4-1-2017

Multiple Mini-Interview Performance And First Semester Achievement In A Baccalaureate Respiratory Care Program

Megan S. Koster
University of New England

MULTIPLE MINI-INTERVIEW PERFORMANCE AND FIRST SEMESTER ACHIEVEMENT IN A BACCALAUREATE RESPIRATORY CARE PROGRAM

By

Megan S. Koster MHS, RRT

BS (Boise State University) 2007
MHS (Boise State University) 2011

A DISSERTATION

Presented to the Affiliated Faculty of

The College of Graduate and Professional Studies

at the University of New England

In Partial Fulfillment of Requirements

For the degree of Doctor of Education

Portland & Biddeford, Maine

April, 2017

Megan S. Koster
April 2017
Educational Leadership

MULTIPLE MINI-INTERVIEW PERFORMANCE AND FIRST SEMESTER ACHIEVEMENT IN A BACCALAUREATE RESPIRATORY CARE PROGRAM

ABSTRACT

Success in an undergraduate respiratory care program requires that students demonstrate skills that although not traditionally assessed in the admissions process, are indicative of success in the clinical environment. Attributes like critical and interpersonal skills, empathy, and self-appraisal are competencies developed by different yet integrated intellectual processes and contribute significantly to the overall perception of intelligence. However, despite limited efficacy in predicting rate of attrition in an undergraduate clinical program such respiratory care, traditional admissions criteria continue to focus solely on objective indicators of academic ability. The purpose of this quantitative case study was to investigate the utility of the multiple mini-interview (MMI) as an adjunct method of selecting candidates to a small cohort-based baccalaureate respiratory care program. The MMI is a method of student assessment designed to more accurately evaluate non-cognitive skills inherent to successful clinicians during the admissions process. A three-station MMI was integrated into the 2016 cohort admission process at the participating institution. Data including performance on the MMI, course achievement, and rate of attrition in the first semester of core respiratory care curriculum were recorded. Data for sixty-nine students across three separate cohort groups were collected and analyzed. Results of this study indicated a significant relationship between both total MMI points and MMI rank and achievement in the introductory clinical component of this program (r (23) =.528, *p*= .007 and r (23) = .509, *p*= .009, respectively). A logistic regression analysis revealed that a multidimensional assessment model may be more effective in predicting likelihood of attrition in any of the cohorts, $\chi^2(2) = 11.19$, $p = .004$. Limitations include a small sample and differences across cohort scoring methods.

The MMI was found to have a predictive role in identifying key competencies required for success in a baccalaureate respiratory care program. Future research should include a larger sample and a mixed-method approach to investigate the student and faculty perception of utilizing a multimodal approach to undergraduate admissions.

University of New England

Doctor of Education
Educational Leadership

This dissertation was presented
By

Megan S. Koster

It was presented on
April 3, 2017
and approved by:

Carey Clark, Ph.D
Lead Advisor
University of New England

Peter Fifield, Ed.D
Secondary Advisor
University of New England

Janet Reis, Ph.D
Affiliate Committee Member
Boise State University

ACKNOWLEDGEMENTS

I would like to thank my dissertation committee. Drs. Clark, Collay, Fifield, and Reis, thank you for the hours upon hours spent reviewing, recommending, and lending of expertise to this process. Each of you were invaluable to this process and it has been both a privilege and an honor to work with each of you. To my research team, thank you for the academic and moral support throughout our years of study together. I am fortunate to know each of you and look forward to endless possibilities for collaborations in the future.

To my amazing colleagues, Lutana Haan, Lonny Ashworth, TJ Wing, Jeff Anderson, Jody Lester, Samantha Davis, Coleen Dudley, and Keiko Knudson, this would not have been possible without each of you. There are not enough words to fully express my gratitude so, simply put, thank you from the bottom of my heart.

Mom and Dad, thank you for the unwavering support since day one, literally. Although perhaps terrifying at times, the blind faith and certainty you've always had in me has been a motivator in nearly all aspects of my life. Thank you for always believing in me.

Most importantly, to my husband, I am so grateful to have you by my side. The pursuit of this goal has encompassed most of our marriage and has required significant sacrifices. Nevertheless, you have selflessly supported me every step of the way. You've patiently listened, quietly recommended, and borne the brunt of the added stress with your quiet and contagious calm. I love you and thank you for never losing sight of the leap of faith that brought us together.

Finally, I would like to dedicate this manuscript to my son. Rex, you're the only tangible proof that miracles exist. You're the light at the end of every tunnel.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Successful completion of an undergraduate degree is a necessity in the current occupational marketplace. To be marketable for employment in a competitive workplace, such as health care, students must demonstrate a range of competencies that reflect the dynamic needs of an evolving profession. In referencing the Accreditation Council for Graduate Medical Education (ACGME), Stanford School of Medicine (2016) outlined six overarching competencies considered as core requirements for future healthcare practitioners. In addition to medical knowledge, expectations include interpersonal and communication skills, critical thinking ability, described by the Stanford School of Medicine as the ability to "appraise and assimilate scientific evidence" (Stanford School of Medicine, 2016, para. 5), and the demonstrable ability to respond to the larger context and system of healthcare by working effectively in various, and often interdisciplinary, settings.

The field of respiratory care exemplifies this. The American Association of Respiratory Care (AARC) issued a statement in early 2016 as an extension of a larger multiyear project aimed at navigating the changing landscape of health care and to determine the role of respiratory care practitioners of the future. They stated that the field of respiratory care has experienced, "growth in scope, complexity of skills, and diversity of care sites" (AARC, 2016a, para. 1). These changes have highlighted the need for clinicians who are not only technically competent, but also those who can demonstrate critical thinking, interpersonal, and communication skills. The challenge then, is for academic programs offering an undergraduate respiratory care curriculum, one that integrates and emphasizes both cognitive and noncognitive attributes, to identify and select students who will be successful in not just completing but also mastering it.

These skills potentially are best obtained through a 4-year undergraduate degree. For example, although a 2-year associate degree has traditionally been the benchmark credential for several health professions (e.g., nursing, respiratory care), there has been a major push to have a baccalaureate degree as an entry-level requirement (Nursinglicensure.org, n.d.; AARC, 2016b). The major differences between the requirements for a higher-level degree upon entry to the workforce likely stem from the shifting requirements of the jobs themselves (Nursinglicensure.org, n.d.). The baccalaureate curriculum often features additional instruction to develop communication, leadership, and critical thinking skills–all of which better align with competencies now desired for successful practicing clinicians (Koenig et al., 2013; Nursinglicensure.org, n.d.). The AARC board of directors has issued a statement recommending that the field of respiratory care move to a bachelor’s degree minimum for entering the profession and has set a goal for 80 percent of all practicing respiratory care practitioners to have bachelor's degrees by 2020 (AARC, 2016b). As the AARC is the most influential organization in the respiratory care field, this shift towards a focus of both depth and breadth of clinical skill has resulted in a reactive shift in the curriculum design of many undergraduate respiratory care programs. The overarching goal of these programs is to provide an inclusive curriculum designed to prepare students for the realities and expectations of the workplace (Barnes, Gale, Kacmarek, & Kageler, 2010).

In thinking about curriculum expansion in 4-year respiratory care programs, several other issues arise, including student retention and attrition. Although many programs have integrated a more inclusive curriculum, these programs are subject to the same rates of attrition that plague higher education in general. To better understand the issue of attrition throughout higher education, Raisman (2013) conducted an analysis of 1,669 4-year academic institutions throughout the United States and found that the collective loss in revenue due to attrition was upwards of $16 billion, with publicly assisted schools losing an average of approximately $13 million ($13,267,214), and a loss of approximately $8 million ($8,331,593) reported in the private sector (p. 4). Data about the publicly assisted institution where this study was conducted was included in this examination. This particular institution experienced a 74 percent 6-year attrition rate at a projected loss of approximately $24 million ($24,337, 376)–this equates to a 26 percent 6-year graduation rate. Raisman (2013) observed that if the institutions included in his analysis were to be graded on the typical A to F scale, with A being superior and F representing a failing grade, 1,152 of the 1,669 (69%) would receive a failing grade regarding graduation rates, the institutional site where this study was conducted included. These numbers highlight a major concern at an institutional level; however, rates of attrition at the departmental or program level should also be addressed.

In general, health-related undergraduate programs are highly competitive and require strict focus and commitment from those students who are admitted (Wittenbel, Murphy, & Vines, 2009). Unfortunately, not all students who are admitted to such programs will successfully complete program requirements and proceed to graduation and licensure examinations. Although some attrition is to be expected, evidence has shown that health care programming typically experiences higher than average rates of attrition than other disciplines, despite stringent admission practices (Pau et al., 2015; Wittenbel et al., 2009). For example, Wittenbel et al. (2009) reported a 47 percent rate of attrition in one respiratory care program over a 5-year period. The respiratory care program included in this investigation reported an attrition rate of 20-30 percent over the academic years included in this study (i.e., 2013, 2014, and 2016).

These program-specific statistics reflect not only the seemingly overarching issue of attrition within higher education, but also highlight the need for institutions to investigate how to better identify and serve student needs. One such method may be to revise admissions practices to include a more holistic approach to student selection, one that provides a more inclusive perception of student preparedness and potential fit for competitive instructional programming (Urban Universities for Health, 2014).

There are several ways in which traditional admissions practices may contribute to the increased rate of attrition experienced by these programs. For example, typical methods of student selection focus on structured admission practices that emphasize the demonstration of traditional intelligence as measured through cognitive attributes, such as grade point average (GPA) or standardized test scores (Siu & Reiter, 2009). These measures of intelligence are objective and relatively easy to quantify. Therefore, these variables continue to be heralded as the most predictive indicators of student success in undergraduate education and thus, have been established as the baseline expectation in most admissions decisions (Siu & Reiter, 2009).

However, several researchers have posited the utility of noncognitive attributes in the admissions process as a means of better identifying more well-rounded students (Eva, Rosenfeld, Reiter, & Norman, 2004; Eva et al., 2012; Prideaux et al., 2011). Support for the acknowledgment of the value of these variables is growing, as underscored by the AARC, and undergirds the paradigm that successful clinicians must be able to demonstrate more than the ability to acquire knowledge. Rather, the ability to interpret and apply information to variable contexts may be more indicative of success in a rapidly evolving professional workplace

(Kulatunga-Moruzi & Norman, 2002; Siu & Reiter, 2009). As such, the potential for success in these types of programs may be better identified utilizing alternative admission procedures designed to acknowledge intelligence as a multifaceted phenomenon wherein there is value attached to more subjective measures of student ability.

Many researchers have hypothesized the value of noncognitive attributes in the evaluation and predictability of student success (Eva, Rosenfeld et al., 2004; Eva et al., 2012; Prideaux et al., 2011; Sedlacek, 2004; Siu & Reiter, 2009; Sternberg, 1984). Characteristics such as interpersonal skill, empathy, honesty, and self-appraisal have been identified as desirable among health care graduates (Koenig et al., 2013; Sperle, 2013). However, there remains a lack of consensus about how best to evaluate and integrate noncognitive attributes in the selection process and which attributes are the most valuable (Cox, McLaughlin, Singer, Lewis, & Dinkins, 2015; Siu & Reiter, 2009).

Despite the potential of including these qualities in the admission process, prevailing methods for selecting students for admittance into specialized health programming do not adequately evaluate these characteristics. Failure to adequately screen students for potential fit with program objectives through the evaluation of noncognitive characteristics may contribute to higher than average rates of attrition and therefore, the utility of noncognitive attributes should be addressed through further inquiry (Joyner, Cox, White-Harris, & Blalock, 2007). The multiple mini-interview (MMI), developed by the McMaster University School of Medicine in 2004, has been touted as a potentially useful tool in bridging the gap between the theoretical ideal of a more holistic approach to student admissions and the more practical need for a defensible, reliable, and valid method through which to do so (Knorr & Hissbach, 2014).

It is a goal of most academic institutions to admit students who will be successful. Schmitt et al. (2009) pointed out that the definition of success must be broadened if institutions are to achieve this goal. To achieve academic, interpersonal, or psychological success, it seems appropriate to expand admissions criteria to include noncognitive attributes that may have previously limited students in admissions decisions (Schmitt et al., 2009). For example, assessing student potential in a more holistic way may not only help to better match students well-suited for a clinical career and thus, potentially decreasing programmatic rates of attrition, but may also influence the diversity of candidates who apply to such programs (Girotti, Park, & Tekian, 2015; Siu & Reiter, 2009).

Several studies have highlighted the inherent inequity of standardized testing practices and have postulated that admissions practices that focus solely on academic factors, such as GPA, tend to alienate students from various backgrounds (Girotti et al., 2015; Rooks, 2012; Sedlacek, 2004; Sternberg, 2015). Schmitt et al. (2009) found that while minority students often score lower on standardized cognitive evaluations, there is evidence that relatively "small or no differences existed between majority and minority groups on many noncognitive assessments" (p. 1480). Researchers in support of integrating noncognitive attributes into the admissions process have posited that these populations of students likely have valuable experiences grounded in diverse contexts that may aide in rich application of academic material (Girotti et al., 2015; Sedlacek, 2004; Sternberg 1984, 1997, 2015). Students who participated in admissions processes such as the MMI, that value these experiences, have reported that the process was preferable to traditional methods of admission processes because they allowed the student to present her or himself in a more accurate and honest way (Pau et al., 2013).

Purpose of the Study

The purpose of this quantitative case study is to examine the utility of the multiple mini-interview (MMI) as an adjunct method of predicting first-semester success in a baccalaureate respiratory care program. Although the integration of noncognitive traits into admissions processes is becoming more prevalent, most of the research continues to focus on students applying to either medical school or other postgraduate educational programs (Cox et al., 2015; Eva, Rosenfeld et al., 2004; Eva et al., 2012; Irby, Cooke, & O'Brien, 2010; Knorr & Hissbach, 2014; Lemay, Lockyer, Collins, & Brownell, 2007; Moruzi & Norman, 2002; Phelan, Obenshain, & Galey, 1993). There is a need to evaluate the utility of noncognitive evaluations in undergraduate health education to better assess student ability and preparedness for high attrition programs such as respiratory care (Newton & Moore, 2009; Urwin et al., 2010; Wells, 2003).

This study will focus specifically on the academic progress of the 25 respiratory care students who were admitted to the fall 2016 cohort at the participating institution. These students were subjected to a mixed-method selection process, which differed from the cognitively-focused admission process traditionally conducted by this program, wherein the demonstration of select noncognitive competencies were assessed through an MMI. These competencies or attributes were selected by the respiratory care admissions committee as both reflective of the program mission as well as indicative of a successful clinician. The aggregate score of three scenario-based stations on a MMI served as a weighted, adjunct criterion for candidate selection.

To investigate the utility of the MMI as an adjunct criterion for selection into this particular program, this study followed the academic progress of these 25 students throughout the first semester of select respiratory care-specific curriculum in order to investigate the relationships among academic performance, MMI rank, MMI score, GPA, and rate of attrition.

The select courses identified as central to this investigation were those courses within this respiratory care program wherein students typically experienced the highest rates of first-semester attrition. Data from students admitted to the respiratory care program in 2016 was compared to retrospective data collected during the admission processes of students applying for admission into the program in both 2013 and 2014. Students who were admitted to these previous cohorts were not subjected to the MMI process throughout their respective admission cycle. Descriptive statistics, as well as a broad comparative analysis among admissions criteria will be conducted to further explore the relationships and associations among cognitive and noncognitive variables, and final grades at the end of the first semester.

Statement of the Problem

Experiences with healthcare students' training and subsequent employment suggests that traditional assessments of intelligence tend to overemphasize the value of the ability to simply acquire knowledge (Kalutunga-Moruzi & Norman, 2009; Sternberg, 2015). Although this ability is an important foundational requirement for success in an undergraduate respiratory care program, the clinical component inherent to the field necessitates a demonstration of skills indicative of an ability to apply knowledge in a range of contexts. Hart Research Associates (2015) found that both students and employers realize that to achieve long-term career success graduates must have both field-specific knowledge and a broad range of skills.

Several studies have indicated that there are specific competencies inherent to successful health care practitioners that are consistent with those outlined by the ACGME (Barnes et al., 2010; Koenig et al., 2013; Sperle, 2013). Several of these competencies, such as critical thinking ability, interpersonal and communication skills, empathy, adaptability, and self-appraisal can be attributed to the development of the noncognitive facets attributable to personality (Koenig et al., 2013, p. 607). Sternberg (1984, 1997, 2015) and other incremental theorists have argued that these facets of personality are heavily influenced through experience and can be developed when nurtured and applied to new contexts. Although professional expectations of healthcare workers continue to emphasize the demonstrable importance of these attributes in the workforce, very few undergraduate health programs have integrated methods by which they may evaluate these competencies as part of the admissions process.

Admissions practices in most undergraduate health care programs continue to emphasize these noncognitive competencies by focusing almost exclusively on a student's ability to retain information as an indicator of adequate preparation for program requirements. Prior to the integration of the MMI, admissions practices traditionally implemented by this respiratory care program were no different; student selection methods utilized a primarily academic review that placed heavy emphasis on both cumulative GPA as well as a combined math and science GPA. It is apparent however, given this program's rate of attrition over the past four years (see Table 1), that the sole emphasis on these cognitive attributes as indicators of academic prowess reflects only a one-dimensional perspective on student ability, and therefore highlight potential discrepancies in not only the ability of cognitive measures to adequately indicate student preparation for a clinically-based respiratory care program, but also in how well current admissions practices work to align academic objectives with professional expectations.

Table 1

Program Specific Rates of Attrition by Academic Year

Academic Year	Cohort Population	Rate of Attrition	Average Cumulative GPA of students who experienced attrition
2013	26[a]	6 (24%)	2.99
2014	24[a]	7 (33%)	3.08
2016	25	TBD	TBD

[a] Some students in this cohort are candidates readmitted from previous cohort

Note. The 2015 cohort of students has been excluded from this study due to alterations in Fall teaching assignments that may confound the comparison of attrition rates

The purpose of integrating the MMI into the selection process for this specific program was to deemphasize the influence of cognitive measures, such as GPA, to provide an opportunity to investigate the utility of noncognitive measures in identifying and selecting candidates who best demonstrate key clinical competencies. There have been several studies that provided a theoretical rationale for the integration of a more holistic approach to the process of admissions by integrating evaluative measures designed to identify valuable noncognitive attributes (Lemay et al., 2007; Koenig et al., 2013; Prideaux et al., 2011; Siu & Reiter, 2009). The selection committee hypothesized that by integrating a process designed specifically to identify competencies attributed to success in a clinical environment (i.e., the MMI), there would be a decrease in the program's rate of first-semester attrition. They rationalized that in a competitive undergraduate program wherein most students are considered to be above average (i.e., have a cumulative GPA greater than a 2.0 on a 4.0 scale), there must be some other aspect of curriculum requirements where student ability falls short. The committee further hypothesized that adding a noncognitive admission criterion may increase the opportunity to select students who may not excel in the traditional academic sense (i.e., those who have a below average cumulative GPA), but may better demonstrate the ability to think about, apply, and adapt information to dynamic contexts than do their academically superior peers.

The institution where this study took place is a midsized metropolitan university that serves a population of over 16,000 undergraduate students, a large percentage (31%) of whom may be considered ‘nontraditional’ based on age alone. As part of the mission statement for the department of respiratory care at this institution, student experience and background are valued as influential in the process of learning. An additional highlight of using the MMI as an adjunct method of candidate selection was to help maximize the opportunity to diversify the cohort of students admitted to the 2016 cohort.

Research Questions

The overarching goal of this study was to determine the utility of the MMI as an adjunct method of admission though which to better identify key noncognitive competencies required of students throughout this specific respiratory care curriculum. To best understand the ability of the MMI instrument to achieve this goal, several research questions were developed:

1. What relationships exist between performance on the MMI and academic performance in the first semester of select respiratory care courses?
2. What relationships exist among cognitive admission criteria (e.g. grade point average), and performance in the first semester of select respiratory care courses? Do these relationships differ from those identified in question 1?
3. How effective are each of these admission criteria in predicting attrition in either the first semester or academic year of this particular respiratory care program?

