.004	0.4405
Model 6	Preadmission Overall GPA Extraversion	0.0425	0.0449	0.0027	0.5264

*indicates results are significant

Predicting PANCE Score with the Preadmission Overall GPA and the Big Five Personality Traits

Conscientiousness is not a significant predictor of PANCE score when included in a model with overall preadmission GPA also as a predictor. Preadmission overall GPA alone PANCE score predicted with a significant R^2 of 0.0970. Adding conscientiousness improved that to 0.0973, i.e., a 0.0003 improvement in R^2 ($p = 0.8277$).

Agreeableness is not a significant predictor of PANCE score when included in a model with overall preadmission GPA also as a predictor. However, it did approach significance ($p = 0.0563$). Preadmission overall GPA alone predicted PANCE score with a significant R^2 of 0.0970. Adding agreeableness improved that to 0.1198, i.e., a 0.0228 improvement in R^2 ($p = 0.0563$).

Neuroticism is not a significant predictor of PANCE score when included in a model with overall preadmission GPA also as a predictor. Preadmission overall GPA alone predicted PANCE score with a significant R^2 of 0.0970. Adding neuroticism improved that to 0.0989, i.e., a 0.0019 improvement in R^2 ($p = 0.5838$).

Openness is not a significant predictor of PANCE score when included in a model with overall preadmission GPA also as a predictor. Preadmission overall GPA alone predicted PANCE score with a significant R^2 of 0. 0.0970. Adding openness improved that to 0.1010 i.e., a 0.004 improvement in R^2 ($p = 0.4264$).

Extraversion is not a significant predictor of PANCE score when included in a model with overall preadmission GPA also as a predictor. Preadmission overall GPA alone predicted PANCE score with a significant R^2 of 0. 0.0970. Adding extraversion improved that to 0.0991, i.e., a 0.0021 improvement in R^2 ($p = 0.5646$).

Table 20 represents the inferential tests of difference models to predict PANCE score. Model 1 predicts PANCE score using preadmission overall GPA alone. Models 2 through 6 add each of the Big Five personality predictors to preadmission overall GPA to predict PANCE score.

Table 20

Inferential Tests for Predicting PANCE Score with Preadmission Overall GPA and the Big Five Personality Traits

	Predictors	R^2	*p* – value	ΔR^2	p (ΔR^2)
Model 1	Preadmission Overall GPA	0.097	0.0001		
Model 2	Preadmission Overall GPA Conscientiousness	0.0973	0.0007	0.0003	0.8277
Model 3	Preadmission Overall GPA Agreeableness	0.1198	0.0001	0.0228	0.0563
Model 4	Preadmission Overall GPA Neuroticism	0.0989	0.0006	0.0019	0.5838
Model 5	Preadmission Overall GPA Openness	0.101	0.0005	0.004	0.4264
Model 6	Preadmission Overall GPA Extraversion	0.0991	0.0006	0.0021	0.5646

Predicting PANCE pass/fail with Preadmission Overall GPA and the Big Five Personality Traits

As previously discussed, PANCE pass/fail is dichotomous and therefore logistic regression was used to predict this outcome.

Conscientiousness alone is not a significant predictor of PANCE pass/fail. Conscientiousness is not a significant predictor of PANCE pass/fail when combined with preadmission overall GPA.

Agreeableness alone is a significant predictor of PANCE pass/fail (p = 0.0230). Agreeableness demonstrates that for every 1-point increase in Agreeableness score, e.g. move from 3 to 4 on the Agreeableness scale, the participant has a 5.142 fold increase in his odds of passing the PANCE. When combined with preadmission overall GPA agreeableness is a

significant predictor of PANCE pass/fail together ($p = 0.0229$). However, there is no significant increase in predictive value ($p = 0.4419$) from agreeableness alone after adding preadmission overall GPA.

Neither neuroticism, openness, nor extraversion are significant predictors of PANCE pass/fail. Neither neuroticism, openness, nor extraversion are significant predictors of PANCE pass/fail together with preadmission overall GPA.

Summary

This chapter presented the results of the study. Data were collected from 146 PA students in a state higher education institution. SAS 9.4 for Windows (SAS Institute, Cary, NC) was used for analyses.

Research question one, pertaining to the relationship between the Big Five personality traits and academic success, identified three of the Big Five personality traits significantly correlated with academic success. Specifically, conscientiousness is correlated with the preclinical GPA ($p = 0.0189$) and clinical GPA ($p = 0.0214$), agreeableness is correlated with preclinical GPA ($p = 0.0212$) and PACKRAT score ($p = 0.0427$), and extraversion is correlated with clinical GPA ($p = 0.0161$). As well, logistic regression identified that agreeableness ($p = 0.023$) is associated with PANCE pass/fail.

Research question two, pertaining to the relationship between preadmission academic variables and PA student success, identified overall preadmission GPA as significantly correlated with preclinical GPA ($p < 0.0001$), clinical GPA ($p = 0.0279$), PACKRAT score ($p = 0.0158$), and PANCE score ($p = 0.0001$). The preadmission science GPA is significantly correlated with preclinical GPA ($p < 0.0001$), clinical GPA ($p = 0.0355$), and PANCE score ($p = 0.0053$).