Conceptual Framework

Shifting the paradigm that intelligence is somehow inextricably linked to cognitive measures of academic performance is paramount in establishing a multidimensional approach to student selection, with overarching goals that include decreasing rates of attrition, increasing program equity and diversity, and better matching students for a successful career in the healthcare field. Sternberg's triarchic theory (1984, 1997, 2015) provides the theoretical framework through which to view overall intelligence as a multifaceted phenomenon wherein each facet is both valuable and developable, and the interaction among facets is fluid.

With his triarchic theory Sternberg (1984, 1997, 2015) posited that there are three primary facets of intellect–componential, experiential, and contextual–that form the construct of applied intelligence. Componential intellect can be summarized as the ability to acquire knowledge and recall facts. Experiential intellect draws upon knowledge acquired through lived experiences and the ability to apply that understanding to new situations. Finally, contextual intellect is the ability to demonstrate adaptability and application of knowledge to changing contexts.

The development of these facets is the result of continued exposure to tasks on a continuum of novelty. Movement on this continuum then is dependent upon the ability of an individual to decipher the experiential relationships that are formed between understanding and operation, or demonstration. That is, as a task or concept becomes more familiar, the feedback loop between the internal (metacomonents) environment and the external environment (practical and knowledge-based components) of an individual becomes more automated (Sternberg, 1984)

This theoretical approach to perceiving intelligence as a multidimensional phenomenon undergirds the rationale for integrating evaluative methods of noncognitive attributes into the selection process. This is because competencies relevant to success in a respiratory care program, such as critical thinking, communication, interpersonal skill, empathy, and self-appraisal are demonstrable abilities which are not measured through traditional cognitive measures such as GPA, nor are they the focus of popular standardized testing methods (Sedlacek, 2004; Sternberg 1984, 1997, 2015).

In a 2004 study conducted at Whitman, Christopherson (2004) found that there were essentially no differences between the rate of attrition of top performing students (i.e., students admitted with a GPA in the top 25 percent of the cohort) and that of middle performing students (i.e., students with GPA's in the middle 50 percent of the cohort). This finding paralleled what the respiratory care program at the participating institution found in a small informal investigation into the program-specific rates of attrition over the past 4 years; that is, admitting GPA was not necessarily a guarantor of student retention (see Table 1). It is perhaps for this reason a more holistic approach to student selection is warranted. To help guide health-focused academic programs to integrate a more inclusive process of student selection, the Association of American Medical Colleges (AAMC) provided a specific definition of the holistic review, stating such a review should provide balanced consideration to experiences, attributes, and academic metrics (Urban Universities for Health, 2014).

Rationale and Significance

To maintain the number of highly skilled respiratory care practitioners graduating into a dynamic workplace, programs must identify students who best exemplify the unique competencies of a successful health care practitioner (Barnes et al., 2010). Barnes et al. (2010) indicated that the scope of health care workers, such as respiratory care practitioners, would broaden to compensate for a shortage in nursing graduates. In a 2010 conference projecting future goals for the profession, attendees, including Barnes et al. (2010), identified 69 competencies needed by graduate respiratory care practitioners. This broad range of competencies includes skills that are generally identified as componential in nature; however, there was also a strong emphasis on noncognitive competencies, such as critical thinking skills, which may be a better reflection of both experiential and contextual intelligence (Sternberg, 1984, 2015).

The integration of noncognitive attributes into the selection process through valid and reliable methods, such as the MMI, may provide undergraduate program selection committees with the tools needed to evaluate students in a way that is more inclusive of experience and practical ability–rather than a sole emphasis on the ability to recall information, as is demonstrated through cognitive measures, such as GPA. Ideally, this integrated approach to holistic student evaluation will result in the selection of students who are best suited to demonstrate identified clinical competencies, thereby decreasing rates of program specific attrition and working to diversify candidate pools by attaching value to the knowledge obtained through lived experiences in variable environmental contexts.

Definition of Terms

For the purposes of this study, the following terms are defined:

Attrition: The American Institutes for Research ([AIR], 2012) described academic attrition as "departure from all forms of higher education prior to completion of a degree or other credential" (p. 3). For the purposes of this study, the term attrition will relate specifically to attrition within the respiratory care department at the participating institution; that is, students who did not meet minimum academic performance requirements as defined by the department (i.e., letter grade less than C-). Students who were admitted to the program but who experienced attrition as defined by the AIR, although not typically re-admitted to the respiratory care program, could continue pursuing an alternate degree within the institution.

Cognitive attributes. The literature included in this study generally describes cognitive attributes as standardized and objective measures of intelligence as they are generally perceived. That is, as the measurable ability to acquire and apply knowledge in a static context (Sternberg, 1984, 1997, 2015). Examples of cognitive attributes that are pertinent to this study include GPA, individual course scores, and standardized test scores.

First-semester. Students included in this study have been admitted to a 2-year cohort baccalaureate respiratory care program. For the purposes of this study and specifically to examine the relationship of noncognitive attributes to student success, the term first semester will refer to the completion of the first semester in the baccalaureate respiratory care program and range from the August 2016 to December 2016. This distinction was made because students may be admitted to the respiratory care program who are at varying points in their academic career, and as such may be classified by the university as a freshman, sophomore, or junior student, based on the accumulation of academic credits. However, once admitted to the program, first-year students are considered ‘sophomores’ and second year students are considered ‘juniors.' The final year of the program is offered completely online and as there is no particular order in which these final requirements must be completed, some students opt to complete these requirements within the 2 years during which they are also taking courses in either the ‘sophomore’ or ‘junior’ years of the program.

Health care provider. Casually, the term health care provider could refer to any clinician who provides a medical service to a patient through an interpersonal and medically-focused interaction. However, a more formal definition of ‘health care provider’ is defined in section 1861(u) of the Social Security Act, 42 U.S.C. 1395x(u)) as “a provider of medical or health services and any other person or organization who furnishes, bills, or is paid for health care in the normal course of business” (Hippa.com, 2016).

Intellect. Intellect will be referred to as a specific facet of reasoning and understanding objectively, especially regarding abstract or academic matters. The theoretical framework of this study assumes that there are several different types of intellect, specifically componential, experiential, and contextual intellects. It is also assumed under Sternberg’s (1984) triarchic theory that each of these intellectual facets are valuable, developable, and interconnected to convey an overarching sense of intelligence. As such, this study proposes that methods of predicting student success should consider both cognitive and noncognitive attributes towards a more holistic approach to student admission processes.

Intelligence. Intelligence is generally understood as the ability to acquire and apply both knowledge and skill and is quantifiably measured utilizing standardized or objective methods (Sternberg, 1984). For the purpose of this study, intelligence is assumed to be a multifaceted phenomenological goal inherent to both successful students and practitioners. Therefore, intelligence will be described throughout this study in a more elaborate sense that includes the ability to achieve goals by capitalizing on intellect-specific strengths and compensating for contrasting weaknesses to adapt to dynamic environments; thus creating equitable value among the componential, experiential, and contextual facets of intellect as described by Sternberg (1984, 2015).

Noncognitive attribute. The term ‘noncognitive attribute’ refers to those subjective facets of intelligence that are not as easily quantified as the ability to simply acquire and recall information (i.e., componential intellect), but are thought to better reflect the ability to apply information or experience to changing contexts through adaptation (Sternberg, 1984, 2015). Therefore, these measures better demonstrate experiential or contextual intellect. Literature germane to this study generally identifies noncognitive attributes such as critical thinking skills, practical intellect, empathy, and interpersonal skills as examples of desirable competencies inherent to successful clinicians (Koenig et al., 2013). It is the evaluation of these attributes that may contribute to a more holistic and inclusive approach to student selection (Urban Universities for Health, 2014).

Student success. Student success in this study will be measured as a student's ability to perform academically in accordance with the site-specific departmental policies. That is, students must pass the selected core curriculum courses with a grade of a C- or better to continue in the program. A student who did not meet this criterion was dropped from the program and deemed unsuccessful in completing the first semester of the program. Student success was measured at the end of the first semester during the first academic year in the program. Students who experienced non-academic attrition were also monitored and evaluated for inclusion in this study.

Limitations

This study is limited to students who applied for admission to the 2016 cohort of students into the respiratory care program at the institution where the study is being conducted. Therefore, findings from this study cannot be generalized to larger, noncohort based, health care programs. Although based on the pioneering MMI methodologies of both McMaster University and the University of Calgary, the MMI methodology for this study was amended to best utilize available program resources such as faculty time and program expense, and identified key competencies specified by the selection committee at this particular institution. Therefore, the integration of a similar instrument may not be applicable to other institutions with access to a different applicant pool.

Assumptions

Students who participated in the MMI process participated to the best of their ability and without coaching or practice. Interviewers who conducted the MMIs reviewed the training materials prior to the interview process and felt both comfortable and confident in the procedures.

Summary

Research has identified competencies that are unique to health care providers; however, there is little to no consistency in the evaluation of these competencies in the selection processes for admission to undergraduate health care programming. There are likely several reasons for this. For example, there seems to be a mismatch in emphasis between cognitive measures of success in academia and importance of those measures in the postacademic world of a successful clinician in the workplace. The use of noncognitive attributes as predictors of student success is not novel; on the contrary, over a century of research has been conducted to investigate the phenomenon of intelligence. The debate over the utility and value of these attributes in predicting student success continues; however, there is a growing body of evidence that supports a more holistic approach to student selection into health-focused programs. The overarching goals of a more holistic admissions approach in this case are to impact program-specific rate of attrition, better identify students who are well suited for a career in the respiratory care field, and to increase program diversity.

The holistic approach to student admission is founded on the assumption that intelligence is a multifaceted phenomenon wherein each facet is considered valuable. This approach is difficult to integrate into the well-established and empirically supported admissions practices throughout higher education. However, as the cost of student attrition rises, institutions must re-evaluate the efficacy of current methods though which students are assessed for academic preparedness. They should begin to consider the additive value of admission methods specifically designed to better evaluate the demonstration of key competencies unique to clinically-based programs, wherein intellectual emphasis is more equitably distributed between cognitive and noncognitive requirements.

CHAPTER 2

LITERATURE REVIEW

The purpose of this study is to investigate the utility of the multiple mini-interview (MMI) as an adjunct method of predicting first-year success in a baccalaureate respiratory care program. Although there is very limited research investigating the role of noncognitive attributes as indicators of student success in respiratory care, there is evidence that methods used to assess specific characteristics of personality may be useful in evaluating students applying to medical school (Eva, Rosenfeld et al., 2004; Koenig et al., 2013; Newton & Moore, 2009). Since there is a considerable degree of consistency across the psychosocial and clinical expectations of health care programming–including those of nursing, medical school, and allied health programs, such as respiratory care–this study extrapolates the literature available on the use of alternative methods of predicting student readiness for medical school to those requirements of a baccalaureate respiratory care program.

Characteristics such as critical, interpersonal and communication skills, empathy, and self-appraisal are required for success not only while students are enrolled in courses, but also upon entry of the clinical workforce (Koenig et al., 2013; Sperle, 2013). These noncognitive attributes, such as positive self-concept, self-appraisal, interpersonal skills, and leadership are measures of the ability to generate, discern, and implement creative, analytic, and practical capabilities and can be used to augment current methods of student evaluation (Lemay et al., 2007; Sternberg, 2009; Weissbourd, 2014). However, there is currently very little information regarding the use of noncognitive evaluation of key clinical competencies in undergraduate respiratory care programs, and prevailing methods of student assessment may not adequately evaluate these characteristics in students seeking admission to clinical programs.

To assess the utility of the MMI process in this particular sample, this review investigated the base of literature available regarding the relationships among cognitive measures (e.g., GPA), student success, and performance on the MMI. Relatively little literature exists regarding the association between performance on a MMI and academic performance throughout the first year in undergraduate health-related programs. However, this review will include the information pertinent to the central focus of this study in order to establish both the theoretical and practical generalizability of the existing literature regarding the utility of the MMI in addressing the needs of this particular baccalaureate respiratory care program.

Attrition has been defined as a group of interrelated factors that result in a longitudinal interaction between a student and either institutional or external forces that lead to varying forms of drop-out (Tinto, 1975). Unfortunately, 4-year colleges in the United States have an attrition rate of approximately 30-40 percent (Raisman, 2013; Sparkman, Maulding, & Roberts, 2012). Attrition is financially detrimental for both organizations and students. There are also psychological implications that impact motivation for at-risk students, which can attribute to rates of attrition (Nicholson, Putwain, Connors, & Hornby-Atkinson, 2013)

As the industry of higher education moves towards more of a business-type model, rates of attrition must be controlled not only to maintain the profit margins of institutions, but also to ensure graduates matriculate prepared to enter and contribute to the workforce (Newton & Moore, 2009; Newton, Smith, Moore, & Magnan, 2007). Therefore, it is imperative to investigate which assessment methods are the best when evaluating students for preparedness and fit for programs that emphasize critical and interpersonal skill in addition to foundational knowledge. Understanding how to best select students who will be successful in such programs may contribute to a growing base of evidence in support of a more holistic approach to the evaluation of intellect as a multifaceted phenomenon, as well as provide more opportunities to diversify cohorts and better prepare graduates for the expectations of the workforce.

Literature Review Methods

This integrative literature review summarizes literature related to the historical and theoretical conceptualization of intelligence, the inequity of standardizing the evaluation of intellect, cognitive and noncognitive variables as predictors of student success, characteristics unique to health care providers, methodologies of noncognitive evaluation, the impact of attrition, and the potential benefits of holistic student evaluation. These areas are addressed in the context of Sternberg's (1984) triarchic theory with the hope of establishing a foundational understanding of traditional assessment measures as well as highlighting the potential inherent shortcomings of these prevailing methodologies throughout higher education.

The utility of noncognitive assessment of student potential through the integration of the MMI as an adjunct selection criterion to predict first-semester success in a baccalaureate respiratory care program will also be explored. The impact of these factors on both academic performance and preparedness for employment post-graduation is also addressed in summarizing the review of related literature.

Methods used to investigate the relevant literature and identify peer-reviewed articles included a search of online databases such as ERIC, Health Source, Elsevier, PubMed, ScienceDirect, and Academic Search Premier.. Key texts were obtained both electronically through an online keyword search as well as through an institutional-specific library. Chain sampling search techniques stemming from key sources were also employed to identify relevant and related literature.

Theoretical content from foundational inquiries into the phenomenon of intelligence in the contexts of both nature and nurture were reviewed. Peer-reviewed research studies on both the subject of intelligence and its emphasis throughout higher education were also included. A variety of literary sources were used, ranging from early published works, included to help frame the evolution of intelligence as a concept, to recent works that highlight advances made in the evaluation and construct of multiple intellects. Avenues of applicability to the field of higher education were explored and included a review of the research regarding recent work on the application of alternative methods of intellectual assessment.

Context for the Study

This section will investigate the historical and theoretical foundations for the investigation into this subject. It will explore the literature to identify the general nature and perception of intelligence as well as the various methods used to assess intelligence throughout higher education. A review of the literature regarding the inclusivity and equity of these methods as well as the identification of alternative or adjunct measures of holistic assessment is included. Finally, a brief investigation and overview of competencies identified as requisite of a successful clinician and the efficacy of both noncognitive and cognitive measures of assessment in predicting successful demonstration of these competencies is summarized.

Historical and Theoretical Conceptualizations of Intelligence

For over a century, psychological theorists have debated over the nature, origin, and influence of intellect. Perhaps the biggest dilemma in the conceptualization of intellect is that there is not a consensual definition of what intelligence *is*. Merriam-Webster describes intelligence as the ability to deal with new or difficult tasks or to learn to understand things (Merriam-Webster.com, n.d.). This definition is vague and offers little substantiation to the theory of intelligence as being primarily a heritable attribute or one that is heavily influenced through interaction with external environments.

The most definitive consensus regarding the ‘nature-versus-nurture’ debate was proffered in the early-20th century by a group of prominent psychologists who gathered for a summit. In referencing a 1921 survey of 14 prominent psychologists, Sternberg (1997) highlighted two recurrent themes regarding the definition of intelligence. This group agreed that in addition to the capacity to learn from experience, intelligence encompasses the ability to adapt to the surrounding environment (Sternberg, 1997, p. 91).

Intelligence then, may be best understood as the ability to integrate understanding through inference and association with variable environments. Although perhaps not any less vague than the traditional definition, the observation that intelligence may not be a purely natural or purely developable asset underscores just how much has yet to be discovered about this phenomenon. However, the question of whether intelligence is a natural entity, as proposed by entity theorists, remains contentiously debated by those who proffer that the acquisition of intelligence is an incremental and dynamic process, influenced by both exposure and experience, as has been hypothesized by Sternberg and other incremental theorists.

Entity Theory and Factor Analysis

In the early days of psychometric investigation, the human brain was thought to be a frontier unique to the individual, and navigable given the correct instruments. That is, intelligence was considered an entity of one’s being and could be understood, given the proper tools (Sternberg, 1997). Per Charles Spearman (1904), the best way to isolate the origin of intellect was to view it as a hereditable trait, one that could be mapped using statistical analysis of factors perceived as related to intelligence. Spearman, in pioneering entity theory, also developed factor analysis as the best method through which to isolate and identify intelligence (1904).

Although the work of Francis Galton (1822-1911) is perhaps one of the first theories of intelligence as a hereditable trait, Spearman (1904) was perhaps the most foundational of entity theorists (Lubinski, 2004). By positing that intellect was the result of a single hereditable trait, he developed and utilized a method of statistical factor analysis to isolate intelligence as a sole, quantifiable construct. Spearman has been described as the father of classical test theory, and his generalized intelligence factor, widely known as the *g* factor, became the most widely accepted understanding of intelligence throughout the 20th century (Digman, 1996; Sedlacek, 2004; Sternberg, 1997). It remains the foundational concept behind standardized intelligence testing today.

Lubinski (2004) described how Louis Thurstone challenged Spearman's theory of intelligence as an inborn ability. In addition to seriously questioning the validity of Spearman's factorial methodology, Thurstone was among the first to question the variability of intelligence, and in questioning Spearman's approach became a pioneer of the incremental theory of intelligence (Lubinski, 2004). Thurstone was not alone in questioning the statistical validity of factorial analysis to isolate intelligence. Later psychologists, such as Sternberg (1984, 1997, 2015), pointed out that there was some deception in the explanation of intelligence as a single identifiable factor.

For example, factor analysis as utilized by Spearman (1904) works to observe response patterns of similar variables to isolate some latent variable; for any number of factors within a set of data (i.e., questions on an intelligence test) there are an equal number of variables influencing that factor (Rahn, 2015; Sternberg, 1997, 2015). As such, there is an explainable degree of variance in the observed factors, and because these are listed in the order of greatest variability, it is of no surprise that the strongest source of individual difference is in the first factor–or the *g* factor (Rahn, 2015; Sternberg, 1997).

Although this type of analysis is generally applicable to complex concepts such as behavioral patterns, the issue with extrapolating the methodology to the field of intelligence is that there are an infinite number of response scenarios wherein the initial factor solution will be a generalizable factor (Sternberg, 1997). This means that rather than isolating any *one* specific factor, the method may be manipulated to identify whichever variable has the greatest variability in a set of data; as such, there is some question regarding the validity of this method to identify intelligence as one specific, measurable, and generalizable entity (Sternberg, 1997).

The allure of the product of factor analysis as a measure of generalized intelligence, or *g* factor, is that it is easily quantifiable in nature and therefore relatable and reproducible. In education, measurement of this type of intelligence continues to be the standard of summative assessment prevalent throughout higher education and is often measured through individual course grades, GPAs, or even more generally through standardized academic tests, such as the Scholastic Aptitude Test (SAT) or the American College Test (ACT) (Sedlacek, 2004).

Incremental Theory

In contrast to entity theory, incremental theorists argue that intelligence increases with exposure to variable situations and environments (Sternberg, 1997). Garner's (2011) paradigm-shifting theory of multiple intelligences, originally postulated in 1983, focused on ability, and was perhaps one of the first to attempt to bridge the divide between entity and incremental theories. Garner posited that there are up to nine affinity-based intelligences to which any one individual may gravitate (Sternberg, 2015). However, although a person may have an affinity towards one type of intelligence, other intelligences are being developed in concert through exposure and experiences (Garner, 2011). Garner argued that these intelligences do not operate independently as a sole measure of a person's ability; rather these intelligences–no matter the stage of development–are often used simultaneously and tend to influence one another as the individual works to develop a skill or solve a problem (Smith, 2008).