Research question three assessed multivariate relationships between the Big Five personality variables along with preadmission cognitive variables as predictors of PA student academic performance/success. Multiple linear regression identified agreeableness ($p = 0.0154$) and preadmission overall GPA as co-predictors of preclinical GPA. Multiple linear regression identified conscientiousness ($p = 0.0442$) and extraversion ($p = 0.0184$) together with preadmission overall GPA as co-predictors of clinical GPA. Multiple linear regression also identified agreeableness ($p = 0.0445$) together with preadmission overall GPA as co-predictors of PACKRAT score. Logistic regression identified a relationship between agreeableness ($p = 0.023$) and PANCE pass/fail. Multiple logistic regression identified agreeableness ($p = 0.0229$) together with preadmission overall GPA as co-predictors of PANCE pass/fail. Finally, there is no significant increase in predictive value ($p = 0.4419$) from agreeableness alone after adding preadmission overall GPA.

Chapter 4 included data analysis to investigate the three questions presented in the study. Chapter 5 discusses these findings, their limitations, and their potential implications. To conclude, recommendations for further study are offered.

Chapter Five: Discussion

Overview of the Study

The primary purpose of the study was to determine if noncognitive variables (Big Five personality traits) and cognitive variables (overall preadmission and science GPA) predict PA student academic success (defined here as preclinical GPA, clinical GPA, PACKRAT score, PANCE score and PANCE pass/fail). The findings of this study lend support to some prior research and shed light on potential new directions for PA education research. This chapter presents the major findings of the study in the context of the current literature, the scientific and practical implications of the findings, the study limitations, and concludes with suggested topics for future research.

Research Questions

This study was designed to answer three research questions: (1) What relationships do personality traits, as measured by the Big Five Inventory, have with academic performance, as indicated by program preclinical GPA, clinical GPA, PACKRAT, PANCE score, and PANCE pass/fail? (2) What relationships, if any, do preadmission overall and science GPA scores have with PA program academic performance, as indicated by program preclinical GPA, clinical GPA, PACKRAT, PANCE score, and PANCE pass/fail? (3) What Big Five Inventory characteristics (conscientiousness, agreeableness, neuroticism, openness to experience, extraversion), preadmission overall GPA and science GPA predict academic success in PA school (preclinical GPA, clinical phase GPA, PACKRAT, PANCE score, and PANCE pass/fail)? The first two questions were approached by Pearson correlation testing and logistic regression. The third question applied linear and logistic regression. Any significant effects were identified at an appropriate significance level ($p \leq 0.05$).

The findings of this study revealed that three of the Big Five (noncognitive) personality variables were related to academic success. Specifically, conscientiousness was positively correlated with preclinical and clinical GPA. Therefore, the more conscientious the participant the higher the resulting preclinical and clinical GPAs. Agreeableness was positively correlated with preclinical GPA and PACKRAT score. Therefore, the more agreeable the participant the higher the resulting preclinical GPA and PACKRAT scores. PANCE pass/fail was also positively correlated with agreeableness. Therefore, the more agreeable the participant the higher the likelihood of passing the PANCE. Finally, extraversion was positively correlated with clinical GPA. Therefore, the more extraverted the participant the higher the resulting clinical GPA.

This study also examined the relationship between cognitive factors (overall preadmission and science GPA) and academic success. Findings revealed that higher overall preadmission GPA was related to increased academic success, where specifically an overall preadmission GPA was positively correlated with preclinical GPA, clinical GPA, PACKRAT score, and PANCE score. Therefore, the higher the participants' overall preadmission GPA the better their preclinical GPA, clinical GPA, PACKRAT score, and PANCE score. A higher science GPA was positively correlated with preclinical GPA, clinical GPA, and PANCE score. Therefore, the higher the participant's science GPA the better their preclinical GPA, clinical GPA, and PANCE score. Interestingly, PANCE pass/fail was not significantly related to overall preadmission or science GPA.

Finally, this study examined what noncognitive (Big Five personality traits) and cognitive traits (overall preadmission GPA and science GPA) can together predict academic success. Findings revealed that conscientiousness was a significant predictor together with overall

preadmission GPA when predicting clinical GPA. Agreeableness was correlated with preclinical GPA when predicting together with overall preadmission GPA. Agreeableness was also a significant predictor together with overall preadmission GPA when predicting PACKRAT score. That is, agreeableness adds significantly to the predictive value of the PACKRAT score above the overall preadmission GPA alone. Extraversion was a significant predictor together with overall preadmission GPA when predicting clinical GPA.

Finally, logistic regression identified a relationship between agreeableness and PANCE pass/fail when predicting together with overall preadmission GPA. That is, the higher the participant's agreeableness the higher likelihood he or she passed the PANCE on his or her first attempt. While agreeableness was predictive of PANCE pass/fail when predicting with overall preadmission GPA, there was no significant increase in predictive value outside of agreeableness alone. These and related findings are discussed in the following pages.

Conclusions and Major Findings

Research question one: Correlation to determine the relationship between noncognitive (Big Five personality traits) factors and academic performance. The Pearson correlation coefficients among the Big Five personality traits (conscientiousness, agreeableness, neuroticism, openness to experience, extraversion) and academic success indicated positive relationships for three out of five of the personality traits (conscientiousness, agreeableness, extraversion). Cohen (1988) provides guidelines to use when interpreting the strength of the R^2 effect size in correlations, where 0.01 is a small correlation, 0.09 is a medium correlation, and 0.25 is a large correlation. Applying Pearson's R^2 correlation and Cohen's definitions, conscientiousness ($R^2 = 0.038$) had a small relationship to preclinical GPA. Conscientiousness ($R^2 = 0.036$) had a small relationship to clinical GPA. Agreeableness ($R^2 = 0.036$) had a small

relationship to preclinical GPA. Agreeableness ($R^2 = 0.028$) had a small relationship to PACKRAT score. Extraversion ($R^2 = 0.040$) had a small relationship to clinical GPA.

The current medical literature has shown that students with higher levels of conscientiousness will achieve higher levels of academic success than students with lower levels of conscientiousness (Doherty & Nugent, 2011; Ferguson et al., 2003; Grehan et al., 2011; Haight et al., 2012; Hojat et al., 2013; Lievens et al., 2002; Lievens et al., 2009; McAbee & Oswald, 2013; Moser & Dereczyk, 2012; Tyssen et al., 2007). The results of this study identified significant relationships between conscientiousness and preclinical and clinical GPA among PA students, and therefore align with previous conclusions.

Research suggests that medical students higher in agreeableness would outperform students lower in agreeableness in the clinical phase (Hojat et al., 2013). The results of this study did not identify a positive or negative relationship between agreeableness and clinical GPA. The results of this study suggest that PA students who are higher in agreeableness outperform students lower in agreeableness on the PACKRAT. Logistic regression identified a relationship between agreeableness and PANCE pass/fail. Therefore, the higher the participant's agreeableness the higher likelihood he or she passed the PANCE.

Research has identified students with higher levels of neuroticism are more likely to perform poorly on academic tests (Hojat et al., 2013). The results of this study did not identify a positive or negative relationship between neuroticism and academic success. Therefore, this study of PA students did not support that conclusion from previous research.

Prior research identified students who were higher in openness to experience achieved higher levels of academic success than students who had lower levels of openness to experience, especially in the clinical phase (Lievens et al., 2002; Lievens et al., 2009). The results of this

study did not identify a positive or negative relationship between openness to experience and academic success. Therefore, this study of PA students did not support the conclusion from previous studies.

Research has identified that students with higher levels of extraversion will achieve higher levels of academic success than students with lower levels of extraversion. Specifically, extraversion more consistently predicts clinical performance (Davis & Banken, 2005; Ferguson et al., 2003; Haight et al., 2012; Hojat et al., 2004; Knights & Kennedy, 2007; McManus et al., 2004; Tyssen et al., 2007). The results of this study concur with prior medical literature identifying a significant relationship between extraversion and clinical GPA.

Research question two: Correlation to determine the relationship of cognitive (overall preadmission and science GPA) factors to academic performance. The research found that overall preadmission GPA ($R^2 = 0.182$) had a medium relationship to preclinical GPA, overall preadmission GPA ($R^2 = 0.033$) had a small relationship to clinical GPA, overall preadmission GPA ($R^2 = 0.040$) had a small relationship to PACKRAT score, and overall preadmission GPA ($R^2 = 0.097$) had a medium relationship to PANCE score.

Preadmission science GPA ($R^2 = 0.124$) had a medium relationship to preclinical GPA; preadmission science GPA ($R^2 = 0.030$) had a small relationship to clinical GPA, and preadmission science GPA ($R^2 = 0.053$) also had a small relationship to PANCE score.

In examination of the current literature the present results confirm what other medical researchers (Ferguson et al., 2003; Haight et al., 2012; Julian, 2005; Koenig et al., 1998; Kulatunga Moruzi & Norman, 2002; McManus et al., 2005; McManus et al., 2003; Tyssen et al., 2007) have reported; significant relationships between cognitive variables, i.e., cumulative GPA, science GPA, MCAT and GRE score, and academic success exist in medical school. This study

confirms other PA education research concluding that students meeting higher academic standards, such overall GPA, science GPA, and GRE have higher degrees of academic success in PA programs (Andreeff, 2014; Ennulat et al., 2011; Higgins et al., 2010; Jones et al., 2014).

Research question three: Multiple regression modeling to predict the relationship between noncognitive and cognitive variables and academic success. The regression model found agreeableness is a significant predictor of preclinical GPA and PACKRAT score when predicting together with overall preadmission GPA. Conscientiousness is also a significant predictor of clinical GPA when predicting with overall preadmission GPA. Extraversion is a significant predictor of clinical GPA when predicting together with overall preadmission GPA. When considering PANCE pass/fail, only agreeableness was a significant predictor of outcome. Agreeableness was a significant predictor of PANCE pass/fail when predicting together with overall preadmission GPA. However, there was no significant increase in predictive value ($p = 0.4419$) from agreeableness alone after adding overall preadmission GPA. Therefore, having the ability to measure agreeableness, conscientiousness, and extraversion adds to the predictive value of academic success above and beyond overall preadmission GPA alone in the admissions process.