Incremental theories suggest that both experience and perception likely contribute significantly to the evolution of intelligence throughout life. Starke Hathaway, the developer of the Minnesota multiphasic personality inventory (MMPI), once said, "We tend to think of general intelligence as if it only operated in educational and vocational contexts, yet it saturates almost everything we do" (Lubinski, 2004, p. 96). Hathaway highlighted that intelligence may be influenced by external factors that shape a person's worldview (Lubinski, 2004).

This view of intelligence as a developmental product has been shown to influence student motivation, highlighting the potential value of understanding intelligence as a multifaceted phenomenon, rather than as a hereditable attribute, especially throughout the admissions process (Blackwell, Trzesniewski, & Dweck, 2007; Dinger & Dickhäuser, 2013). For example, it seems that when students perceive intelligence as a quality over which he or she may have some control, and which can be developed (rather than something inborn over which they have no control), their efforts may become more focused on learning goals rather than performance ones (Blackwell et al, 2007, p. 247; Gagne & Deci, 2005). This emphasis on ability shifts some of the responsibility of learning onto the learner and highlights metacognition as a key construct in the theory of acquirable intelligence (Onyekuru & Njoku, 2015; Sternberg, 1997).

Research suggests that the metacognitive process is linked to self-efficacy and is essential to higher-order learning processes that include planning to learn, problem solving, and calibrating learning (Coutinho & Neuman, 2008). This higher-order process of thinking suggests that intelligence is an integrated product of knowledge, experience, and adaptation. The integration of these factors–knowledge, experience, and adaptation–is foundational to the framework of Sternberg's triarchic theory of intelligence. Exploring these facets of intellect through the lens of triarchic theory may help to explain the noncognitive characteristics unique to health care practitioners and help provide a rationale for supplementing the admissions practices of health programming with evaluative methods that reflect the value of these characteristics.

Triarchic Theory of Intelligence

Sternberg's triarchic theory of intelligence posits that there are three subtheories of intelligence, or intellects, whose interconnectivity conveys the general perception of intelligence (Sternberg, 1984, 1997, 2007, 2009, 2015). Sternberg argued that the three distinct and developable facets of intelligence–componential, experiential, and contextual–should be considered as equally valuable in considering a person's potential to learn and apply knowledge to new contexts.

A multifaceted approach to the investigation of intellect is not altogether novel; rather, Sternberg's triarchic theory builds upon centuries of investigation into psychometric evaluation. However, in contrast to the work done by Spearman (1904) and Thurstone (1924), Sternberg's triarchic theory of intelligence does not attempt to explain intelligence as the result of either nature or nurture but rather as a combination; it is a result of learned information applied along a continuum of experience and in a sociocultural context unique to the individual (Sternberg, 1997).

Componential intellect. Componential intellect can be described as the ability to acquire and store knowledge (Sedlacek, 2004; Sternberg, 1984, 1996). This executive process in metacognition is the most fundamental component of intelligence (Livingston, 1997; Sternberg, 2015). Mass mandated education, as is publicly offered throughout the United States, is one example of a methodology used to deliver, develop, and assess componential intelligence. As acquiring knowledge in a stepwise process through standardized curriculum is the focus of the current educational paradigm, it serves to reason that high stakes assessment measures, examples of which can range from weighted course exams to the Scholastic Aptitude Test (SAT) to professional licensure exams, are designed to assess componential intelligence. But, as Cheng (2015) noted when discussing the SAT, these measures were and continue to be designed to simply measure capacity to learn through recall.

The potential limitation of these measures is that they serve as a static and unidimensional indicator of intelligence, a perspective that has been debated by incremental theorists such as Sternberg (1984, 1997, 2015) and Sedlacek (2004). However, these measures do little to address the question of how well students can incorporate or apply what has been learned. The sole focus on capacity to learn through this approach to intellectual assessment has both influenced and affected how student success in their program is described; that is, academic success under this paradigm can be described as the ability to perform well on high stakes standardized measures (Sacks, 2009; Sedlacek, 2004, 2011; Sternberg, 1997). Although metacognitive performance in the form of knowledge acquisition is important, it does not account for all intellectual ability and should be considered as only one aspect of student potential (Sedlacek, 2004; Sternberg, 1984, 1997).

Experiential intellect. Sternberg (1984, 1997) argued that to be intelligent, one must understand how and when acquired knowledge is applicable. The sub-theory of experiential intellect suggests that successful intelligence is the result of behaviors that can be interpreted along a continuum of experience from that of a novice to that of an expert (Boshuizen & Schmidt, 2008; Sternberg, 1984, 1997). This paradigm assumes that there is value in lived experiences and that one must be exposed to applicable situations in which stored knowledge becomes both useful and familiar (Sternberg, 1984, 1997). The premise is that there is a distinguishable relationship between student behavior on a task or given situation and the amount of experience applied to that task or in such a situation (Sternberg, 1984, 1997).

Drawing from Kolb's (1984) theory of experiential learning, Sternberg (1984, 1997) posited that the influence of experience in learning differs drastically from that described by cognitive theories that emphasize the acquisition of knowledge. Kolb (1984) emphasized that the influence of experience in the theory of learning is a more holistic and integrative approach that combines experience, perception, cognition, and behavior. Experiential learning in this sense is a foundational component of the clinical curriculum unique to health programs, such as respiratory care. The integration or evaluation of a student's ability to effectively integrate these learning components into a higher-order of meaning in context, however, remains consistently undervalued throughout the admissions process (Moruzi & Norman, 2009).

Contextual intellect. The ability to apply acquired knowledge in a way that is inherent to the situation at hand is the premise of contextual intellect (Sternberg, 1984, 1997). The application of theory to reality, in context, is an essential part of intelligence and accounts for the adaptability of the student to transition away from the structured context of academia to the dynamic contextual demands of the evolving workforce (Khanna, 2014; Newton et al., 2007).

Sternberg (1984) argued that the development of contextual intellect was the result of continued exposure to a task such that through both performance of and knowledge about the task, reactions became at first familiar, then automatic. Once the response was automatized, the information and response could be adapted to new situations or scenarios by selecting and shaping the environment as appropriate to the task or response required. Contextual intellect then, can best be described as the interrelation between both the internal world of an individual and the external environment in which he or she functions (Sternberg, 1984).

Measuring intelligence using the triarchic theory. The subtheories of Sternberg's triarchic theory should not be viewed as paramount to one another. Rather, it is imperative to understand the concepts as complementary and considered equally in terms of both admission and assessment. The continuum of intellectual ability along which each of these facets are developed is illustrated in Figure 1.

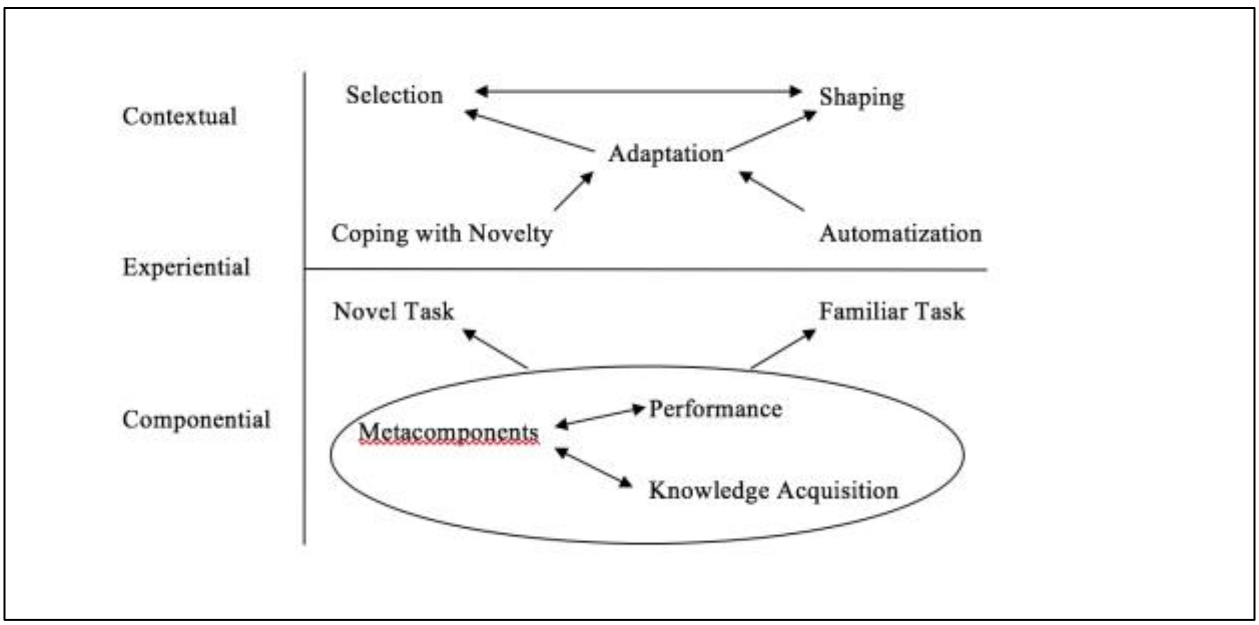

Figure 1. Sternberg's (1984) triarchic theory of intelligence (p. 68).

Traditional measures of assessment tend to focus on componential intellect as the sole measure of cognitive ability and further objectify this ability by standardizing the measure into quantifiable metrics (i.e., standardized test scores or GPA) (Sedlacek, 2004, 2011; Sternberg, 1984, 1997, 2015). However, there seems to be a clear disconnect between the measure of intellect from an academic perspective and the emphasis of that ability upon entry to the general workforce (Hyde & Bravo, 2015; Newton et al., 2007). According to a recent study conducted by the Association of American Colleges and Universities (2015), employers reported that both field experience and a broad range of skills are necessary for students to achieve career success. It seems apparent that a shift in assessment paradigm is required to address the gap between the expectations of academia and those in the workplace.

History of Standardization in Academia

Prior to the standardization of educational curricula, the focus of an education was primarily on the development of tradable or marketable skills. For most students, education was primarily offered via the apprentice model (Collins & Halverson, 2009; Dennen & Jonassen, 2004). This concept of cognitive apprenticeship viewed learning as a skill passed from an expert to a novice; the foundation being mastery of fairly well-determined and generally practical skills. To master a skill, the novice must understand what is to be learned, why it should be learned, and both how and when this knowledge should be applied. But as America became more culturally diverse, concern began to grow that without a standardized educational foundation, the new American generation lacked not only basic literacy, but also value-based educational cohesion (Collins & Halverson, 2009).

The shift away from the apprentice model towards that of a factory-model classroom was inspired, in part, by Horace Mann during the early 20th century (Rose, 2012). This factory model, centered in the classroom rather than the workplace, not only became the standardized method of ensuring consistent national values and baseline literacy, but also adhered to the industrialization movement seen during that time (Rose, 2012). In using a factory model that worked so well in the scope of material production, Mann's application of the one-size-fits-all approach to educational delivery included implementing rigid class structure, credit requirements, age-based grade levels, and standardized testing as the blueprint for educational delivery (Collins & Halverson, 2009; Rose, 2012).

This approach was designed to achieve very defined objectives. That is, it was intended to be efficient, cost-effective, and result in measureable knowledge and demonstrable skills (Collins & Halverson, 2009). These objectives were typically met in the bounded system of what society required of public education during the mid-20th century, wherein the conceptual framework for mass instructional delivery was conceived (Collins & Halverson, 2009).

However, although the bounds of the requirements have changed throughout the latter portion of the twentieth century and into the 21st century, the framework for educational delivery remains unchanged and inflexible to the demands of a modern society (Collins & Halverson, 2009). Although once a relevant and successful approach to educational delivery, it is important to continue to question its relevance and ability to fulfill the needs of a modern and dynamic society. This is because the traditional focus on the acquisition of knowledge as an objective of learning detracts from the process of learning wherein analysis and application are the main foci (Alon & Tienda, 2007).

Standardized measures of the didactic facets of education epitomize the emphasis placed on componential intelligence throughout the field of education. These measures, although designed to be objective, tend to measure only one facet of the multidimensional phenomenon that *is* intelligence and thus may contribute to inequity within academic institutions (Alon & Tienda, 2007; Duckworth, Quinn, & Tsukayama, 2012; Sedlacek, 2004; Sternberg, 1984, 1997, 2015). In limiting the focus of success to the ability to pass a standardized assessment, the traditional model of educational delivery does little to develop well-rounded students and foster intellectual diversity (Collins & Halverson; 2009; Hyde & Bravo, 2015; Sedlacek, 2004).

This challenge (i.e., how to wholly measure intelligence) is evident in the rates of attrition experienced throughout higher education, especially in health programs (Newton & Moore, 2009). Despite an emphasis on cognitive variables (e.g., GPA) as predictors of academic success in health care programs and in selection methods, there remains a higher than average rate of attrition in health care-related programs such as nursing, medical school, and respiratory care (Fraher, Belsky, Gaul, & Carpenter, 2010; Newton & Moore, 2009).

In an effort to not only shift the educational paradigm towards a more holistic view of student potential, but also to better match students with program and workplace expectations, it is essential that methods of assessment consider intellect as a multifaceted phenomenon, inclusive of more than just an ability to acquire facts. Given this perspective on the available literature, it can be argued that a new approach is required to select students for health care programming, one that recognizes that contextual and experiential aspects of intellect are not only relevant and valuable, but also developable (Sedlacek, 2004; Sternberg, 1984, 1997).

Sternberg (1984, 1997, 2007) argued that student background is a relevant contributor to both experiential and contextual intellect. These types of intelligence are valued in both a clinical setting as well as in the workplace and can be thought of as what Sternberg (1997, 2009) described as *successful intelligence*. Each measure of intellect should be considered a legitimate barometer of potential success and be considered when evaluating how prepared a student is for the collegiate learning environment or specific program.

Cognitive and Noncognitive Variables as Predictors of Student Success

As Field, Freeman, and Dyrenfurth (2004) acknowledged, the trajectory of student assessment is away from the traditional emphasis on grades and towards ensuring students meet the expectations of both the educational institution and external stakeholders–such as those employers who hire graduates. Although there are stark differences in the measurement of cognitive and noncognitive variables, a holistic approach that encompasses an integrated evaluation of student potential may provide a better understanding of student potential (Field et al., 2004). There are both benefits and barriers to the use of both cognitive and noncognitive variables and each type of variable will be explored further.

Cognitive Variables

Côté and Miner (2006) described cognition as a specialty of general intelligence. That is, cognition reflects mental processes such as memory and recall and is most frequently measured using traditional methods of recall-based testing (Côté & Miners, 2006). These cognitive measures continue to be the standard measure of intelligence that are used to identify success in an academic environment, typically as products of high-stakes summative course assessments or standardized test scores.

As Stiggins (2005) mentioned, these forms of assessment measures have served as education’s greatest intimidators, as mistaken "motivators" for achievement (p. 324). The traditional structure of academia, modeled after Mann’s factory model, provides a rigid structure within which students must "learn on demand," creating somewhat of a forced relationship between academic confidence and mandated success (Stiggins, 2005). Students who understand how to navigate this system tend to do well on these assessment measures, whereas those who do not tend to lack motivation towards achievement in a system that is designed to leave them behind (Duckworth et al., 2012; Stiggins, 2005).

Justification for cognitive evaluation. There is a wide base of literature that identifies cognitive factors, such as GPA or standardized test scores, as the best predictor of success in a collegiate environment (Al-Alwan, Al Kusi, Tamin, Magzoub, & Elzubeir, 2012; Moruzi & Norman, 2009). But the sole dependence on cognitive assessments as the only measure of student ability may be responsible for perpetuating the perception of a causal relationship between an ability to acquire knowledge and intellect; adhering to an educational paradigm that continues to fall short of objectives, as indicated by national attrition rates (Newton & Moore, 2009; Sparkman et al., 2012; Wheatley, 2006; Wittnebel, Murphy, & Vines, 2009).

However, there is strong evidence that this paradigm is changing due to the evolution of both student learning styles and methods of educational delivery, both of which may be attributable to an increase in the availability and access of information. This phenomenon, referred to by Collins and Halverson (2009) as "just-in-time" learning, deemphasizes the need for students to recall information without resources and therefore reducing the perception of the demonstration of componential intellect as superior to other facets of intelligence (Sternberg, 2009). Per Collins and Halverson (2009), just-in-time learning better aligns the type of knowledge with the context in which it is to be used and is therefore more "skill based than fact based" (p. 15). This alteration in paradigm underscores the opportunity to consider the value of skill-based, noncognitive attributes through a more quantum and holistic perception of academic success (Universities for Health, 2014; Wheatley, 2006). However, as this method of evaluation is subjective and difficult to measure on a large scale, cognitive measures such as GPA and standardized test scores remain the empirical default in the evaluation of student achievement at certain junctures, like admission (Sacks, 2009).

Grade point average. GPA continues to be the most studied indicator of student success, likely due to the easily quantifiable nature of the measure and its emphasis throughout the educational system. GPA is a collective measure of achievement over some span of academic study and is believed to demonstrate a student's average intelligence over that time in a scale-based measure (Sedlacek, 2011). Historically, GPA has been the strongest predictor of student success (Olani, 2009; Wittenbel et al., 2009).

However, the current emphasis on GPA in both the process of student selection and assessment is increasingly inconsistent with the expectations and needs of the workforce, especially in healthcare (Newton et al., 2007). As the landscape of healthcare changes, there is an increased emphasis on patient wellness rather than a sole focus on the absence of infirmary.

Although clinicians must be able to demonstrate componential intelligence in the form of recalling and demonstrating foundational information pertinent to a respective discipline, the changing focus to holistic care means that clinicians are now expected to demonstrate effective interpersonal, critical, and creative problem solving skills in constantly changing environments (Helmes & Pachana, 2008; Koenig et al., 2013; Lemay et al., 2007). These requirements are more closely aligned with both Sedlacek's (2004) and Sternberg's (1984, 1997, 2015) descriptions of experiential and contextual intelligence. Intelligence, suggested Sternberg (1997), is best developed when students are taught to "think *with* content, not just to memorize" (p. 90). The ability to recall enough information to pass a standardized board exam is akin to memorizing trivia in that it does not cultivate the higher order thinking and application skills required of the workforce (Koenig et al., 2013; Sternberg, 1997), highlighting the need to more closely align evaluative measures of student success with future career expectations.

Standardized testing. Standardized testing scores are among the most heavily emphasized measures of student intelligence and potential for success in higher education (Nusche, 2008; Sedlacek, 2004; Sternberg, 1984, 1997, 2015; Wittnebel et al., 2009). Standardized tests, such as the Scholastic Assessment Test (SAT) or the American College Test (ACT), were designed to measure a specific type of intelligence, as deduced from the ability to acquire knowledge (Digman, 1996; Sedlacek, 2004; Sternberg, 1984, 1997, 2015).

The current debate surrounding these types of measures includes the argument that these tests are unable to reflect more than componential intelligence and ignore a diverse demographic (i.e., minorities, women, and those who identify as gay, lesbian, bi or transsexual, or transgendered with valuable attributes (Sedlacek, 2004, 2005. Prideaux et al. (2011) noted a sort of flawed dichotomy between the theoretical and practical applications of standardized tests that measure aptitude, defined as a natural ability to do something, and achievement, described as doing something successfully in terms of either effort or skill (Merriam-Webster, n.d.). That is, “aptitude tests purport to measure potential for achievement while achievement tests purport to measure actual achievement” (Prideaux et al., 2011, p. 216).

This design results not only in misleading scores, but also misleading applicability of study findings (Prideaux et al., 2011). For example, in referencing work done by Koenig, Sireci, and Wiley (1998) and Tekian (1998), Prideaux et al. (2011) underscored that standardized tests, such as the Medical College Admissions Test (MCAT), over-predict performance in medical school while neglecting insightful variables of student ability such as diligence, motivation, and communication skills (p. 217). The inability of these tests to reflect the importance of experiential and contextual intelligence results in a one-dimensional projection of predictive success, one based on only one specific measure of success.

It can be argued that standardized tests are no longer representative of the student population, and therefore should no longer be emphasized as heavily in admission decisions (Alon & Tienda, 2007; Sedlacek, 2004). In fact, Alon and Tienda (2007) went so far as to say that "the apparent tension between merit and diversity exists only when merit is narrowly defined by test scores" (p. 487).

Influence of Grade Inflation on Cognitive Variables

The emphasis on cognitive variables, such as GPA or course grades, in determining student potential may also be somewhat misguided due to the theory of grade inflation, when grades trend towards the top of a 4.0 grade scale (Noonan, Sedlacek, & Veerasamy, 2005). Although this subject is relevant to this literature review, it remains a contentious topic among academics and therefore, much of the relevant literature presents a dichotomous perspective on the existence of grade inflation, let alone its impact on student assessment.

Within the debate regarding grade inflation and its impact on student development and assessment, there is general disagreement as to what constitutes grade inflation. For example, Watts and Winters (2016) simply defined grade inflation as an increase in the number of "A" grades distributed to students. However, Pattinson, Grodsky, and Muller (2013) challenged this simplistic definition of an increase in GPA, stating that this narrow scope failed to consider the "signaling power of grades–their ability to provide information to and about students" (p. 259). Regardless of exact definition, the ramifications of grade inflation are serious and include grade compression, higher rates of attrition in college, and later a failure to succeed in the workplace (Goodwin, 2011; Watts & Winters, 2016).

Grade compression has been attributed to several issues inherent to postsecondary education, and include teacher workload, consumerism, and untrained faculty (Watts & Winters, 2016). As revenue streams sourcing higher education rely upon tuition paid by students, a certain degree of the grade inflation issue has been blamed on consumerism (Watts & Winters, 2016). Watts and Winters (2016) pointed out that due to the economic framework of higher education, there has been a power shift away from instructor and towards students. Although a more equitable distribution of power in this environment is not necessarily a negative construct, concerns about assessment arise when students who view higher education as more of a product, rather than an experience, expect instructors to provide them with everything needed to be successful in a course–shifting the responsibility of learning entirely away from the student (Hubbell, 2015; Tucker & Courts, 2010). This shift in dynamic highlights several facets that likely potentiate grade inflation, such as inadequate professional development for faculty regarding clear-cut learning objectives, inadequate resources available for conflict resolution between faculty and students, and faculty workload (Pattinson et al., 2010; Watts & Winters, 2016).

Finally, and perhaps among the most concerning outcomes regarding grade inflation in the health sciences, are those of later attrition and failure to succeed in the workplace. As Goodwin (2011) highlighted, grade inflation may impact the student’s expectations of success, as grades are the typical gauge used by the student to understand his or her abilities. If grades are not an adequate reflection of ability, students may be more likely to experience attrition attributed to either a misjudgment of ability or to a mismatch in expectations between that of the student and those of the institution or program (Watts & Winters, 2016). Due to the inflation effect, higher grades may no longer represent exceptional work and thus become an inaccurate and even deceptive measure of skills attained (Watts & Winters, 2016).

Watts and Winters (2016) have also pointed out that, in addition to deemphasizing the value of a degree, grade inflation in the health sciences has the potential to impact patient safety–as grade inflation that leads to higher grades may not always mean a high quality of information synthesis. Several authors have noticed an increase in grades without an increase in other cognitive measures, such as medical examinations or other standardized cognitive measures, raising the question of whether the value of certain cognitive variables, such as grades or GPA, hold the explicit value that institutions or students may perceive them to (Fazio, Papp, Torre, & DeFer, 2013; Weaver, Humbert, Besinger, Graber, & Brizendine, 2007).

Noncognitive Variables

Several researchers have identified different noncognitive attributes as predictive measures. However, relatively few researchers have successfully developed a valid methodological process to gather enough empirical evidence to alter current practices (Eva et al., 2012; Koenig et al., 2013; Sperle, 2013). Attention to more comprehensive evaluation has resulted in the integration of several types of assessments directed at evaluating noncognitive variables into admissions practices, such as written essays or letters of recommendation.

However, several studies have questioned whether these measures accurately reflect a candidate’s potential and instead have recommended interviews or tests of situational judgment as both more popular and more reflective of the candidate’s nature (Koenig et al., 2013; Lievens & Sackett, 2012). Although barriers still exist, some institutions have realized the value of augmenting current admission practices with noncognitive measures to better predict student success to decrease rates of attrition and address other factors like satisfaction with program of study (Rooks, 2012; Weissbourd, 2014).

Methods of Noncognitive Evaluation

Student admission to professional health programs is typically extremely competitive and admissions committees are tasked with the difficult challenge of assessing and matching students who best fit both the program mission and requirements (Newton & Moore, 2009; Pau et al., 2013). As such, a holistic assessment of the student should include factors of both cognitive and noncognitive ability (Oranye, 2016; Prideaux et al., 2011; Salvatori, 2001; Urban Universities for Health, 2014). The theory of utilizing noncognitive variables is generally supported throughout much of the health-related literature (Al-Alwan et al., 2012; Fraher et al., 2010; Moruzi & Norman, 2009; Siu & Rieter, 2008; Sperle, 2013).

In a 2010 analysis of medical school applicants, Irby et al. (2010) found that students had difficulty understanding nonclinical dimensions of the care provider role (i.e., interpersonal and communication skills), indicating a lack of holistic patient view. The authors found that the overall perception was that most undergraduate curricula lacked focus on these dimensions. Further, Irby et al. (2010) indicated students who did not understand the multidimensional role of a clinician lacked the skills required to meet the health care needs of the American population, highlighting the gap in academic ability compared to functional ability in the workplace (p. 224).

Adding to the difficulty, noncognitive attributes are inconsistently applied to selection processes due to a lack of consensus as to which attributes are most desirable in students seeking admission to health-related programs (Irby et al., 2010; Koenig et al., 2013). Prideaux et al. (2010) outlined several recommendations from the 2010 Ottawa Conference regarding the assessment for selection to health professions programming. However, the scope of this investigation is limited to those methods most commonly implemented to assess noncognitive skill, including standard interview techniques, situational tests, and the MMI.

Interviewing methods. The traditional face-to-face interview remains a popular assessment tool among admissions committees. The methods through which interviews are conducted vary widely depending on the structure of the interview itself. As a generalized position, the 2010 Ottawa Conference stated that the reliability of such methods is equivocal, at best, due to the degree of variability amongst interview formats (Prideaux et al., 2011). They also seriously questioned the degree of the interviewer bias inherent to the process.

Validity remains the largest barrier to the use of interview techniques (Helmes & Pachana, 2008, p. 252). The nature of the traditional interview is highly subjective and results are difficult to measure quantitatively; however, Helmes and Pachana (2008) found that very structured interviews, those with upwards of 15 components, have validity coefficients comparable to similar tests of cognitive ability. Similarly, Prideaux et al. (2011) highlighted a 2007 study conducted by Poole, Catano, and Cunningham wherein the standard interview was highly structured to identify eight competencies of dental school applicants. The results of this study revealed an interrater reliability coefficient of 0.81 and positive correlations between interview scores and clinical performance, suggesting that there are ways to improve the interview process to provide useful and reliable measures of student potential.

Tests of situational judgment. Successful clinicians are required to have effective interpersonal skills; however, these skills are difficult to assess in an admission setting (Lievens & Sackett, 2012). Although the ability to evaluate interpersonal skills through the direct observation of applicants in a patient care setting prior to admission is desirable, such a process is unrealistic due to issues of access, applicant's current skill level, and confidentiality. Instead, tests of situational judgment (SJT) have been used to simulate patient-centered scenarios through which applicant competencies may be assessed (Krisberg, 2015).

Some research has suggested that SJTs are a valid substitute and are predictive of clinical performance (Lievens & Sackett, 2012). However, as McDaniel and Whetzel (2005) noted, although SJTs are designed to assess "non-academic, practical intelligence" (p. 8), there may be some inherent issues with SJT methodology. For example, most SJTs utilize a multiple-choice format in which the question has a stem and several responses. This format, not unlike a general intelligence test, forms a general factor (i.e., a *g* factor) (McDaniel & Whetzel, 2005). Due to the nature of these methods, results of SJTs may be influenced by altering the characteristics of the question, and therefore which factor is the most generalizable, and therefore which students do well on any one question (McDaniel & Whetzel, 2005).

According to a review conducted by Lievens and Sackett (2012), medical school applicant performance on SJTs added significant value to the selection process, especially in predicting performance in courses focused on interpersonal communication. However, for most other outcomes, cognitive tests (i.e., traditional tests of science-based knowledge) remained more predictive of medical school completion (p. 182). These results underscore the potential additive value of a noncognitive assessment to an existing selection process. But more research is required to identify the best method for assessing these attributes (Lievens & Sackett, 2012).

Multiple mini-interviews. Lemay et al. (2007) identified the admission interview as a valued aspect of the admission process; but there remain flaws in the construct of such interviews (Koenig et al., 2013; Lemay et al., 2007). For example, unstructured interviews tend to lack reliability and involve a substantial amount of interviewer bias (Koenig et al., 2013).

In response to these concerns, the Michael G. DeGroot School of Medicine at McMaster University in Canada developed the MMI as an integrated series of brief semi-structured assessment stations (Jerant et al. 2012; Prideaux et al., 2011). The MMI is structured as a time-limited interval station assessment that utilizes one rater at each station or scenario, similar to that of an OSCE, as the applicant moves from station to station and receives a score for that station (Knorr & Hissbach, 2014; Lemay et al., 2007; Prideaux et al., 2011). The format of the MMI can be adapted to assess a multitude of noncognitive domains and can also discriminate between attributes at different stations (Lemay et al., 2007). Common traits evaluated often highlight characteristics unique to health care providers and include ethical decision-making, advocacy, empathy, interpersonal skills, critical thinking, self-assessment, and cultural sensitivity (Koenig et al., 2013; Lemay et al., 2007).

This structure utilizes principles of an objective standardized clinical examination (OSCE) in that the measure is a multiple sample of clinical competencies (Eva, Rosenfeld et al., 2004). Current literature on the implementation of the MMI reveals reasonable reliability and may predict academic success in medical school as well as on subsequent licensure exams. This is likely because the test-retest structure better indicates quality of testing due to its focus on the testing scenario, rather than the operation (Eva et al., 2012; Jerant et al., 2007; Prideaux et al., 2011). That is, the structure of the MMI is designed to focus on *how* the student responds to the assessment, not necessarily with *what* they respond.

Utility of MMI in Accessing Intelligence

The objectives of integrating noncognitive assessment measures into the selection process are to not only better match student ability with program mission and requirements, but also to alter the assessment paradigm to be more holistic and equitable. To achieve these objectives in the most direct and resource-conscious way, the MMI can be utilized to assess a variety of intellectual functions throughout the mini-interview experience. Sternberg (1984, 1997, 2015) argued that this feat is achievable because there is a common set of universal processes underlying of all theories of intelligence; that is, regardless of cultural context, an intelligent person understands the need to define a problem and to identify and translate strategies to solve that problem. These universal processes can be broken down into three primary categories, and thus the MMI is designed to assess a student's ability to demonstrate the executive, performance, and acquisition components of the intellectual process (Eva, Rosenfeld et al., 2004; Prideaux et al., 2011; Sternberg, 2015).

Executive processes, or metacomponents, are described as the abilities to both recognize and define a problem, identify a strategy by which to address and solve the problem, as well as the ability to monitor and evaluate the process (Sternberg, 2015). Performance components are responsible for executing the functions of metacomponents. Finally, the process of acquiring knowledge requires the acquisition of a factual understanding of a problem and then an ability to use selective encoding, comparison, and combination to distinguish relevance of context (Sternberg, 2015).

Although each aspect of intelligence (i.e., componential, experiential, and contextual) requires proficiency in each of these processes, Sternberg (2015) suggested that there is some variability in the application of these aspects, given the requirements of specific situations or tasks, and therefore intelligence is potentially more complex than can be assessed through an objective measurement of one process (Sedlacek, 2004; Sternberg, 2015). Rather, a true assessment of student potential should represent a holistic view of intelligence and evaluate a range of intellectual skills; such is the objective of the MMI process (Burkhardt et al., 2015;

Koenig et al., 2013; Lemay et al., 2007; Poole, Shulruf, Rudland, & Wilkinson, 2012). The MMI method of student evaluation matches Salvatori's (2001) recommendation that because the selection of candidates for the health professions is highly competitive, "a multistaged process that includes assessment of both cognitive abilities and personal qualities" (p. 159) is needed.

Potential Benefits of Holistic Student Evaluation

The landscape of higher education has evolved from that of the mid-20th century. New methods are needed to assess clinical students in holistic ways that not only increase institutional and program diversity but also matches academic with workplace expectations. But attributes like creativity, critical thinking, curiosity, honesty, empathy, and self-awareness are not the focus of most standardized evaluations. This highlights a glaring dichotomy between what the workplace and academia value in a graduate (Harris, Smith, & Harris, 2011; Koenig et al., 2013). As Lievens and Sackett (2012) noted, although most medical schools integrate curricula that emphasizes both cognitive and noncognitive foci, admission processes typically focus solely on cognitively-oriented tests.

Better Evaluation of Core Competencies

Selecting applicants for admission into health care programs presents a unique challenge due to the multifaceted requirements of not only the program curriculum but also to the field itself. Pruitt and Eping-Jordan (2005) highlighted five core competencies outlined by the World Health Organization (WHO) as recommendations for preparing healthcare workers for the needs of the 21st century. These competencies include (a) patient centered care, (b) partnering, (c) quality improvement, (d) information and communication technology, and (e) a public health perspective. These broad expectations for new health practitioners help to provide a rationale for health program administrators to adjust their admission processes to select students who can meet the needs of the workforce by focusing on holistic approach to evaluating competencies that are relevant to practitioners (Urban Universities for Health, 2014).

The Association of American Medical Colleges (AAMC) has identified nine personal competencies that are predictive of success in medical school: ethical responsibility, reliability and dependability, service orientation, social skills, capacity for improvement, resilience and adaptability, cultural competence, oral communication, and teamwork (Koenig et al., 2013). However, although the AAMC has identified these competencies as being relevant predictors of success in medical schools, there has been little guidance as how to best evaluate these measures of intellect.

There is little debate as to the importance of demonstrable componential intelligence. However, there remains debate as to which potential noncognitive assessment measures may best identify experiential and contextual intellect as predictors of student success as health care providers (Koenig et al., 2013). Per Koenig et al. (2013), assessing student competencies as they relate to success is difficult primarily because there is not a consensus as to which competencies are most relevant for applicants. However, developing a holistic view of student potential is imperative because without such alteration in the admission process, graduate composition and rates of attrition are unlikely to change. Several medical programs (Burkhardt et al., 2015; Al Alwan, Al Kusi, Tamim, Magzoub, & Elzubeir, 2012; Jerant et al., 2012) have integrated methods through which to glean information about the value of noncognitive traits. More specifically, several studies have identified the MMI as a unique approach to understanding the influence of personal competencies in predicting academic success (Eva, Rosenfeld et al., 2004; Knorr & Hissbach, 2014; Lemay et al., 2007; Pau et al., 2013).

Reduced Attrition

It is likely that a portion of the current rates of attrition are influenced by the mismatch between current methods of predicting student success, revealing the need for a more inclusive method of evaluation (Newton & Moore, 2009; Raisman, 2013; Sedlacek, 2004; Sternberg, 1984, 1997, 2015). Per a national study conducted by Urban Universities for Health (2014), graduates from institutions that have implemented a holistic approach, including the assessment of noncognitive measures, tended to have more engagement with the community, an increased level of cooperation in teamwork settings, and were more open to ideas and perspectives that differed from their own (Urban Universities for Health, 2014). These institutions also reported that not only were measures of academic performance, primarily GPA, largely unchanged or improved, rates of graduation also remained the same or improved compared to previous measures (Urban Universities for Health, 2014).

Program Diversity

Traditional methods of predicting success have neglected to highlight issues in fairness among diverse populations (Camara, 2005; Sedlecek, 2004; Sternberg, 1984, 1997). Au (2008) argued that standardized testing measures are designed to structure knowledge in a way that "actively selects and regulates student identities" (p. 639). However, standardized tests (e.g., the SAT) were not conceptualized to evaluate diverse populations, such as those of minority descent, women, nontraditional students, and those of varied sexual orientation (Harris et al., 2011; Sedlecek, 2004; Sternberg, 2010).

This is concerning in higher education, as institutions are being pressed to create not only a more diverse environment but also a more diverse experience for students. This is a systemic problem because, although standardized testing has become inherent to educational regulation, standardized tests do not adequately represent diverse populations (Au, 2008; Sedlacek, 2004; Sternberg, 1984, 1997, 2015).

Standardized testing methodologies have been designed to identify one type of easily quantifiable intelligence in one population (i.e., male, Caucasian, with mid- to high-socioeconomic status) (Sternberg, 2007). However, cultural contexts of intelligence may be just as valuable to both the academic setting and that of the workplace. Noncognitive measures, such as MMI scores that reflect intellectual processes indicative of empathy as well as both interpersonal and critical thinking skills, are designed to evaluate the experiential and contextual domains of intelligence and may therefore be better able to successfully predict not only academic success, but also success on licensure exams and job placement (Eva et al., 2012; Lievens & Sackett, 2012; Reiter, Eva, Rosenfeld, & Norman, 2007; Sperle, 2013; Sternberg, 1984, 2007). Additionally, institutions that integrate more holistic measures of applicant selection increase diversity by creating a more equitable pool of competitive applicants (Urban Universities for Health, 2014).

Matching Professional Expectations in the Workplace

A goal of any academic institution should be to prepare students to enter the workforce with a reasonable amount of the knowledge and skills required to meet job requirements. The dichotomy between the current educational paradigm and professional expectations of student ability must be addressed. Rather than teaching students *what* to think, the goal of higher education should be to teach students *how* to think (Collins & Halverson, 2009; Sedlacek, 2004; Sternberg, 1984, 1997, 2015). As such, methods through which students are assessed for admittance into highly competitive programs should encompass all domains of intelligence rather than a sole measure of the ability to acquire knowledge in a static context.

Conceptual Framework

Methods of student evaluation have long centered on the paradigm that intellect and ability are inextricably linked to quantifiable measures, such as GPA (GPA) or standardized test scores (Sedlacek, 2004; Sternberg, 1984, 1997, 2015). These measures, although traditionally used to predict academic success–especially in the process of admissions–may fail to adequately assess student readiness for not only program specific but also workplace expectations (Newton & Moore, 2009). Research has suggested that the demands of clinical programs, such as respiratory care, are not only academically rigorous but also require that students demonstrate the ability to think critically, communicate effectively, and adapt to evolving environments (Newton et al., 2007; Sperle, 2013).

This mismatch between academic and workforce expectations has led to the exploration of a more holistic approach to assessing student competencies during the selection process (Newton et al., 2007). In order to graduate students competent in the six overarching categories outlined by the ACGME as well as those identified by Barnes et al. (2010) and to decrease programmatic rates of attrition, it is imperative that health programs admit capable students who demonstrate desirable cognitive and noncognitive attributes. They must design an inclusive curriculum effective at developing the competencies emphasized in the workplace, and develop adequate assessment measures reflective of the program's mission.

In the interest of identifying a more equitable method of predicting student success by better matching admission criteria with programmatic objectives, this study asserts that intellect is a multidimensional phenomenon. Sternberg's (1984, 1997, 2015) triarchic theory of intelligence provides the framework through which to investigate the additive value of experiential and contextual ability on intellect and the prediction of student performance in a respiratory care program by integrating methods of experiential and contextual assessment into the process of admission (Figure 2). To assess measures of noncognitive ability, this study builds on existing literature regarding the utility of the MMI process, as adapted from the original McMaster format, to evaluate core personal competencies unique to successful clinicians (Koenig et al., 2013).