In summary, noncognitive and cognitive traits are related to PA student academic success. Specifically, conscientiousness is positively associated with preclinical and clinical GPA. Individuals high in conscientiousness may be better able to perform academically and clinically given those persons tend to be organized, efficient, self-disciplined, circumspect, adherent to principles, and hold a need to achieve (Chibnall et al., 2009; Lievens et al., 2009). Agreeableness is positively associated with preclinical GPA and PACKRAT score. Agreeableness is positively associated with PANCE pass/fail. That is, the more agreeable the

participant is, the more likely he or she will pass the PANCE. More agreeable individuals may be better able to persevere through the rigors of PA education. An individual higher in agreeableness indicates someone who is empathic, cooperative, straightforward, and sensitive; these traits are important to the patient-provider relationship (Chibnall et al., 2009; Lievens et al., 2002; Lievens et al., 2009) and associated with positive clinical outcomes (Magalhães et al., 2012). Furthermore, extraversion is positively associated with clinical GPA. Based on the literature, this would stand to reason given that individuals higher in extraversion indicate a person who is confident, assertive, social (John & Srivastava, 1999), friendly, and has a tendency toward group affiliation (Chibnall et al., 2009).

Finally, overall preadmission GPA is positively associated with each of the academic success variables (preclinical GPA, clinical GPA, PACKRAT score, PANCE score). That is, the higher the preadmission overall GPA the higher the participants preclinical GPA, clinical GPA, PACKRAT score, and PANCE score. Specifically, preadmission science GPA is positively associated with preclinical GPA, clinical GPA, and PANCE score. That is, the higher the participants' science GPA, the higher the preclinical GPA, clinical GPA, and PANCE score.

Implications

In general, many implications are present in these results, and several will be explained in the following section in order to assist PA educational administrators, admissions committees, advisors, and faculty. First, cognitive variables are related to PA student academic success. Second, noncognitive variables (personality traits) are related to PA student academic success.

In this study, PA students scoring higher in conscientiousness, agreeableness, and extraversion had better academic outcomes (preclinical GPA, clinical GPA, and PACKRAT score) than those scoring lower in conscientiousness, agreeableness, and extraversion. This study

also found that cognitive variables (overall preadmission and science GPA) correlate with PA students' academic success, supporting the notion that prior success predicts future success (Jones et al., 2014). This study also supports the conclusion made by Jones et al. (2014), that success in the classroom is based on a different set of variables from those in the clinical setting.

Limitations

In examining the results of this study, certain limitations should be considered. These limitations include: survey instrument selection, generalizability, range restriction, multicollinearity, small validity coefficients, changes in predictor-criterion, and clinical GPA calculation.

Survey instrument selection. The survey instrument selected for this study was the BFI, with the M-C (1) 10 incorporated. The BFI and M-C (1) 10 have demonstrated reliability and validity. The BFI measures only the Big Five personality variables and does not include other noncognitive traits such as grit, determination, resilience, professionalism, and empathy. Each of these listed noncognitive traits as well as others may contribute to academic success but they were not included in this study.

Generalizability. This study is a retrospective study completed at one PA program in the midwest of the United States. Therefore, different results may occur in other locations across the country and the results of this study cannot be generalized to other programs.

Range Restriction. Restricted range is one reason for the low correlations found in this study (Muijs, 2011). According to Hojat et al. (2013), correlation coefficients are highly dependent on the range and variability of the measures which are limited through selection and attrition of students. Therefore, select admissions criteria, e.g., minimum overall preadmission GPA requirements, restrict the range of the variables thereby shrinking validity coefficients.

Attrition further limits the range of the variables by limiting range only to those students who completed the program (Hojat et al., 2013). The admissions process, as previously discussed, limits the range of applicant GPAs; that is, by the time applicants are selected for interviews their GPAs tend to have a small range of possible values (Muijs, 2011). The range is further restricted by the final admission selection process. The range restriction identified in this study causes the correlation coefficients to be artificially low (Muijs, 2011). The only way to effectively address this in a study would be to randomly select students for inclusion without concern for preadmission cognitive variables. Therefore, this study was limited by range restriction for the above reasons.

Multicollinearity. The present analyses were challenged by collinearity. As described by Hojat et al. (2013), relationships between personality traits and academic success traits cannot be realized when the predictors themselves are highly correlated. Multicollinearity occurs when variables are strongly correlated with one another (Muijs, 2011). For example, in this study, the overall preadmission GPA and Science GPA were strongly correlated with one another. This finding suggests that the two variables are measuring the same thing (Muijs, 2011). The collinearity of the two variables effectively cancel one another out in multivariate models. To effectively manage this, the researcher utilized the better of the two variables, and found overall GPA was a better predictor of academic success. Utimately, the issue of collinearity may account for the modest multivariate associations (Hojat et al., 2013) reported here and in other research.