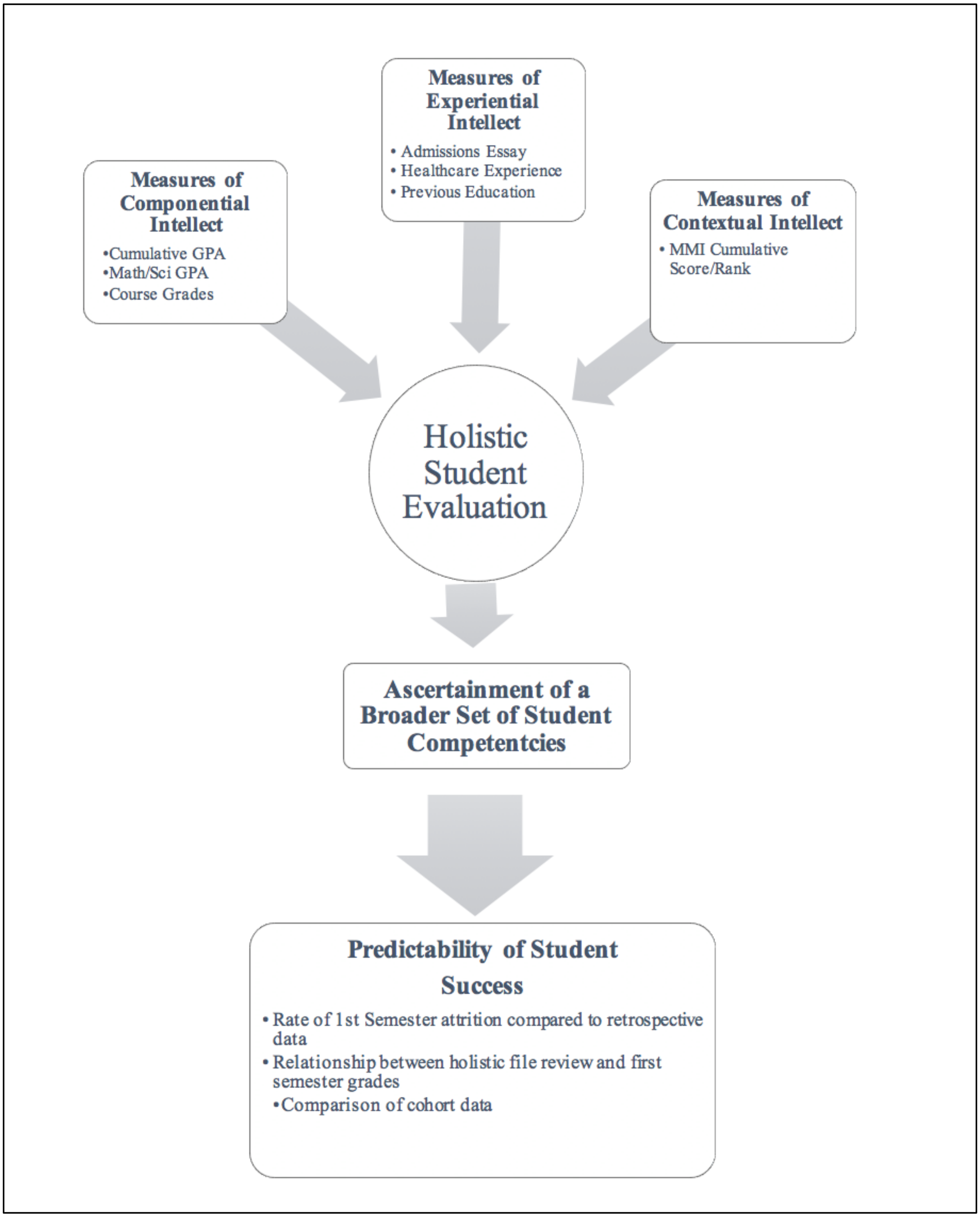

Figure 2. Theoretical framework: Holistic approach to evaluating candidates for admission into a respiratory care program in the context of Sternberg's (1984) triarchic theory of intelligence.

Summary

There is a clear disconnect between the objectives of current measures of student achievement in academia and the ability of those measures to identify students who will be successful in a field that requires a broad portfolio of interpersonal skills. It is important to rectify this gap to not only reduce the rates of attrition, but also to increase program diversity and address the dynamic needs of the workforce (Newton et al., 2007). Utilizing solely standardized or cognitive measures neglects the value of student attributes that may be more predictive of academic success in a varied learning environment, such as that of a baccalaureate respiratory care program (Prideaux et al., 2011; Sperle, 2013). The integration of noncognitive variables as an adjunct method of assessment of student achievement suggests an additive and more holistic measure of potential academic success (Koenig et al., 2013; Lemay et al., 2007; Sternberg, 1984, 1997, 2015; Wilson, Sedlacek, & Lowery, 2014).

The student demographic has also changed greatly over the latter portion of the twentieth century (Collins & Halverson, 2009; Sedlacek, 2004). Along with the changes in demographic, come more varied backgrounds, beliefs, and perspectives (Sternberg, 1984, 2007). Each of these aspects of personality are considered valuable in the workplace, but are often overlooked in an academic setting (Koenig et al., 2013). This may be due to strict adherence to the traditional educational paradigm, which focuses on a defined phenotype (Collins & Halverson, 2009; Sedlacek, 2004).

Noncognitive competencies, such as ethical responsibility, reliability and dependability, social skills, teamwork, and capacity for improvement, provide useful and arguably more inclusive information about how prepared a student may be for the demands of health care programming (Koenig et al., 2013; Lemay et al., 2007; Sedlacek, 2004). Currently, there is a glaring gap in recognition of student potential due to the continued reliance on cognitive attributes, such as GPA and standardized test scores (Sedlacek, 2004; Siu & Reiter, 2009; Sternberg, 2015). A multidimensional approach to student evaluation is needed to not only provide students with a more realistic concept of what is required of students who are admitted to health care programs, like respiratory care, but also to ensure success within that environment.

Institutional and program rates of attrition may also be directly affected by a mismatch between the intellectual paradigms within academia and those of the workplace (Newton & Moore, 2009; Pruitt & Epping-Jordan, 2005; Raisman, 2013). Integrating more equitable measures of student evaluation, such as those assessed via the MMI, may not only work to address this gap, but also help to create a more diverse population of students in health care programming.

CHAPTER 3

METHODOLOGY

The purpose of this quantitative case study was to investigate the utility of the multiple mini-interview (MMI) as an adjunct method of student selection for admission to a small, cohort-based respiratory care program. There is growing concern among industry leaders that students lack necessary skills upon entry to the labor market (Jackson, Lower, & Rudman, 2016). This may be due in part to a mismatch between the objectives of academic training, specifically in the areas of communication and teamwork, and those expectations of the workplace (Jackson et al., 2016).

To help address this gap, this study investigated the effectiveness of the MMI in selecting students who demonstrate key competencies, some of which have been identified as being indicative of success in not only health care academic programming, but also in the workplace. The central questions of this study were framed by Sternberg's triarchic theory of intelligence (1984), which assumes intelligence is a multifaceted phenomenon, and were designed to better understand why students who demonstrate above average intelligence, as measured by GPA, continue to experience higher than normal rates of attrition in this particular respiratory care program. In addition to addressing the attrition rate, an overarching objective of this study was to help identify the efficacy of the MMI in identifying and assigning value to the demonstration of key noncognitive competencies during the selection process.

Setting

This study was conducted at a mid-sized metropolitan university. The specific department where this study took place was a small respiratory care department housed in the University's College of Health Sciences' School of Allied Health. The respiratory care department conducts two separate programs: one on-campus program that consists of a two-and-a-half-year undergraduate curriculum culminating in a baccalaureate degree, and a separate online-only degree completion program consisting of practicing clinicians who have obtained an associate's degree from another institution and have transferred to this program to finish requirements to obtain a baccalaureate degree. This study focused on the selection process of students applying for the on-campus program only.

The respiratory care program at the center of this study was highly competitive, typically admitting approximately one third to one half of applicants in an annual enrollment period. Those students who apply to the program must have completed approximately 2 years of prerequisite courses, most of which are institutionally specific requirements, with some additional program-specific requirements that include medical terminology, human anatomy and physiology, and chemistry courses with concurring lab requirements.

Students who are admitted are expected to complete the on-campus program with an integrated didactic and practical curriculum, and finishing the final degree requirements by taking a selection of upper division courses offered exclusively online. Per the requirements of the licensing organization for respiratory care, National Board of Respiratory Care (NBRC), students must complete their entire course of study prior to sitting for the national licensure exam for respiratory care; that is the Registered Respiratory Therapy (RRT) board examination. As this program only offers the option to complete a baccalaureate degree, in contrast to other programs that offer an associate's degree option, students typically cannot sit for the national exam in fewer than two and a half years after being admitted to the program.

The department employs seven full-time faculty and several adjunct and clinical faculty members responsible for teaching all program content. Cumulatively, the seven full-time faculty members have over one hundred years of teaching experience. All full-time faculty also teach at least one clinical course and one laboratory-focused course within the program to help ensure the integration of theoretical course material with the contextual realities of the clinical environment.

Research Design

This study utilized a quantitative case study approach (Creswell, 2012; Gliner, Morgan, & Leech, 2017) to best understand the utility of the MMI process in selecting students who are prepared for success in a baccalaureate respiratory care program. The MMI instrument used in this intervention was adapted to evaluate the key noncognitive competencies of candidates who have also been identified as inherent to successful clinicians. The exploration of the relationships among admissions variables and between aggregate MMI score and final semester grades may help to evaluate the usefulness of the MMI in undergraduate health program admissions processes (Figure 3). The data available that describes these relationships exists and is available per standard data collection and storage policies within the Department of Respiratory Care.

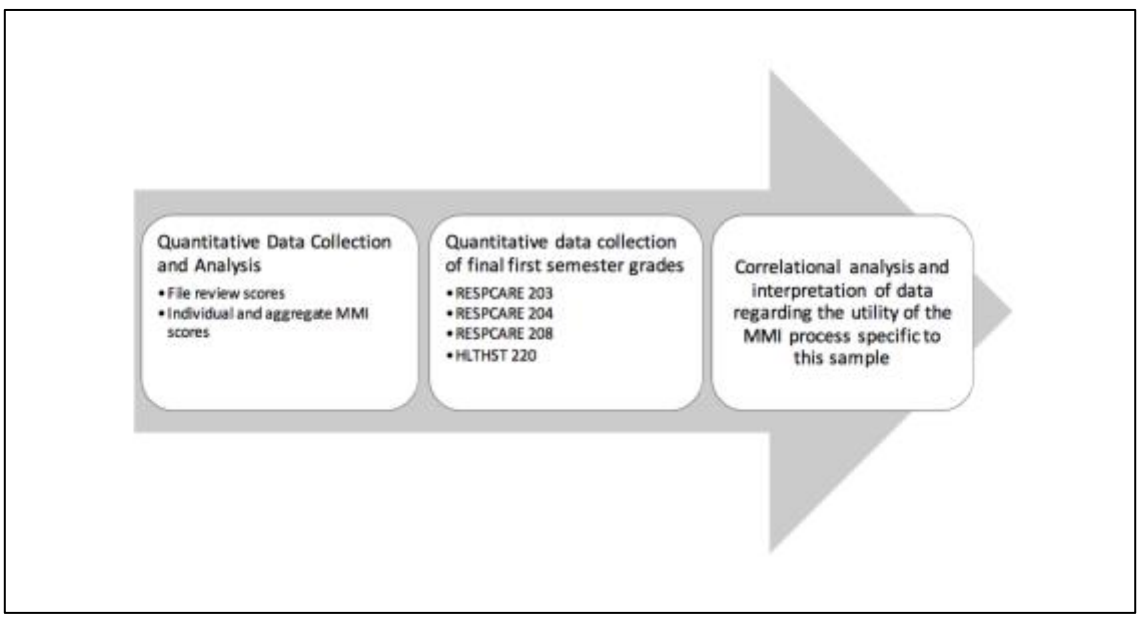

Figure 3. Quantitative case study design.

Participants and Data Collection

The data collected throughout the admissions process regarded 25 students who applied and were ultimately selected for admission into the 2016 respiratory care cohort at this institution prior to May 31, 2016. Additional data, including the final first-semester grades of those students, was explored in order to investigate the relationships among performance on the admissions MMI and academic performance throughout the first semester, as measured through final course grades. This sample of students, although convenient, was selected purposefully to evaluate the utility of the MMI in evaluating candidates for admission to this specific baccalaureate respiratory care program.

Upon application to the program, an academic profile of each candidate is compiled and stored by an administrative assistant within the program staff. This profile includes information that will be referred to as the *academic file review* (Appendix A); that is, this is the information used by the admissions committee to evaluate each candidate. Each admissions criterion is assigned a specific point value that is then weighted in proportion to the other admissions variables. The total applicant score reflects a holistic evaluation of the candidates' componential, experiential, and contextual intellects.

A subset of this information was utilized for the purposes of this study. Admission variables were categorized based on which dimension of intelligence they were intended to evaluate and were described using terms identified by Sternberg's triarchic theory (1984) as either cognitive (componential), experiential, or contextual in nature.

Cognitive Variables

Variables coded as 'cognitive' in nature are described as objective measures of intelligence and include course grades for both prerequisite courses and final respiratory care-specific courses as well as select measures of GPA. The following section will provide both an overview and rationale of included cognitive variables.

Human Anatomy and Physiology I. This course is the first in a two-semester sequence of a focused inquiry into human anatomy and physiology and has a co-requisite laboratory component. This course is described by the participating institution as a rigorous sophomore-level introduction to the fundamentals of human anatomy and physiology. Although both semesters of this sequence are required for entry into the respiratory care program, most program applicants are in the process of completing the second course at the time of application, due to a spring application deadline. As such, only cognitive data reflecting student performance in the first half of the sequence was included in this study.

Foundational math course. Students eligible for admission into the respiratory care program must have completed a math course that satisfies the institutional foundational requirements. Math courses that satisfy this foundational requirement include courses that focus on quantitative reasoning, college algebra, either a survey of or introduction to calculus, applied statistics with computers, or geometry and probability for teachers. The majority of students admitted to the 2016 cohort completed either a course in college algebra (48%) or applied statistics with computers (40%).

Cumulative GPA. Cumulative GPA is considered an indication of achievement across an academic career. The selection committee opts to evaluate cumulative GPA to evaluate both student persistence and academic behavior.

Combined math and science GPA. Sperle (2013) indicated that achievement in math and sciences courses predict performance in related courses of study. Typically, the math/science GPA variable is calculated using the grade received in the foundational mathematics prerequisite and the grade received in either the first of the human anatomy and physiology sequence courses or the first of the chemistry requirement sequence, whichever of the grades is the highest.

At the time of application, there were several candidates who had yet to complete the first of the chemistry requirements. Due to the large amount of missing data, this variable was not included in this investigation. If students had not yet completed this requirement, the grade for the first anatomy and physiology course was used by default. Prior to the integration of the MMI, this program over-emphasized the value of performance in math and science courses. To more evenly distribute emphases on other facets of intellect, the weight carried by this variable was considerably lessened in the 2016 admissions cycle.

Science or math courses taken above and beyond foundational requirements. In some cases, students had taken additional science or math courses prior to applying to the respiratory care program. Additional points are awarded to those students who chose to take additional and more difficult courses, such as those math and/or science courses that are considered above and beyond the foundational requirements of the participating institution or those required for entry into the program.

It is possible that awarding additional points to those students who have experienced a longer academic career than others may put newer students (i.e., true freshmen) at a mathematical disadvantage in the admissions process. To counteract this discrepancy, there is a specific category to identify these 'true freshmen' and award additional points for which other students are ineligible.

Health Studies 220 (HLTHST 220). This course is described as an in-depth introduction to the normal and physiological functions of the pulmonary, circulatory, and renal systems. This is a required curriculum listing for the department and it is preferred that students take this course the first semester in which they have been admitted to the program. Occasionally, a student will have taken this course prior to applying for admission to the program; however, all students admitted to the 2016 cohort took the course during the fall semester of 2016.

This course is described as the foundational course upon which most of the respiratory care curriculum is built, and lists both semesters of human anatomy and physiology as prerequisites. The course, although listed as a Health Studies course, is taught by a faculty member of the Department of Respiratory Care with an extensive background in physiology. The course is offered in a hybrid format, which offers flexibility to students who would prefer to view a recording of the course, rather than attend a live session. Course grade is the culmination of three course exams and a cumulative final. Due to the modality of the course offering, all tests are taken open-book and are conducted online through the Blackboard Learning Management System (©Blackboard Inc.).

Respiratory Care Theory I (RESPCARE 203). This course is a fundamental introduction to the field of respiratory care. The course curriculum focuses on introducing new students to the broad concepts that will provide the framework for disease management, fluid dynamics, and patient care. Although a considerable amount of information is provided, there is a distinct shift in the expectation of knowledge synthesis towards application and analysis of content rather than of pure recall. This course has been taught by consistent members of the Respiratory Care faculty for each of the three years included in this investigation. Co-requisites for this course include RESPCARE 204 and RESPCARE 208.

Respiratory Care Laboratory I (RESPCARE 204). This course is the ‘hands on’ introduction to the fundamentals of respiratory care. Objectives of this course include the application of theoretical information provided in RESPCARE 203 to real-time scenarios that require critical thinking and analytical skills. There is often a high rate of attrition in this course. Anecdotally, the faculty have postulated that the reason for this is the abrupt shift away from the traditional recall-based expectations students experience throughout their first 2 years in general education requirements towards a critical synthesis of information in variable contexts. This laboratory course has been taught by consistent faculty within the department for each of the three years included in this investigation. Co-requisites include both RESPCARE 203 and RESPCARE 208.

Clinical Practicum I (RESPCARE 208). The curriculum within this particular respiratory care department is unique in comparison to other undergraduate health programs in that students admitted to this program begin clinical rotations in area hospitals by the eighth week of instruction. Early introduction to clinical practicum is a major component of the mission statement of the department. Assessment of this course is done by clinical preceptors using a standardized grading form developed by the Director of Clinical Education (DCE). Students are graded on professional behavior, application of theory, demonstration of clinical skill, and patient interaction. Additional assessment measures in this course include clinical case study analyses performed by each student and evaluated by the DCE. Co-requisites for this course include RESPCARE 203 and RESPCARE 204.

Experiential Variables

According to Sternberg (1984), experiential intellect is dependent upon the degree of novelty; that is, the mastery of a concept or the development of intelligence is dependent upon the ability of one to cope with the novelty of the experience. This idea of iterative processes providing the foundation of mastery guided the categorization of the following variables as experiential.

Health care experience. Candidates who have health care experience were given additional points. One point was awarded to those students who indicated they had and could provide proof of experience within the health care field. The Department of Respiratory Care opted to define health care experience as a licensed or certified professional that included but was not limited to a Certified Nursing Assistant (CNA), Emergency Medical Technician (EMT), or Corpsman.

Upper division respiratory care courses taken early. There are five upper-division elective courses required to complete a Bachelor of Science in Respiratory Care at the participating institution. These courses, although technically part of the respiratory care curriculum, may be taken by students who are not yet admitted to the program. Typically, students who enroll in these courses are advised to do so by a faculty advisor within the department if the student is both a strong candidate and has fulfilled all the prerequisites. Rather than advising the student to take superfluous courses, students can enroll in one of the 10 senior-level courses as an elective.

Enrollment in one or more of these courses does not guarantee that a student will be selected for admission. However, the selection committee feels that opting to enroll in a respiratory care-focused class not only indicates continued interest in the field, but also exposes the student to respiratory care focused content, establishing the first degree of experiential novelty. Students may be awarded one additional point in the admissions process, regardless of how many senior level courses are taken prior to admission to the program.

Evidence of full academic load. The respiratory care curriculum is rigorous and requires that a student be able to balance a full academic load with other roles and responsibilities successfully. To best assess this ability, the selection committee reviews each candidate's entire academic transcript to evaluate that candidate's ability to carry a heavy academic load. Each of the first four semesters of the on-campus curriculum requires an academic load of between 15 and 17 credits.

At the participating institution, students are considered full-time with an academic load of 12 or more academic credits per semester. As such, the selection committee considers the ability to carry an academic load of more than 12 credits with a GPA of 3.0 or greater evidence of academic perseverance. Students may be awarded either two or three points for being able to carry an academic load of 12 or more credits for either one semester or one year, respectively. For those students receiving three points for demonstrating academic perseverance for a year or longer, the semesters do not have to be consecutive. This designation was made due to the volume of students who are returning from long absences from academia.

Exploration into field. Exposure and sustained interest into the field of respiratory care is viewed positively as it is perceived by the committee as evidence of motivation to not only complete the requirements of the respiratory care department but also become a successful respiratory care practitioner. The department offers specialized tours of a local intensive care unit. On these tours, prospective students can speak with practicing respiratory care practitioners, current students, and tour a clinical facility. Students must sign up for these tours through the department and are referred to do so by an advisor in the respiratory care department.

Students who participate in one of these tours are awarded one point during the admissions process. The additional point may also be awarded if students describe other investigational efforts into the field, such as job shadowing or internships.

Essay. The application essay is an opportunity for the candidate to discuss both their motivation for pursuing respiratory care and provide a platform for showcasing strengths and experiences. As two of the selection committee members who reviewed the admission essays also participated as interviewers throughout the MMI process, in order to decrease potential reviewer bias the essays were coded by an administrative assistant within the program. Each candidate essay was reviewed and scored by three separate committee members, each of whom scored the essays. The cumulative essay score was then weighed. Although the weight of the admissions essay was significantly redistributed (reduced) with the addition of the MMI, the selection committee opted to keep the requirement as it often reveals significant details about the candidate that may otherwise be overlooked through more objective admissions measures.

Contextual Variables

Sternberg (1984) describes intelligence as a function of daily living as purposive adaptation; that is, the selection and shaping of environments that are relevant to one's life, novelty level, and innate abilities. Sternberg (1984) posited that although there is no one set of behaviors that are considered universally intelligent, the components of mental self-management (i.e., knowledge acquisition, metacomponents, and performance components) are likely universal; as is the desire to direct these components towards a goal to move from a novel experience towards a more automatic response. For the purposes of this investigation, performance on the MMI served as a measure of contextual intellect by assessing a candidate's response to a novel scenario. Specifically, this investigation looked at the cumulative points a candidate received on the entire MMI, the scores received at each individual station, and the final MMI ranking of each candidate.

To create a more holistic admissions process, the selection committee assigned weights to the variables to emphasize a more equitable distribution of value among intellectual abilities. Using Sternberg's (1984) triarchic theory to account for the interplay among the multiple facets of intelligence and to add value to the relationships among the internal world of the individual, experience, and external environment, the selection committee opted to weight the file review (i.e., the cognitive and experiential variables, less the essay) as 45 percent of the total candidate score, the contextual variables (i.e., MMI performance) as 50 percent, with the essay accounting for the remaining 5 percent of distributed weight. Each of these values was added together to identify a cumulative candidate point value. This value was sorted in descending order to reveal the top 25 candidates and 2 alternates.

Two of the original top 25 candidates declined entry and admission was subsequently offered to the alternates, both of whom elected accepted positions in the fall 2016 cohort. Only the data for the 25 students who entered the program in the fall of 2016 was collected and analyzed. A complete listing of variables included in this investigation and corresponding scale ranges can be found in Appendix B.

Data Analysis

To address the questions central to this study, Pearson's correlation coefficients and chi-square analyses were utilized to measure the degree, direction, and strength of associations between cognitive and noncognitive variables. Academic progress throughout the first semester was tracked by the instructors of each course. Once first-semester grades were final, the administrative assistant responsible for masking the original database for the researcher incorporated first-semester grades into the existing data file.

The specific courses within the respiratory care curriculum that were included in this study are listed in Table 2. These courses were identified as the specific courses wherein students tend to experience the highest rates of attrition. The participating institution utilized a 4.0 grading scale and incorporated a +/- system. For the purposes of this study, the letter grades of the select respiratory care courses were converted to a numerical value representative of this 4.0 scale. A summary of these values is included in Table 3.

Table 2

Selected First Semester Respiratory Care Courses and Academic Credit Value

Course Title	Academic Credit Value
Fundamental Theory I	3 Credits
Respiratory Lab I	2 Credits
Clinical Practicum	2 Credits
Cardiopulmonary Renal Anatomy and Physiology	3 Credits

Note. These courses represent 10 credits of a total required curriculum load of 17 academic credits for the Sophomore Fall semester.

Table 3

Summary of Letter to Numeric Grade Conversion on a 4.0 Scale

Letter grade	Quality Points per Credit Hour Used to Calculate GPA
A+	4.0
A	4.0
A-	3.7
B+	3.3
B	3.0
B-	2.7
C+	2.3
C	2.0
C-	1.7
D+	1.3
D	1.0
D-	0.7
F	0.0

Program-Specific MMI Instrumentation

The MMI instrument used by this institution was somewhat of a modification of tools developed by both the Michael G. DeGroote School of Medicine at McMaster University (Trinh & Edge, 2012) and the University of Calgary Medical School (2008). The instrument was altered to meet the requirements set forth by the selection committee within the respiratory care department at the participating institution. An example of each of the three MMI stations, as well as how students were scored on specific subscales, is included in Appendix C.

Each of the three stations were targeted towards the evaluation of a specific noncognitive attribute. Table 4 provides an overview of each of the three station's target attribute and corresponding topic. The topic scenarios remained relatively unchanged from those used by the University of Calgary (2008), aside from the alteration of the setting of 'medical school' to the setting of 'respiratory care program' in scenario 3. These target attributes were selected to closely align with key competencies identified as essential to successful clinicians, as outlined in the literature (Koenig et al, 2013; Sperle, 2013).

Table 4

Summary of Station Specific Attributes and Topics

Station	Target Attributes	Scenario Topic
1	Ethical perspective, interpersonal skill	Every week your classmates gather at the local coffee house to review the lessons from that week. In the last month, everyone has been working on a major paper on Roman history, which accounts for 40 percent of the course grade. One of your classmates has copies of two of the papers that last years' students wrote for the same course. Your classmate has emailed copies of the papers to you and the other people in the group. What would you do in this situation and explain why?
2	Critical thinking, time management, empathy	In this scenario, you are a physician who provides full service family medicine. It is late in the afternoon and you still have four patients left to be seen in the waiting room. You expect that you can comfortably see them and head home. You are not on call; your medical partners will look after any of your patients that require medical assistance. You have promised your significant other that you will be home in time to attend a family event Just before seeing one of these four patients, the local nursing home calls to tell you that Mrs. Andrews' health is deteriorating dramatically. You have looked after Mrs. Andrews and her family for several years. Mrs. Andrews and her family had previously agreed to a 'Do Not Resuscitate' (DNR) order so that when she got ill again, she would be allowed to die comfortably, but without intervention. The family is now questioning whether they made the correct decision and wants to discuss it with you as soon as possible. How will you manage your time?
3*	Self-appraisal, communication	You are halfway through your first year of the Respiratory Care Program. Your school has a peer professionalism assessment program that requires that six (6) of your classmates assess you each year. You also do a self-assessment.

* This station includes a scored reference chart. Please see Appendix C for the complete question.

The ranking tool used by this particular program was adapted from the one outlined in the *McMaster University Interviewer Handbook* (Trinh & Edge, 2012), but was altered to include a set of stations 'factors', or subscales. Subscales provide additional, more detailed information on participant performance throughout the MMI process (Knorr & Hissbach, 2014). In this case, the final score for an individual station was the cumulative score on each of the five subscales. This means that any one student could score a maximum of 20 points on any one station. As there were three separate stations, the maximum cumulative points available to any one student on the overall MMI was 60 points (i.e., three stations, with a maximum appropriated point value of 20 points).

The factors identified by the selection committee of this specific program included the ability to understand and address the objectives of the scenario, communication skills displayed, strength of arguments presented, and suitability for a career in respiratory care. The department committee chose to utilize a focused evaluation of these subscale requirements on an anchored Likert-type scale of 1 to 4, with a score of 1 being an unsatisfactory fulfillment of the scenario factor and 4 being an excellent demonstration of the individual factor.

This methodology derived from the McMaster University format, which utilized a 10-point Likert scale on which to evaluate candidates, with a score of 1 being an unsuitable performance and 10 being an outstanding performance on any one station. This deviation of instrumentation was based on Knorr and Hissbach's (2014) meta-analysis of MMI methodology. Knorr and Hissbach (2014) indicated that most MMI scoring systems rate student performance on a Likert-type scale that includes between 4 and 10 points.

In considering how to score an individual student on each of these factors at any one station, a list of considerations for interviewers to review was identified by the selection committee and respiratory care faculty and was included as a reference to interviewers on the actual score sheet. A list of these factor considerations is included, along with the rest of the scoring sheet in Appendix C, but is also presented here, in Table 5, as a quick reference for the reader.

Table 5

Subscale Factors and Scoring Considerations

Factor	Scoring Considerations
Ability to understand and address objectives of the scenario:	Does student ask multiple clarification questions?
	Does the student seem to understand the topic as it is presented?
	Does the student take a moment to consider the question?
	Does the student reply appropriately to the question?
Communication skills displayed:	Does the student make eye contact while speaking?
	Does the student appear comfortable speaking with the interviewer?
	Does the student clearly articulate his or her arguments/opinions regarding the scenario?
	Does the student's response stay on 'track' to answer the question posed?
	Does the student speak professionally and politely?
Strength of arguments presented:	Does the student logically explain their rationale for their answer?
	Does the student appear calm when prompted?
	Does the student appear upset when prompted?
	Is the student able to logically present thoughts related to the scenario?
	Can the student successfully demonstrate rhetoric?
Suitability for a career in Respiratory Care:	Is this person personable?
	Would this student be able to communicate effectively with patients?
	Would you let this student work with a loved one?
	Would you like to work with this student?
	Will this student be a good representative for the field?
Overall Performance	Did this student appear engaged?
	Did this person appear confident/collected?
	Would you feel comfortable having this student in clinical/class?
	Do you feel that this student will be a good clinician?

In scoring each candidate, the interviewers were instructed to consider each factor when analyzing the candidates' overall station performance. The interviewers were also encouraged to take an ample number of notes regarding the candidate’s performance. This practice was essential to the process because, although each candidate received a cumulative station score based on the fulfillment of each factor, the interviewers were required to provide an overall ordinal ranking of all the candidates at the end of the interview period. This approach was incorporated as an equitable and defensible way to distinguish candidates with similar scores at any one station.

Interviewers were encouraged to ‘pencil-in’ candidate rankings throughout the first day, as rankings were not finalized until the last candidate’s interviews were conducted. To do this, interviewers were required to rank each student such that no one rank could be duplicated at any one station; that is, students were to be ranked on a scale from 1 to 35 (where the rank of 35 represented the best candidate and the rank of 1 represented the least qualified candidate). Because it was possible that two students could receive the same station score, interviewer comments were used to help distinguish candidates who were closely ranked (e.g., candidate 8 from candidate 9 when both candidates achieved a hypothetical station score of 12).

Interviewer Training and Pilot Testing

Interviewers were trained on the MMI process prior to the implementation using the training documents developed by the selection committee (Appendix D). To test the process and ensure that interviewers were consistent and comfortable in scoring an interview, a pilot test interview was conducted. Due to scheduling conflicts among interviewers, interviewers were sent a link to an online video to observe an MMI in process and were instructed to use the scoring subscale instrument developed by this selection committee at the participating institution (Appendix C) to score the observed interview.

As the researcher was primarily responsible for the logistical coordination of the MMI process and interviewer training at this institution, interviewers submitted the pilot test scores to the researcher via email. There was a 100 percent consistency in ranking among interviewers on the pilot study (scores of 15, 15, and 16 among the three interviewers) and it was determined by both the researcher and the committee that no further training was required prior to the implementation of the MMI.

Program-Specific MMI Process

After reviewing the relevant literature, the selection committee felt that an MMI process could be reasonably be conducted using existing financial and human resources to fulfill the needs of the department. The committee selected three scenario-based stations, heavily adapted from both McMaster University and the University of Calgary. Pau et al. (2013) found that in the 30 MMI studies reviewed the number of stations ranged from 4 to 12. The committee at this institution felt that adding another station would require either another interviewer or an extra day of interviews, neither of which was favorable due to human resource restraints and timeline for selecting candidates.

Each of the three stations were conducted using one interviewer, and each interview was scheduled to last 8 minutes. These criteria were consistent with what Pau et al. (2013) found to be the average for station construction among the studies included in their meta-analysis. As is detailed in the process outline included in Appendix D, upon arrival to the station each student is given approximately one minute to read the scenario, followed by 4 to 5 minutes of response time. Interviewers were instructed to remain neutral and allow the candidate to utilize all their response time without interjection.

This methodology is central to the goal of the MMI process; that is, the interviewers are to have limited engagement with the candidates in order to decrease potential interview bias as well as to allow the candidates adequate time to formulate a logical and articulate response to the scenario prompt. Some prompt questions that were specific to each scenario were provided to the interviewers in case he or she felt a student needed some provocation to elaborate on his or her response. Although this was discouraged so that the interviewer did not 'lead' the student's response or to form a rapport through discussion, students were not allowed to leave the station until the allotted 8 minutes had passed; therefore, if students fell exceptionally short in either time or content of response, the interviewers used their discretion regarding whether to prompt the student to continue. The remaining 2 minutes of the scenario time were reserved for candidates to transition between stations and for interviewers to comment on the candidate's performance. A sample schedule for the 2-day MMI process at this institution is provided in Table 6.

Table 6

Sample Day 1 Schedule for MMI Process

Time	Station 1	Station 2	Station 3
0900-0910	Candidate 1	Candidate 2	Candidate 3
0910-0920	Candidate 3	Candidate 1	Candidate 2
0920-0930	Candidate 2	Candidate 3	Candidate 1
0930-0940	Candidate 4	Candidate 5	Candidate 6
0940-0950	Candidate 6	Candidate 4	Candidate 5
0950-1000	Candidate 5	Candidate 6	Candidate 4
1000-1010	Candidate 7	Candidate 8	Candidate 9
1010-1020	Candidate 9	Candidate 7	Candidate 8
1020-1030	Candidate 8	Candidate 9	Candidate 7
1030-1040	Candidate 10	Candidate 11	Candidate 12
1040-1050	Candidate 12	Candidate 10	Candidate 11
1050-1100	Candidate 11	Candidate 12	Candidate 10
1100-1110	Candidate 13	Candidate 14	Candidate 15
1110-1120	Candidate 15	Candidate 13	Candidate 14
1120-1130	Candidate 14	Candidate 15	Candidate 13

The selection committee interviewed a total of 35 candidates over 2 days. Candidates were pre-scheduled in 30-minute increments using a web-based scheduling tool that was managed by the program's administrative assistant. The model selected by the department allowed for three students to complete a full interview rotation every 30 minutes by rotating through each of the three stations in 8-minute intervals. This timeline included a slight buffer of

6 minutes for each group, to provide time for interviewers to gather thoughts about the previous candidate, prepare for the next, or to take a brief break if needed.

There were three applicants who were unable to attend the MMI process in-person. These interviews were conducted using Apple's Facetime (Apple, 2016). There were two candidates who were unavailable on either of the original interview days; these interviews were rescheduled for an in-person format. All five of these students were rescheduled to complete the interview process on a single but separate day, using the same MMI format with the same interviewers and addressing the same MMI scenarios. For those students who completed the interview process via Facetime, the station scenarios were emailed to the students approximately 5 minutes prior to their scheduled interview times to keep the process as similar as possible to the on-campus interviews.

Interviewer Selection

Interviewers were identified by the faculty and staff as both leaders in the local respiratory care community and those who had experience with either the student selection processes or in interviewing potential practitioners in the hospital setting. To have wide breadth of perspectives on candidate selection, two faculty members within the department who practice vastly different teaching paradigms were selected. This was done intentionally to ensure students would experience a range of different interviewer personalities. It was important to the selection committee to diversify the background of the interviewers, and therefore it sought the participation of a practicing respiratory care clinician. The third and final interviewer was identified as not only an active practitioner in the field of respiratory care but also as someone whose position was responsible for hiring new practitioners to one of the local hospitals. This interviewer also served as an adjunct faculty member in the online program offered by the department.

This group of three interviewers had approximately 65 years of teaching and student evaluation experience and represented the diverse, engaged, and dedicated individuals who are part of the respiratory care community. Perceived strengths of each of the interviewers were discussed by the committee and used to assign each of the interviewers to a station as a best-fit.

Addressing Potential Interviewer Bias

A benefit of the methodology of the MMI compared to the traditional panel interview to assess noncognitive attributes of student potential is that the framework of the MMI was designed to inhibit interviewer bias (Eva, Rosenfeld et al., 2004; Siu & Reiter, 2009). Because two of the three interviewers who participated in the MMI process were also on the selection committee and were responsible for evaluating candidates' file review data (i.e., cognitive variables such as GPA), it was imperative that the order in which the review of candidate profiles and interviews were conducted be such that the former did not influence the latter. Where in previous application cycles, all members of the selection committee had access to candidate data, to mitigate interviewer bias for the 2016 admission cycle, interviewers were not allowed to review any candidate files prior to the scheduled MMIs.

The researcher, as the only member of the selection committee *not* participating in interviews, was responsible for the initial candidate file review. This included evaluating candidate transcripts for pre-requisite completion, GPAs, and course grades as well as designating point values to the other admission criteria. The researcher was responsible for inputting all data into the master application spreadsheet and did not discuss any candidate data with the rest of the committee until all interviews had been conducted.

To negate any potential bias in reading and scoring candidate essays after the interviews had been conducted, the essays were blinded and coded by an administrative assistant in the department prior to being released to the committee. Each member of the committee, including the researcher, read and scored the essays individually. The scores were then returned to the administrative assistant, who added the essay scores into the master applicant spreadsheet. Neither the researcher nor the interviewers had access to the essay-coding key.

Participant Rights

As the selected sample of students were over the age of 18 and had already completed the MMI as part of the admissions process, data regarding this process had already been gathered and stored as standard practice of the Department of Respiratory Care. As such, there was no need to gain permission from the individual students to access this data. However, all student data was de-identified by an administrative assistant within the department to protect student privacy.

Institutional review board (IRB) permission to access and utilize this information at the participating educational institution for the purposes of this study was obtained. All information was kept confidential to the research team, stored on an external hard drive to kept in the researcher’s locked office, and will be destroyed after use in accordance with IRB guidelines. There are no foreseeable unintended outcomes regarding participation in this study.

Potential Limitations

Potential limitations of this study include the researcher’s relationship to the project. The researcher was involved with the logistical planning and implementation of the MMI process at this institution. However, the researcher did not have any direct involvement with the actual student interviews.

Although the instrumentation utilized throughout the MMI process was adapted from a tool that has been studied, the instrument had not been used to evaluate undergraduate students in a respiratory care program and was adapted specifically for the needs of this program. Therefore, the methods through which this instrument was used may not be extrapolated to other populations.

Although the sample of students included in this investigation is most pertinent to the research questions outlined in Chapter 1, the relatively small sample size (total N = 69) may have affected the strength of the analysis. Further complicating this limitation is that both sample size and characteristics varied between cohorts. The lack of uniformity among cohort demographics may have distorted sample distributions both within and among cohort groups and affected the findings of this investigation.

Admissions practices between cohorts were altered by the department of respiratory care so that no two cohort data sets contained exactly the same data. Although the admissions variables most pertinent to the focus of this investigation existed, scoring practices of candidate admissions files were altered between years. The changes in scoring practices may have affected statistical distributions of cohort data sets and likewise affect data analyses and interpretation.

Additional limitations included the unforeseen life events that may have affected academic progress throughout the first semester. This study included data from all students who experienced attrition in the first semester, as whether a student was removed from the program could not be determined until semester grades were final. Therefore, unless a student withdrew from classes prior to this time, all attrition was considered academic in nature.

CHAPTER 4

RESULTS

The purpose of this quantitative case study was to investigate the utility of the MMI as an adjunct method of selection in an undergraduate respiratory care program. To best investigate this question, an analysis of admission data pertinent to the 2016 cohort of students was required, as well as a retrospective analysis of admission data from two previous cohorts (2013, 2014) who had not participated in an MMI throughout their respective admission cycle. Admission data for each of the years included in this study (i.e., 2013, 2014, and 2016) were examined both independently as well as comparatively. These comparative analyses were conducted to best answer the central question of this study; that is, whether the addition of the MMI provided a more inclusive, holistic perspective of a candidate's potential to succeed in the first semester of this particular program.