Small validity coefficients. Overall, in this study the validity coefficients for personality traits are relatively small. The validity coefficients are not surprising as the predictive validity coefficients for this study are statistically small. Concerns on this issue have been raised

previously and may be one of the reasons some researchers have questioned the use of personality measures in medical education admissions (Hojat et al., 2013). According to Hojat et al. (2013) such small validity coefficients should not come as a surprise "given the conceptual and methodological issues involved in studying the relationships between personality measures on the one hand, and criterion measures on the other hand" (p. 1285). To put the validity coefficients in context, it is important to understand that they are to be expected in personality research. According to Hojat et al. (2013), the average validity coefficient for personality research is only 0.21. In graduate medical education the average predicitive validity coefficient is only 0.14 (Hojat et al., 2013). Ultimately, from a practical standpoint, any additional evidence-based information that can be used in admissions decisions is a positive. Not only can the evidence in this study assist admission committees to make better admissions decisions but it can help faculty advisors provide better guidance for their students' academic success.

Changes in predictor-criterion. The variation of the predictive validity of personality measures changes over the course of a medical student's education, that is, it changes from the preclinical to clinical phase. In the preclinical phase students are evaluated by exams that recall factual information. Clinical phase students are evaluated by the clinical faculty's ratings of clinical competence or by simulated patients in an OSCE and other methods. Therefore, different skills and abilities are measured in different phases of the curriculum. In one phase students are being evaluated over their test taking skills and ability to recall factual information while in the other phase students are being evaluated, at least in part, on their interpersonal and communication skills, attitudes, and bedside mannerisms (Hojat et al., 2013).

Clinical GPA. The clinical GPA was calculated from three discreet areas: preceptor evaluation of the student, end-of-rotation exam, and in-course assignments. Therefore, the

correlation identified in clinical GPA represents not only clinical performance as judged by the clinical faculty but also multiple-choice exam and assignment performance; ultimately this may have introduced noise and affected the correlation between clinical GPA and the academic success variables.

Recommendations

Physician assistant programs, specifically, admissions committees, faculty advisors, and program directors should be aware of some recommendations based on the current research findings. Based on this study's results, the following recommendations are provided:

- Additional research should be conducted using a larger and broader sample of PA students, to increase the generalizability of the findings. For example, a sample of students from various regions of the country and in larger communities may yield significantly different results.
- Additional research should be undertaken which more fully considers the implications of ethnic diversity and socioeconomic factors.
- Additional research should be undertaken which more fully examines the Big Five personality traits and their impact on clinical phase success.
- Additional research should examine additional noncognitive traits such as learning motivation, grit, determination, and professionalism in PA student success.
- Additional research should examine the association between the Big Five personality traits and PA student professionalism measures.
- Additional research should include the Big Five personality traits and their impact on clinical practice performance (e.g., patient satisfaction and clinical outcomes).

- Additional research should include the Big Five personality traits and overall career satisfaction for PAs.

Concluding Comments

The results of the study suggest that academic success is affected by both participants' cognitive and noncognitive traits. That is to say, prior success and individual personality traits each contribute to PA school academic performance. This study reaffirms that cognitive variables (overall preadmission and science GPA) are associated with academic success in PA school as higher overall preadmission and science GPAs (cognitive variables) correlate to a student receiving a higher preclinical GPA, clinical GPA, PACKRAT score, and PANCE score. A review of the literature suggests that these cognitive factors have become the gold standard used by admissions committees to predict medical school performance (Kulatunga Moruzi & Norman, 2002), and these cognitive factors have shown to be the best predictors of academic success in the health professions (Jones et al., 2014).

Although this study is not suggesting that PA programs disregard students' cognitive traits as prior success does predict future success, the results do demonstrate that personality traits (noncognitive) contribute significantly to a student's academic success in PA school. Therefore, including both cognitive and noncognitive considerations in the admissions process would provide additional information for admissions committees to make educated, evidence-based admissions decisions. While prior research has shown that cognitive traits lose some predictive power as medical students move from the preclinical to clinical phase of the program, and noncognitive traits become increasingly meaningful as students' progress to actual patient care (Lievens et al., 2009), this study suggests that personality traits, specifically agreeableness and extraversion are associated with academic success in the clinical phase. These findings

concur with the conclusion by Jones et al. (2014) that student success in the classroom is based on a different set of skills than student success in the clinical phase.

This research has identified a uniform model that can be used for future PA student personality research. The use of multiple personality instruments in medical education has presented a unique challenge in interpreting results across instruments and reinforces the importance of selecting a personality instrument that measures those attributes that are relevant to performance in medical education and patient care (Hojat et al., 2013). Lievens, Coetsier, De Fruyt, and De Maeseneer (2002) suggest that the five-factor model "may serve as a uniform, comprehensive and robust framework for describing medical students' personality characteristics and for substantially advancing our understanding of whether these traits relate to academic success" (p. 1051).

Ultimately, the present study identifies both cognitive and noncognitive traits which contribute to higher academic performance in PA students. Additionally, the results of this study add to the literature on the value of cognitive and noncognitive variables among PA students in the admissions and advising process.