A descriptive analysis was performed of each cohort data set to provide an overview of each cohort as well as to identify key factors (i.e., GPAs, enrollment numbers) for comparison. Descriptive analyses for each of the 2013, 2014, and 2016 cohorts are presented individually in this chapter, and the data itself in Appendices E, F, and G, respectively.

To best explore existing relationships among the admission criteria for each of these years, as well as between those criteria and student performance in select respiratory care courses in the respiratory care curriculum at the end of the respective first semester, correlation analyses using Pearson's correlation coefficients were conducted between each of the admission variables. Admissions variables were categorized as either cognitive, experiential, or contextual in nature. Each group of variables is presented in relation to course performance to not only identify key relationships within each of the individual cohorts, but also to assess for patterns of significance across cohorts.

Finally, to explore the effect of independent admissions variables as predictors of attrition, either the first year (e.g., 2013 and 2014) or first semester (e.g., 2016), cohort-specific binary logistic regressions were conducted. Although results are reported, it should be noted that the outcome variable used in each regression (attrition) had fewer than 10 observations, which classifies these analyses as rare-event data. As such, the results of these logistical regressions should be interpreted within the contextual bounds of this case study. To fully rectify this issue, either a larger sample would be required or fewer predictor variables should be included in the models. Given the scope of this investigation, a larger sample size was not possible; therefore, the reader will notice alterations to the number of covariates included in each analysis. This was done intentionally to strengthen the significance of these analyses.

Analysis Method

Data analysis was conducted by first de-identifying all applicant data. This was done by an administrative assistant within the Department of Respiratory Care. The de-identified Microsoft Excel© spreadsheets were then provided to the researcher. Each of the data sets were uploaded and analyzed using International Business Machines (IBM) Statistical Package for Social Science (SPSS), version 24.0 software.

Database Coding

To ensure all data would be transferred accurately from Microsoft Excel © to SPSS©, the entire data sets for each of the years was uploaded independently. Once uploaded, the data was edited to reflect only data pertinent to this investigation. Extraneous variables were deleted from the data sets to ensure accuracy. Some variables required recoding to maintain consistent analyses practices across each of the data sets. Variables that were recoded are demarcated with the prefix ‘recoded.’ There was an issue in uploading the 2013 data set that required all variables to be recoded to ensure that the name of the variable matched the data within the corresponding column, which why all variables within that data set include the prefix ‘recoded’.

Data Organization

The variables within the 2013 and 2014 cohort data sets were organized to reflect the priority that criterion was given during the respective admission cycle. For each of these years, the admissions process simply included a review of student performance in prerequisite courses (i.e., cognitive review) and a few variables considered by the department to reflect important noncognitive attributes (i.e., health care experience, previous education, and admissions essay). As each of these criteria were assigned a point value by the admissions committee, the cumulative candidate score (i.e., overall total point score) reflected the candidate’s ranking for admission into the program. Cognitive data (e.g., cumulative GPA, Math/Science GPA) were reflected in the overall total points as the actual numeric value, meaning that each of these variables accounted for more points than did other variables with lesser point values.

The inclusion of the MMI for the 2016 admission cycle required the selection committee to revise the priority and weight assigned to each of the admissions criteria. The traditional file review, including the transcript evaluation and candidate history assessment accounted for 45 percent of the total candidate score. The combined essay score accounted for 5 percent of the overall score–this criterion was deemphasized purposefully due to concerns about academic honesty experienced throughout previous admissions cycles. The final 50 percent of the candidate’s score was comprised of candidate performance on the MMI. Performance on the MMI was further stratified into cumulative total points received on the MMI (25%) and average

MMI ranking (25%). This criterion was stratified to reflect interviewer perspective on candidate performance, which accounted for differentiation between candidates with like MMI scores.

Results

This section begins with a summary of the descriptive statistics of each cohort and an exploration of the distribution of each admission criterion within the respective cohorts. Next, the results of pairwise correlation coefficients computed using Pearson's correlation coefficient are reported. Statistical significance was set at 5 percent and 1 percent, two-tailed, with both values reported in this analysis. Finally, a logistical regression was conducted to address the patterns of low academic performance leading to attrition. The findings of these studies were used to best answer each of the three research questions central to this investigation.

Descriptive Statistics

Data for each cohort were gathered from the electronic admissions records kept by the department of respiratory care. Although the weight placed on each criterion varied between the admissions processes for the years included in this investigation, the variables themselves were consistent. Descriptive analyses were used to provide general information about each of the variables included in each cohort's admissions cycles. Descriptive information for the 2013 cohort is summarized in Table 7.

Table 7

Descriptive Statistics 2013 Cohort

	N	Range	Mean	*SD* [a]	Variance	Skewness	Kurtosis
Cumulative GPA	21	1.43	3.2967	.39825	.159	.116	-.519
Math/Science GPA	21	1.58	3.4376	.45423	.206	-.230	-.522
Extra science	21	2.00	1.0952	.87491	.765	-.136	-1.789
HC Experience	21	2.00	.8810	.72292	.523	.569	-.937
RC courses early	21	2.00	1.0476	.92066	.848	-.101	-1.907
Previous education	21	3.00	1.8571	.65465	.429	-2.219	5.870
Evidence of academic load	21	3.00	1.7143	1.14642	1.314	-.256	-1.358
Career exploration	21	1.00	1.9048	.30079	.090	-2.975	7.562
JA Essay (reviewer 1)	21	4.00	4.8333	1.20761	1.458	-1.191	1.033
LA Essay (reviewer 2)	21	3.50	4.8286	1.01101	1.022	-.560	-.382
MS Essay (reviewer 3)	21	3.50	4.6667	.97895	.958	-.298	-.431
Essay Average	21	3.67	4.7714	1.00091	1.002	-.722	.297
Overall Total Points	21	8.51	26.8552	2.70195	7.301	.537	-1.081
Fall 2013 Term GPA	21	1.71	3.2929	.47008	.221	-.549	-.248
HLTST 220 Grade	21	1.30	3.7095	.41582	.173	-1.407	.733
RESPCARE 203 Grade	21	2.00	2.9714	.66494	.442	.211	-1.337
RESPCARE 204 Grade	21	2.00	2.6857	.57470	.330	-.074	-.570
RESPCARE 208 Grade	21	1.30	3.4619	.39303	.154	-.144	-1.024

[a] *SD* = standard deviation

Analyses of both skewness and kurtosis were included to investigate the symmetry of the distribution and the weight of the distribution's tails. The skewness for a normal distribution is zero, with negative values indicating data that are skewed left of the center point and positive values representing data that are skewed towards the right of the distribution. Most of the variables included in the 2013 cohort descriptive analysis are approximately symmetrical. There are some variables that appear to be negatively skewed, including the previous education (-2.219), career exploration (-2.975), first reviewer's essay score (-1.191), and HLTHST 220 grade (-1.407). These variables appear to be skewed to the left of the distribution, indicating that not only was the mean value within each of these criteria less than the median value, but also that the distribution of students within these criteria was substantially asymmetrical. Normally distributed data have kurtosis of zero. The farther the kurtosis value is away from zero, the more abnormally lighter the tails of the respective distribution are, in cases of values less than -1, or heavier, in those cases of values greater than 1. As is indicated in Table 7, there are several values that have a kurtosis of less than -1 or higher than 1, indicating an extremely abnormal distribution of students within that criterion.

Descriptive analyses for the 2014 cohort is included in Table 8. As was seen in the 2013 cohort, most of the admissions variables representing the 2014 cohort are normally distributed, with skewness values close to zero. However, there appeared to be a selection of variables that were negatively skewed: Second reviewer essay score (-1.582), fall 2014 term GPA (-1.766), HLTHST 220 (-1.459), RESPARE 204 grade (-2.037), and RESPCARE 208 grade (-2.763) as well as one variable positively skewered (previous education, 2.200). Each of these variables represented a criterion within which the distribution of student scores was not symmetrical. Several of these asymmetrically distributed variables also had kurtosis values of either greater or less than zero, indicating distribution tails that were either heavier or lighter, respectively, than normal.

Table 8

Descriptive Statistics 2014 Cohort

	N	Range	Mean	SD [a]	Variance	Skewness	Kurtosis
Cumulative GPA	23	1.22	3.2626	.33158	.110	-.502	-.163
Math/Science GPA	23	1.57	3.4004	.45842	.210	-.789	-.036
Extra science	23	2	1.39	.783	.613	-.851	-.765
HC Experience	23	1.5	1.065	.6087	.371	.723	-1.064
RC courses taken early	23	2	1.09	.848	.719	-.175	-1.607
Previous education	23	3	.43	1.037	1.075	2.200	3.297
Ability to carry academic load	23	3	2.04	.767	.589	-.737	1.024
Career exploration	23	2.0	1.239	.5614	.315	.165	-.422
Essay LH (reviewer 1)	23	3	5.13	.869	.755	-.725	-.074
Essay LA (Reviewer 2)	23	4	5.09	.949	.901	-1.582	3.940
Essay MS (Reviewer 3)	23	4	4.52	1.123	1.261	-.587	-.383
Essay average	23	2.70	4.8913	.77513	.601	-.539	-.212
Overall total points	23	7.26	22.3670	1.82379	3.326	.634	.089
Fall 2014 Term GPA	23	2.11	3.1417	.42374	.180	-1.766	5.263
HLTHST 220	23	2.0	3.496	.5897	.348	-1.459	1.841
RESPCARE 203 grade	23	2.00	3.0087	.52390	.274	-.987	.694
RESPCARE 204 grade	23	3.00	2.2435	.62800	.394	-2.037	6.822
RESPCARE 208 grade	23	2.70	3.1043	.54812	.300	-2.763	10.059

[a] *SD* = standard deviation

A descriptive analysis of the 2016 cohort data included an analysis of the additional variables that represented MMI performance. A complete summary of the descriptive statistics pertinent to the 2016 cohort can be found in Table 9.

Table 9

Descriptive Statistics 2016 cohort

	N	Range	Mean	*SD* [a]	Variance	Skewness	Kurtosis
Math/Science GPA	25	1.96	3.1648	.61860	.383	-.093	-1.265
Extra Science	25	2	.48	.714	.510	1.195	.145
Cumulative GPA	25	1.43	3.3060	.43697	.191	-.014	-1.202
HC Experience	25	1	.52	.510	.260	-.085	-2.174
RC Courses early	25	1	.44	.507	.257	.257	-2.110
Evidence of academic load	25	3	1.76	1.200	1.440	-.597	-1.192
Career exploration	25	1	.80	.408	.167	-1.597	.593
Second-Semester Freshman	25	4.0	.640	1.4967	2.240	1.975	2.061
Total file points	25	12.35	14.2736	2.91947	8.523	.231	-.099
JL Essay (reviewer 1)	25	1.00	2.4800	.50990	.260	.085	-2.174
LA Essay (reviewer 2)	25	2.00	2.3200	.69041	.477	-.523	-.688
MK Essay (reviewer 3)	25	2.0	2.040	.6110	.373	-.015	.013
Essay Total Points	25	4.0	6.840	1.3441	1.807	-.132	-1.303

Table 9 (continued)

MMI Points JL	25	9.00	17.1200	2.66646	7.110	-.756	-.560
MMI Points LA	25	15.00	14.6000	4.75219	22.583	-.676	-.949
MMI Points GG	25	9.00	15.4800	2.48529	6.177	-.426	-.406
MMI Total Points	25	28.0	47.200	7.2226	52.167	-.856	-.093
Ranking Points JL	25	33	21.56	10.332	106.757	-.386	-1.073
Ranking Points LA	25	32	22.16	9.694	93.973	-.359	-1.068
Ranking Points GG	25	31	20.88	8.748	76.527	-.102	-.808
Overall Total Points	25	82.27	63.1708	15.34442	235.451	-1.460	5.033
HLTST 220 Grade	25	4.0	3.696	.8279	.685	-4.048	17.920
RESPCARE 203 Grade	25	4.0	2.796	.9303	.865	-1.565	2.458
RESPCARE 204 grade	25	1.70	3.0400	.47434	.225	-.653	.269
RESPCARE 208 Grade	25	2.0	3.112	.4885	.239	-.799	.857
Fall2016TermGPA	25	2.41	3.2104	.58957	.348	-1.624	2.452

[a] *SD* = standard deviation

Although there were added criteria included in the 2016 admissions cycle as well as a redistribution of point values to existing variables, the descriptive analysis revealed several skewed criteria. However, the skewness was not quite as severe for most of the variables when compared to that of the data included in the previous year's analyses, save for performance in HLTHST 220 which was severely skewed to the left with a kurtosis value of 17.9–indicating not only an extremely asymmetric distribution, but also one with a heavy tail.

A comparative analysis of key admissions variables representing cognitive ability between cohorts was conducted and is presented in Table 10. Admitting cumulative GPA was calculated by the university registrar's office and represented on a 4.0 scale. Combined math/science GPA was calculated by the department and represented performance in a core math course as well as the introductory semester of anatomy and physiology.

Although cumulative GPA remained consistent across cohorts, there appeared to be more variability in mean combined math/science GPA in the 2016 cohort. Respective term GPA was included in this comparison as an overall indicator of first semester performance and compared to both cumulative GPA and combined math/science GPA as an indicator of consistency between perceived cognitive ability upon admission and actual cognitive performance in the first semester of the respiratory care program. The difference in mean cumulative GPA and term GPA for both the 2014 and 2016 cohorts can likely be explained by the inclusion of low-performing students who either experienced attrition, or were close to doing so, in their respective first semester. The 2013 cohort experienced zero attrition in the first semester.

Table 10

Comparison of Cognitive Variables Between Cohorts

	2013		2014		2016	
	M	*SD*	*M*	*SD*	*M*	*SD*
Cumulative GPA	3.29	.398	3.26	.331	3.31	.436
Combined math/science GPA	3.44	.454	3.40	.458	3.16	.618
Term GPA	3.29	.479	3.14	.423	3.21	.589

Correlational Analyses

To best answer the research questions central to this investigation, correlational analyses were performed to investigate the relationships between admissions variables within each admission cycle as well as between admissions variables of specific cohorts and performance in select first semester respiratory care courses. Complete correlation matrices for each cohort are included in Appendices E, F, and G. However, relationships pertinent to this investigation are highlighted in table form in the following section.

To best summarize pertinent relationships among admissions criteria and performance in select respiratory care courses, admissions variables were categorized into groups respective of which facet of Sternberg's (1984) triarchic intelligences the variable best represented. The following sections will explore the relationships among cognitive, experiential, and contextual variables and academic performance in the first-semester of this specific respiratory care program. Relationships were investigated using simple bivariate correlational analyses. Pearson's correlation coefficients are presented as *r* values and demarcated for a significance level of either 1 percent or 5 percent, two-tailed.

Cognitive variables. Cognitive variables are those objective variables that best measure the ability to recall information in a static context (e.g., course grades) or acquire knowledge over a length of time (e.g., cumulative GPA or combined math/science GPA). The tables included in this section are broken down to illustrate the relationship among cognitive variables and academic performance between the individual cohorts. For example, Table 11 provides a summary of the relationships between cognitive variables and performance in HLTHST 220 across each of the 2013, 2014, and 2016 cohorts. Following this example, Tables 12, 13, and 14 illustrate the relationships among these same cognitive admissions variables and first-semester performance in RESPCARE 203, RESPCARE 204, and RESPCARE 208, respectively, across each of the 2013, 2014, and 2016 cohorts.

Table 11

Cognitive Admissions Criteria and Performance in HLTHST 220

	2013[a]	2014[b]	2016[c]
Anatomy Grade	.359	.586**	.089
Core Math Grade	.312	.128	.442*
Cumulative GPA	.162	.343	.439*
Math/Science GPA	.330	.564**	.230
Extra Science Courses	.018	.417*	.469*
Academic Load	.153	-.090	.288

[a] *N* = 21. [b] *N* = 23. [c] *N* = 25

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 12

Cognitive Admissions Criteria and Performance in RESPCARE 203

	2013[a]	2014[b]	2016[c]
Anatomy Grade	.624**	.365	.364
Core Math Grade	.302	-.023	.728**
Cumulative GPA	-.228	.453*	.541**
Math/Science GPA	.527*	.328	.591**
Extra Science Courses	-.128	.102	-.373
Academic Load	.238	.406	.354

[a] *N* = 21. [b] *N* = 23. [c] *N* = 25

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 13

Cognitive Admissions Criteria and Performance in RESPCARE 204

	2013[a]	2014[b]	2016[c]
Anatomy Grade	.575**	.263	.176
Core Math Grade	.338	.003	.462*
Cumulative GPA	.008	.331	.269
Math/Science GPA	.530*	.197	.335
Extra Science Courses	.256	.066	-.391
Academic Load	.267	.609**	.098

[a] N = 21. [b] N = 23. [c] N = 25

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 14

Cognitive Admissions Criteria and Performance in RESPCARE 208

	2013[a]	2014[b]	2016[c]
Anatomy Grade	.351	.084	.237
Core Math Grade	.091	-.200	.331
Cumulative GPA	-.267	.258	.267
Math/Science GPA	.249	-.027	.307
Extra Science Courses	-.076	.070	-.244
Academic Load	.230	.713**	-.158

[a] *N* = 21. [b] *N* = 23. [c] *N* = 25

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

It is important to note the lack of consistent significant relationships between admissions variables considered indicative of cognitive ability and first semester performance across cohorts. The lack of predictive patterns among cognitive admissions variables, especially that of average grade point values, and first semester performance in these specific courses is enlightening. There were no statistically significant relationships among GPAs and performance in both the practical-based RESPCARE 204 and clinically-based RESPCARE 208, a finding that underscores the inability of traditional admissions practices to adequately evaluate skills required of students in a dynamic clinical environment.

Experiential variables. Variables were considered experiential if the content or topic of that variable were representative of a candidate's ability to acquire or apply knowledge in a dynamic, or changing, setting (Sternberg, 1984). The relationships among experiential variables included in the admissions processes and performance in the first semester of respiratory care curriculum across each of the 2013, 2014, and 2016 cohorts are illustrated in Tables 15 through 18.

Table 15

Experiential Admissions Criteria and Performance in HLTHST 220

	2013[a]	2014[b]	2016[c]
Essay Score	.187	-.186	.089
Health Care Experience	-.171	.001	-.202
RC Courses Taken Early	-.262	-.145	.104
Previous Education	-.050	.353	---
Second Semester Freshmen	---	---	.165

[a] *N* = 21. [b] *N* = 23. [c] *N* = 25

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 16

Experiential Admissions Criteria and Performance in RESPCARE 203

	2013[a]	2014[b]	2016[c]
Essay Score	-.271	.176	.249
Health Care Experience	-.543*	.069	-.364
RC Courses taken early	-.079	-.503*	.251
Previous Education	.025	.009	---
Second Semester Freshmen	---	---	.253

[a] *N* = 21. [b] *N* = 23. [c] *N* = 25

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 17

Experiential Admissions Criteria and Performance in RESPCARE 204

	2013[a]	2014[b]	2016[c]
Essay Score	-.173	.084	.010
Health Care Experience	-.552**	.200	-.365
RC Courses taken early	.077	-.443*	.045
Previous Education	.140	.270	---
Second Semester Freshmen	---	---	.291

[a] *N* = 21. [b] *N* = 23. [c] *N* = 25

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 18

Experiential Admissions Criteria and Performance in RESPCARE 208

	2013[a]	2014[b]	2016[c]
Essay Score	-.107	.204	-.346
Health Care Experience	-.263	.142	-.361
RC Courses taken early	-.009	-.148	-.157
Previous Education	-.081	.180	---
Second Semester Freshmen	---	---	.103

[a] *N* = 21. [b] *N* = 23. [c] *N* = 25

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Like the findings of the cognitive variables, isolating relationships that existed between variables considered experiential in nature and academic performance revealed an overall lack of significance across cohorts. Essay score was not significantly associated with performance in any of the selected courses in any of the cohorts. The only significant relationships that existed between experiential variables and academic performance in 2013 were between health care experience and performance in RESPCARE 203: r (19) = -.543, p = <.011 and RESPCARE 204: r (19) = -.552, p = <.009. Although statistically significant during analysis, further exploration into the nature of these variables in context may explain the level of significance. In 2014, there were just as few significant relationships among experiential variables and performance when compared to cognitive variables; that is, the only significant associations were between that of upper division courses taken early and performances in both RESPCARE 203: r (19) = -.503, p = .014 and RESPCARE 204: r (19) = -.443, p = .034. There were no significant relationships among experiential variables and performance in the fall of 2016.