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Appendix A

University of South Dakota IRB Approval

UNIVERSITY OF SOUTH DAKOTA

December 18, 2015

The University of South Dakota
414 E. Clark Street
Vermillion, SD 57069

PI: William Schweinle,Wade Nilson, Becca Jordre,Julie Johnson **Student PI:** None
Project: 2009.004 - Personality Characteristics and Performance of Physician Assistant Student
Review Level: Expedited 5&7 **Risk:** No More than Minimal Risk
USD IRB Project Approval Period: 12/18/2015-12/17/2016
Continuation or Closure due before: 12/3/2016
Approved items associated with your project:

Date Stamped Informed Consent (4)

Your request for continuation of the above referenced project has been approved by the University of South Dakota Institutional Review Board.

This project has been approved through 12/17/2016.

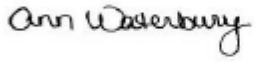
Attached is your original consent document that has been stamped with the IRB approval and expiration dates. You must keep this original on file. Please use this original consent document to make copies for subject enrollment. No other consent form should be used. It must be signed by each subject prior to initiation of any protocol procedures. In addition, each subject must be given a copy of the signed consent form.

When this study is completed please submit a closure form to the IRB. If the study is to continue for more than one year, a continuation form is to be submitted to the IRB prior to the end of the year along with a requesting approval to continue the research study. You must obtain PRIOR approval for any significant changes in your research project.

The forms to assist you in filing your: project closure, continuation, adverse/unanticipated event, project updates /amendments, etc. can be accessed at http://www.usd.edu/research/research-and-sponsored-programs/irb-application-forms-and-templates.cfm.

If you have any questions, please contact: humansubjects@usd.edu or (605) 677-6184.

Sincerely,



Ann Waterbury, M.B.A.
Director, Office of Human Subjects
University of South Dakota
(605) 677-6067

Appendix B

Program Interviewee Consent

IRB Approval effective from: 12/18/2015
IRB Approval not valid after: 12/17/2016
USD IRB

UNIVERSITY OF SOUTH DAKOTA
PA PROGRAM INTERVIEWEE
Informed Consent Statement

Title of Project: Physician Assistant Personality Profile Study

Principle Investigators: William E. Schweinle, PhD
101C Julian Hall, USD
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Wade Nilson, PA-C
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Vermillion, SD 57069
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Other Investigators: Betty Hulse, PA-C, 101D Julian Hall, USD, Vermillion, SD 57069
Julie Johnson, MD, 101A Julian Hall, USD, Vermillion, SD 57069

Purpose of the Study: The purpose of this study is to define some of the personality characteristics that are most important to a physician assistant. Results from this study will help the USD and other physician assistant programs make better admissions decisions. It will also help physician assistant faulty members better advise students about how they can improve their effectiveness as physician assistants, take better advantage of their educational opportunities, and make better career choices.

Procedure: You will be asked to complete a 20-30 minute survey and to allow us to use some of your academic information for the purpose of this research. The academic information used in this research may include:

- The information included in your application to the USD Physician Assistant Program, including:
  - Your CASPA application information
  - Your USD Graduate School Application
  - Your admissions interview responses
  - Faculty evaluations of your admissions interview
  - Your responses to the USD PA Program Questionnaires

Risks: The risk for participating in this research is minimal and does not exceed the risks you encounter in your academic life. Some of the survey questions may cause you some discomfort, though this is very unlikely. If you feel discomfort in answering any of the survey questions, you may contact the investigators at any time.

There is a very small chance that the confidentiality of your academic records may be compromised. However, this risk will not exceed the risk that you already bear as a USD Physician Assistant applicant. All of the research data will be maintained under the same secure conditions as your other application information, all of which is protected by federal law in the **Family and Education Right to Privacy Act**.

If you would have any questions and would like to discuss the risks of this study with the investigators, please contact us.

Benefits: The direct benefits to you directly are minimal. However,

- You may learn more about yourself. You might also learn more about how you may best fulfill the professional role of physician assistant
- This research will benefit the physician assistant profession and ultimately the patients that physician assistants serve. Your agreement to participate in this research will help to improve the selection, education and advising of physician assistant students.

Duration: It will take 20 to 30 minutes to complete the survey.

Statement of Confidentiality: If this research is presented or published, no information that would identify you will be included. The results will be presented only in aggregate form, and your identifiers will in no way be linked to your responses.

All survey responses that we receive will be treated confidentially and stored in a locked file cabinet in the USD Physician Assistant Office. All of the academic information used in this research will also be kept in a locked file cabinet in the USD Physician Assistant Program Office. All of the electronic research data files will be kept on a secure, password protected university server.

Right to Ask Questions: The researchers conducting this study are William Schweinle, PhD and Wade Nilson, PA-C. You may ask any questions you have now. If you later have questions, concerns, or complaints about the research please contact Prof. Schweinle or Prof. Nilson at (605) 677-5128 during the day.

If you have questions regarding your rights as a research subject, you may contact The University of South Dakota Institutional Review Board at (605) 677-6184. You may also call this number with problems, complaints, or concerns about the research. Please call this number if you cannot reach research staff, or if you wish to talk with someone who is an informed individual and is independent of the research team.

General information about being a research subject can be found on the IRB website "Information for Research Participants" http://www.usd.edu/oorsch/compliance/participants.cfm

Compensation: You will not receive any compensation for participating in this research.

IRB Approval effective from: 12/18/2015
IRB Approval not valid after: 12/17/2016
USD IRB

Voluntary Participation: You do not have to participate in this research. You do not have to answer any questions you do not want to answer. You can stop your participation at any time without any penalty, academic or otherwise. **You may refuse to participate or choose to discontinue participation at any time without losing any benefits to which you are otherwise entitled. Your decision to participate or not to participate in this research will not affect your admission chances, and the USD PA Program Faculty will not know who has agreed to participate in this research until all admissions decisions have been made.**

Alternative: You may choose not to participate in this research and may withdraw from this research at any time. There are no other alternatives.

*You must be 18 years of age older to consent to participate in this research study.

The investigators thank you for considering participating in this research project.

Please keep this form for your records or future reference.

I have read, had explained to me, and understand the information contained in this informed consent form. I have also been given a copy of this informed consent document.

I agree to participate in this research.

Signature_____ Date_____

Printed name _____

Appendix C

Survey Instrument

University of South Dakota Physician Assistant Program Survey

(For all your responses please write legibly.)

Name_____

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who likes to spend time with others? Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement.

Disagree Strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
1	2	3	4	5

I see myself as someone who...

E1	1.	Is talkative	**N5R**	24.	Is emotionally stable, not easily upset
MC1	2.	Always tries to practice what I preach	**MC5**	25.	Never resents being asked to return a favor
C1	3.	Does a thorough job	**E6**	26.	Has an assertive personality
N1	4.	Is depressed, blue	**A6R**	27.	Can be cold and aloof
O1	5.	Is original, comes up with new ideas	**C6**	28.	Perseveres until the task is finished
E2R	6.	Is reserved	**MC6R**	29.	Likes to gossip at times
A2	7.	Is helpful and unselfish with others	**O6**	30.	Values artistic, aesthetic experiences
MC2R	8.	Sometimes tries to get even rather than forgive and forget	**E7R**	31.	Is sometimes shy, inhibited
N2R	9.	Is relaxed, handles stress well	**A7**	32.	Is considerate and kind to almost everyone
MC3R	10.	May have felt like smashing things on occasion	**C7**	33.	Does things efficiently
E3	11.	Is full of energy	**N7R**	34.	Remains calm in tense situations
A3R	12.	Starts quarrels with others	**O7R**	35.	Prefers work that is routine
C3	13.	Is a reliable worker	**MC7**	36.	Has never deliberately said something to hurt someone's feelings
N3	14.	Can be tense	**A8R**	37.	Is sometimes rude to others
O3	15.	Is ingenious, a deep thinker	**C8**	38.	Makes plans and follows through with them
E4	16.	Generates a lot of enthusiasm	**MC8R**	39.	Sometimes really insists on having things my own way
MC4	17.	Has never been irked when people express ideas different from my own	**O8**	40.	Likes to reflect, play with ideas
C4R	18.	Tends to be disorganized	**O9R**	41.	Has few artistic interests
N4	19.	Worries a lot	**A9**	42.	Likes to cooperate with others
O4	20.	Has an active imagination	**C9R**	43.	Is easily distracted
E5R	21.	Tends to be quiet	**O10**	44.	Is sophisticated in art, music, or literature
A5	22.	Is generally trusting	**PE1**	45.	Likes to be the best person in my group
C5R	23.	Tends to be lazy	**PE2**	46.	For whom good grades are important

** Please check: Did you write a number in front of each statement? Please continue on the other side.

Disagree Strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
1	2	3	4	5

I am someone who...

MC9	47.	Is always willing to admit it when I make a mistake	**N6**	52.	Can be moody
A1R	48.	Tends to find fault with others	**MC10R**	53.	May have taken advantage of someone on occasion
O5	49.	Is inventive	**C2R**	54.	Can be somewhat careless
A4	50.	Has a forgiving nature	**N8**	55.	Gets nervous easily
E8	51.	Is outgoing, sociable	**O2**	56.	Is curious about many different things

I feel most successful when…

MA1	57.	A lecture or tutorial made me think about things	**MA3**	62.	Something I learned made me want to find out more
AL1	58.	I did almost no work and got away with it.	**AL2**	63.	I didn't have to work too hard
PE3	59.	I got a higher grade than other students	**PE5**	64.	I was the only one who could answer the lecturer's question
MA2	60.	I learned something interesting	**AL3**	65.	All the tasks and assignments were easy
PE4	61.	I showed people that I was smart			

I have felt most satisfied when …

MA4	66.	I learned something new	**AL6**	72.	I realized that I didn't have to prepare for lectures
PE6	67.	I did better than other students in the class	**MA7**	73.	I worked on a challenging task or assignment
AL4	68.	I found the work easy	**MA8**	74.	I saw improvement in my work
AL5	69.	I realized that I was getting through the course without having to work hard	**PE7**	75.	I got one of the highest grades
MA5	70.	I read something interesting	**AL7**	76.	I did well without having to work hard
MA6	71.	I worked hard			

I felt greatly satisfied or positive about myself when I…

PE8	77.	Accomplished something that others in my class could not do	**PE9**	79.	Received recognition or prestige
MA9	78.	Was totally involved in something that I was doing	**PE10**	80.	Enhanced my status in the group

In general, what percentage of student learning is caused by **student** behaviors, characteristics, etc? **SIO1** %

In general, what percentage of student learning is caused by **instructor** behavior, characteristics, etc? **SIO2** %

In general, what percentage of student learning is caused by **other things**? **SIO3** %

TOTAL **100%**

** Please check: Did you write a number in front of each statement?

Appendix D

Enrolled Student Consent

IRB Approval effective from: 12/18/2015
IRB Approval not valid after: 12/17/2016
USD IRB

UNIVERSITY OF SOUTH DAKOTA
ENROLLED USD PA STUDENT
Informed Consent Statement

Title of Project: Physician Assistant Personality Profile Study

Principle Investigators: William E. Schweinle, PhD
254 Julian Hall, USD
Vermillion, SD 57069
605-677-6792
william.schweinle@usd.edu

Wade Nilson, PA-C
253 Julian Hall, USD
Vermillion, SD 57069
605-677-5128
wade.nilson@usd.edu

Other Investigators: Betty Hulse, PA-C, 101D Julian Hall, USD, Vermillion, SD 57069
Julie Johnson, MD, 101A Julian Hall, USD, Vermillion, SD 57069

Purpose of the Study: The purpose of this study is to define some of the personality characteristics that are most important to physician assistant student and to practicing physician assistants. Results from this study will help the USD and other physician assistant programs make better admissions decisions. It will also help physician assistant programs better advise students about how they can improve their effectiveness as physician assistants, take better advantage of their educational opportunities, and make better career choices.

Procedure: You will be asked to complete a 20-30 minute survey and to allow us to use some of your academic information for the purpose of this research. The academic information used in this research may include:

- The information included in your application to the USD Physician Assistant Program, including:
  - Your CASPA application information
  - Your USD Graduate School Application
  - Your admissions interview responses
  - Faculty evaluations of your admissions interview
  - Your responses to the USD PA Program Questionnaires
- Your performance evaluations in both the didactic and the clinical portion of your physician assistant education, including but not limited to:
  - Your class grades
  - Your scores on standardized exams, e.g. the PACKRAT and the PANCE
  - Evaluation information from your class instructors
  - Evaluation information from your clinical preceptors

- Faculty evaluations of your professional development during the physician assistant program
- Information we may ask you for in the future, e.g. during your physician assistant education or after you graduate from the physician assistant program. These questions may include queries about your well-being as a physician assistant student, your happiness with your career choice, your satisfaction with your career as a physician assistant, your employment status, your location, your professional role, etc.

Risks: The risk for participating in this research is minimal and does not exceed the risks you encounter in your academic life. Some of the survey questions may or may not cause you some discomfort. If you feel discomfort in answering any of the survey questions, you may contact the investigators at any time.

There is a very small chance that the confidentiality of your academic records may be compromised. However, this risk will not exceed the risk that you already bear as a USD Physician Assistant student. All of the research data will be maintained under the same secure conditions as your other application and academic information, all of which is protected by federal law in the **Family and Education Right to Privacy Act**.

If you would have any questions and would like to discuss the risks of this study with the investigators, please contact us.

Benefits: The direct benefits to you directly are minimal. However,

- You may learn more about yourself. You might also learn more about how you may best fulfill the professional role of physician assistant
- This research will benefit the physician assistant profession and ultimately the patients that physician assistants serve. Your agreement to participate in this research will help to improve the selection, education and advising of physician assistant students.

Duration: It will take 20 to 30 minutes to complete the survey.

Statement of Confidentiality: If this research is presented or published, no information that would identify you will be included. The results will be presented only in aggregate form, and information by which you could be identified will in no way be linked to your responses.

All of your academic information and survey responses will be treated confidentially and stored in a locked file cabinet in the USD Physician Assistant Office. All of the electronic research data files will be kept on a secure, password protected university server or in a form that does not include your name or other identifying information.

Right to Ask Questions: The researchers conducting this study are William Schweinle, PhD and Wade Nilson, PA-C. You may ask any questions you have now. If you later have questions, concerns, or complaints about the research please contact Prof. Schweinle or Prof. Nilson at (605) 677-5128 during the day.

IRB Approval effective from: 12/18/2015
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USD IRB

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General information about being a research subject can be found on the IRB website "Information for Research Participants" http://www.usd.edu/oorsch/compliance/participants.cfm

Compensation: You will not receive any compensation for participating in this research.

Voluntary Participation: You do not have to participate in this research. You do not have to answer any questions you do not want to answer. You can stop your participation at any time without any penalty, academic or otherwise. **You may refuse to participate or choose to discontinue participation at any time without losing any benefits to which you are otherwise entitled. Your choice to participate or not to participate in this research will not affect your progression in the USD PA Program.**

Alternative: You may choose not to participate in this research and may withdraw from this research at any time. There are no other alternatives.

*You must be 18 years of age older to consent to participate in this research study.

The investigators thank you for considering participating in this research project.

Please keep this form for your records or future reference.

I have read, had explained to me, and understand the information contained in this informed consent form. I have also been given a copy of this informed consent document.

I agree to participate in this research.

Signature_____ Date_____

Printed name _____