Contextual variables. Prior to 2016, the department did not include measures of contextual intellect. Sternberg (1984) described contextual intellect as the ability to apply acquired information to new scenarios or situations. To best evaluate this ability, the department integrated the MMI into the 2016 admissions cycle. Table 19 summarizes the relationship between candidate performance on the MMI and academic performance in the first semester of the selected respiratory care courses. Aside from a significant relationship between ability to carry a heavy academic load in 2014: r (21) = .713, p = .002, no other variable in any other cohort year was associated with performance in RESPCARE 208.

Table 19

Contextual Admissions Criteria and Fall 2016 Academic Performance

	MMI Total Score [a]	MMI Ranking Score [a]
HLTHST 220	-.041	.016
RESPCARE 203	.357	.448*
RESPCARE 204	.336	.485*
RESPCARE 208	.528**	.509**

[a] N = 25

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Percentile rank and attrition. Three students experienced attrition in the Fall of 2016. To better understand the relationship between performance on the MMI and likelihood of attrition in the first semester, further analysis was conducted to evaluate the relationship between performance on the MMI and attrition in the first semester. As the total ranking score of the MMI was positively associated with performance in three of the four selected courses, this variable was selected for further investigation. Although the associations among cumulative GPA and performances were inconsistent, this variable was included in further analysis to address the research questions central to this investigation. MMI ranking scores and cumulative GPA's for the 2016 cohort were categorized into percentiles and a summary of percentile and score breaks are illustrated in Table 20.

Table 20

Percentile and Score Break Points for Total Ranking MMI Score and GPA

Percentile	MMI Ranking Value Threshold	Cumulative GPA Threshold
25	58.50	2.95
50	68.00	3.31
75	77.50	3.70
100	102.00	4.00

Of the students who experienced attrition in the fall of 2016, only one student had a total MMI ranking score of 77, which is in the 75^{th} percentile of overall MMI ranking scores. This student however, had an admitting cumulative GPA of 2.67, which was well below the threshold of the 25^{th} percentile. The two other students who experienced attrition in this semester had MMI ranking scores nearer the 25^{th} percentile (MMI ranking scores of 61 and 20, respectively). These students were also admitted with cumulative GPAs closer to the threshold of the 25^{th} percentile

(2.57 and 3.05, respectively). This finding indicates that students who received MMI ranking scores and with cumulative GPA's in the bottom 25 percent of the candidate pool were more likely to experience attrition than were students with higher MMI ranking scores and higher cumulative GPA's upon admission.

Logistic Regression

The final goal of this investigation was to better understand the predictive relationships among both admitting cumulative GPA and combined math/science GPA as well as performance on the MMI score and likelihood of attrition in the first semester. To best understand these relationships, logistic regression analyses were performed on each cohort data set using Intellectus Statistical Software (2017).

Binary logistic regression was used to examine the relationship between several independent admissions variables and a single dependent outcome variable (attrition). The overarching goal of these analyses is to determine the approximate probability that a candidate would experience attrition. In these analyses, the overall significance of the regression models was tested by computing the significance level for each of the 2013 (p = .046), 2014 (p = <.001), and 2016 (p = .004) cohorts using the χ^2 statistic with the degrees of freedom of 4 (2013), 4 (2014), and 2 (2016) (Intellectus Statistical Software, 2017). A significant overall model means that the set of independent variables significantly predict whether a student experienced attrition in the first semester.

For each logistic regression analysis, data indicating that a student had experienced attrition was isolated. Due to the lack of attrition in first semester of both the 2013 and 2014 cohorts, students who experienced attrition in the second semesters of their respective cohorts were included. A new nominal variable (attrition) was created and coded to indicate which students had experienced attrition. The binary values of 0, indicating that a student had experienced attrition, and 1, indicating a student had been retained, were assigned to all students within each cohort data set using course grades as indicators of attrition (i.e., any student receiving a course grade of lower than a 1.7 on a 4.0 scale).

2013 logistic regression. A binary logistic regression was conducted using Intellectus Statistical Software version 1.01 (2017) to identify whether cumulative GPA, combined math/science GPA, ability to carry a heavy academic load, and average essay score had a significant effect on the odds that a student experienced attrition within their first year in this particular program. The reference category for the dependent variable (attrition) was 1. Assumptions for this analysis were met, as all variance inflation factors (VIF) were less than the maximum upper limit of 10 (Menard, 2009). Variance inflation factors are indicators of model multicollinearity. Variance inflation factors for each of the included covariance variables for the 2013 data set are included in Table 21.

Table 21

Variance Inflation Factors for 2013 Logistic Regression

Variable	*VIF*
Cumulative GPA (recodedCUMGPA)	1.04
Combined math/science GPA (recodedMATHSCIGPA)	1.30
Ability to carry heavy academic load (recodedload)	1.08
Essay average (recodedessayavg)	1.24

The overall model was significant, $\chi^2(4) = 9.68$, $p = .046$. These results suggest that the independent variable set had a significant effect on the odds that a student admitted to the 2013 cohort experienced attrition in the first year of the program. McFadden's R-squared was calculated to determine the model's fit ($R^2 = 0.39$). Per Louviere, Hensher, and Swait (2000), McFadden R-squared values of greater than .2 are considered an excellent fit.

An analysis of the individual regression coefficients revealed that when isolated from the set, none of the independent variables had a significant effect on likelihood of attrition. A summary of individual variable analysis is illustrated in Table 22.

Table 22

Individual Logistic Regression Coefficients 2013

Variable	*B*	*SE*	χ^2	*p*	*OR*
(Intercept)	-15.94	10.66	2.24	.135	
recodedCUMGPA	1.67	2.12	0.62	.431	5.29
recodedMATHSCIGPA	2.67	2.45	1.19	.276	14.45
recodedload	0.93	0.77	1.46	.227	2.53
recodedessayavg	0.29	0.71	0.17	.679	1.34

Note. $\chi^2(4) = 9.68$, $p = .046$, McFadden $R^2 = 0.39$.

2014 logistic regression. Due to the inability for the regression model to converge, the variable representing ability to carry a heavy academic load was not included in the logistic regression of the 2014 cohort data. This may have been due to a minimal overlap in the variability of the variable between those students who experienced attrition and those who did not. However, once this variable was removed from the covariate set, the assumptions for this test were met. Variance inflation factors were calculated to identify the multicollinearity of the model. Table 23 illustrates the VIFs for the 2014 cohort; all predictors in the model have VIFs less than the maximum limit of 10.

Table 23

Variable Inflation Factors for the 2014 Logistic Regression Variables

Variable	*VIF*
Cumulative GPA (RecodedCumGPA)	1.47
Combined math/science GPA (RecodedScienceGradePointAverage)	1.32
Essay average (Recodedessayaverage)	1.71

The overall model was significant, $\chi^2(3) = 9.13$, $p = .028$. This result suggested that the covariate set had a significant effect on the odds that students experienced attrition in the first year of the program curriculum. The model was a good fit, using McFadden's R-squared ($R^2 = 0.038$). Table 24 summarizes the results of the regression model; like the results of the 2013 regression analysis, none of the individual variables had a significant effect on the odds of observing attrition.

Table 24

Individual Logistic Regression Coefficients 2014

Variable	*B*	*SE*	χ^2	*p*	*OR*
(Intercept)	-19.39	9.79	3.92	.048	
RecodedCumGPA	5.59	3.47	2.59	.107	268.80
RecodedScienceGradePointAverage	1.07	1.40	0.59	.443	2.93
Recodedessayaverage	-0.10	1.27	0.01	.938	0.91

2016 logistic regression. To satisfy the assumptions for this model, the only independent variables included as predictors of 2016 attrition were cumulative GPA and total ranking points on the MMI. Using these variables to predict likelihood of attrition, a binary logistic regression was conducted using Intellectus Statistical Software (2017). Upon removal of variables inhibiting convergence (i.e., combined math/science GPA and MMI total points), variables from the model, assumptions for this test were met. All VIFs for included covariates were below the maximum threshold of 10 and are summarized in Table 25.

Table 25

Variable Inflation Factors for the 2016 Logistic Regression Variables

Variable	*VIF*
recodecumgpa	2.10
RankingTotalPoints	2.10

The overall model was significant, $\chi^2(2) = 11.19$, $p = .004$, indicating that the combination of cumulative GPA and total MMI ranking points had a significant effect on the odds of a candidate experiencing attrition within the first semester of the respiratory care program. Model fit was assessed using McFadden's R-squared and was calculated as 0.61, indicating an excellent fit. Like the regression patterns identified in both the 2013 and 2014 data sets, neither independent variable had a significant effect on the likelihood of attrition when isolated. A summary of the 2016 regression model is presented in Table 26.

Table 26

Individual Logistic Regression Coefficients 2016

Variable	*B*	*SE*	χ^2	*p*	*OR*
(Intercept)	-39.54	21.48	3.39	.066	
recodecumgpa	12.07	6.61	3.34	.068	174202.00
RankingTotalPoints	0.11	0.06	2.70	.100	1.11

Summary

The purpose of this analysis was to examine the utility of the MMI as an adjunct method of evaluating candidates for admission into a baccalaureate respiratory care program. To answer this overarching question, 3 years of cohort data were analyzed to identify relationships within individual cohorts as well as patterns across cohorts. First, cohort-specific descriptive statistical analyses were presented within each admission cycle. Next, correlational analyses that examined the relationships among admission variables coded as either cognitive, experiential, or contextual and first semester performance in selected respiratory care courses. Finally, to address the question of whether the MMI impacted the rate of first semester attrition for this specific program, logistical regressions were conducted to isolate variables that best predicted the rate of program attrition.

Research Question 1

Research question 1 of this study sought to understand the relationship between MMI performance and academic performance in the first semester of select respiratory care courses. The results of a correlational analysis indicated a significant relationship between performance on the MMI and performance in RESPCARE 208. Performance on the MMI was broken down into two separate variables, MMI total score and MMI ranking score; both of which were significantly associated with performance in the introductory clinical course of this specific program (r (23) = .528, p = .007 and r (23) = .509, p = .009, respectively). The ranking score on the MMI was also significantly associated with performance in RESPCARE 203 and RESPCARE 204 (r (23) = .448, p = .025 and r (23) = .485, p = .014, respectively).

Research Question 2

The second research question sought to understand the association of cognitive variables, such as GPA, and performance in the first semester of elect respiratory care courses. This analysis revealed an inconsistency in significant relationships between cumulative GPA and course performance across cohorts. A significant relationship existed between performance in HLTHST 220 in the fall of 2016 (r (23) = .439, p = .028). However, no such relationship was identified in either of the previous cohorts. There were also significant relationships among cumulative GPA and course performance in RESPCARE 203 by both the 2014 and 2016 cohorts. However, the strength of these relationships was inconsistent between cohorts (r (21) = .453, p = .030 versus r (21) = .541, p = .005). No significant relationships existed among admitting cumulative GPA and performance in the practical-based RESPCARE 204 and the clinically-focused RESPCARE 208.

Significant discrepancies also existed in the ability of combined math/science GPA to predict performance in the select respiratory care courses. Where there was a relationship between combined math/science GPA and HLTHST 220 in the fall of 2013 (r (21) = .564, p = .005), no such relationship existed in either the 2014 or 2016 cohorts. There also existed significant relationships among combined math/science GPA and performances in RESPCARE 203 by both the 2013 and 2016 cohorts (r (19) = .572, p = .014 and r (23) = .591, p = .002) that did not exist among the 2014 cohort. The only significant relationship between combined math/science GPA and performance in the practically-based RESPCARE 204 was identified in the 2013 cohort (r (19) = .530, p = .013); no such relationship was repeated by either the 2014 or 2016 cohorts. No significant relationship existed among combined math/science GPA and performance in the clinical curriculum of RESPCARE 208 across cohorts.

Research Question 3

The final research question of this investigation sought to investigate the effectiveness of admissions variables in predicting attrition in the first semester of the respiratory care program. Cohort-specific logistic regressions were performed and revealed that although covariate sets were useful in calculating the odds of attrition within each cohort, no one variable had a significant effect on the likelihood of attrition.

Results of this analysis support the integration of the MMI as an adjunct method of selecting candidates to this specific respiratory care program due to the ability of the MMI to better identify those students likely to be successful in a clinical environment. Where traditional methods of academic review failed to adequately assess student potential in a clinical course, both objective and subjective measures of performance (i.e., MMI total score and MMI ranking score) in a three-station MMI process were positively associated with performance in such a course (r (23) = .528, p = .007 and r (23) = .009, p = .509, respectively).

The results of logistic regression analyses revealed that no one variable could consistently predict attrition in any of the cohorts, suggesting that a multimodal approach might be more effective in predicting likelihood of attrition than are evaluations skewed to assess only one type of intellectual ability. It should be noted again, that due to the small sample sizes of each of the cohorts, the analysis of these results is likely specific to the program at this participating institution and are not likely generalizable.

CHAPTER 5

CONCLUSIONS

The paradigm shift towards a more holistic understanding of student potential seems to be gaining momentum. However, there remains a lack of consensus as to not only which but also how noncognitive attributes should be evaluated. This is especially true regarding the value of these competencies in the admissions process. Although several graduate programs, most notably advanced practice clinical specialty programs (e.g., medical schools), have begun to integrate measures of noncognitive ability, few undergraduate health care programs have yet to follow suit. This is concerning given not only the alarming rates of undergraduate attrition experienced by both 4-year institutions in the United States (Raisman, 2013) as well as health-related programs like respiratory care (Wittenbel et al., 2009), but also the consistent increase in demand projected for health-related careers over the next decade (U.S. Department of Labor, 2015).

The purpose of this quantitative case study was to investigate the utility of the MMI as an adjunct method of student selection in a baccalaureate respiratory care program. Correlational relationships were explored among admissions criteria of cohorts prior to the integration of the MMI (i.e., 2013 and 2014 cohorts) and performance indicators (e.g., achievement in core respiratory care courses). The goal of this retrospective analysis was to identify a pattern of student evaluation practices and relative rates of attrition. Correlational analyses were conducted to explore the relationships among admissions variables, including MMI performance by those students admitted to the most recent cohort (i.e., 2016), and performance in the first semester of select respiratory care courses. Regression analyses were performed to assess which admissions variables most affected the likelihood of attrition in either the first academic year, as was the case for both the 2013 and 2014 cohorts, or in the case of the 2016 cohort, the first semester of select respiratory care courses.

This chapter is organized to provide an overview of the implications of the findings with respect to each of the research questions central to this investigation. Following the discussion of general limitations to the study, the limitations, implications of findings, and summary of results specific to each research question will be presented. Recommendations for general application of this research to practical settings are then addressed, followed by a discussion regarding opportunities for future related research. Finally, overarching conclusions are presented.

Limitations

This section identifies and discusses the limitations that affected the three most central research questions in this study. Potential limitations were outlined in Chapter 3 and included the researcher's relationship to the changes in the admissions process at the center of this investigation. Although the researcher was involved in the theoretical development and logistical planning for the integration of the MMI into the admissions process at this institution, the researcher was not directly involved in the interview process and had no access to interviewers' scoring processes until such scores were final and candidates had been ranked.

Sample Size

The relatively small sample size in this investigation (N = 69) was an overarching limiting factor of this investigation and likely affected not only the investigation of relationships within each cohort, but also between cohorts. The number of students admitted to the 2013, 2014, and 2016 cohorts was 21, 23, and 25, respectively; because each cohort group was subjected to a slightly different admissions process, correlation analyses were primarily conducted within the cohorts themselves, increasing the potential for a Type II error to occur.

Additionally, the small cohort sizes contributed an asymmetric distribution of student data within some admissions variables. Descriptive analyses of cohort specific data sets revealed significant skewness and kurtosis values for several of the admissions variables across cohorts. Although several of these values are explainable, these findings make across-cohort comparisons difficult.

Scoring Practices

The evolution of the scoring practices between cohort years may have also played a role in the data analyses process. Although the department of respiratory care maintained the types of variables included in the admissions processes across cohort groups, the point values assigned to those variables differed. This limitation affected how the data could address the research questions most central to this study. This was, in part, due to the inability to establish a baseline pattern of pre-MMI admissions practices against which to compare admissions data that included MMI performance. Therefore, a comparison of certain admissions variables, specifically those that were scored using different scales between cohort groups, may have identified relationships that were the result of Type II errors.

Attrition Rates

Rates of attrition seen in the first semesters for both the 2013 and 2014 cohorts were less than originally anticipated. Both cohorts experienced relatively low rates of academic attrition in the first semester, but higher than anticipated rates of attrition in the following semester. For this reason, rates of attrition for the entire first year were used during logistic regression analyses for both the 2013 and 2014 cohorts.

Intellectual Maturation

The final overarching limitation of this study is that any association between admitting variables and course performance while in the program was subject to the effect of intellectual maturation. That is, throughout this timeframe of study, there existed the potential for students to mature between the time of admission (i.e., March/April) and assessment of course performance at the end of the first semester (i.e., December) in ways that may have affected academic performance. Although this phenomenon was not measured as part of this investigation, it is possible that life events, including the continued exposure to the collegiate environment, enrollment in career-focused courses, or selection to the program itself, may have impacted performance.

Research Questions

The following subsections address the findings of this investigation relative to each research question and in the context of both the relevant literature and Sternberg's (1984) theory of triarchic intelligence.

Research Question 1

The first research question of this study sought to understand the relationship between performance on the MMI and academic performance in the first semester of select respiratory care courses. Based on the findings from this study, the answer to research question 1 is that, given the constraints of this study, the most significant relationship between performance on the MMI and course achievement was identified in RESPCARE 208. Significant correlations between performance on the MMI, as measured by both total MMI points and total ranking points, and academic achievement in RESPCARE 208, measured through final first semester course grade were identified. MMI ranking score was also significantly associated with academic performance in both RESPCARE 203 and RESPCARE 204.

In addition to the overarching limitations outlined for each of the research questions, significant associations identified between performance on the MMI and achievement in a clinical course may be subject to issues with interrater reliability. This limitation is specific to performance in RESPCARE 208 with respect to the dependent variable. Where HLTHST 220, RESCPARE 203, and RESPCARE 204 were courses designed, taught, and assessed by a sole instructor, RESPCARE 208 was a clinical course dependent upon clinical preceptors to both guide student experience and assess performance. Even though clinical preceptors were instructed on course objectives and use of a standardized grading schema developed by the respiratory care Director of Clinical Education, the validity of student assessment practices may not be as strong as those practices implemented by single-instructor courses. Therefore, assessment practices for this course may have impacted the true significance of the association between MMI performance and achievement in RESPCARE 208. However, because the MMI utilizes a similar multi-assessor scoring technique to assess competencies in context, the MMI may be a better tool to evaluate performance in a course such as RESPCARE 208 than are traditional methods of evaluation (Lemay et al., 2007).

The consistency in the associations among the MMI ranking score and performance in three of the four selected respiratory care courses is of interest. Although the three courses were somewhat related regarding content, there were several stark differences in both the context in which the information was learned as well as the modalities by which the content was presented. Indicating the usefulness of the MMI instrument to identify competencies that were valuable across course objectives.

There was a significant relationship between MMI ranking score and RESPCARE 203 grade. Each of the three students who experienced attrition in the Fall of 2016 did so in this course, indicating that the overall ranking scores of candidates was a predictor of attrition in this course. This finding was underscored by a review of candidates whose ranking scores were in the bottom half of the cohort. Two of these three students received MMI ranking scores that fell below the threshold of the 25th percentile of cohort ranking scores. Additionally, a logistic regression analysis of the 2016 cohort data indicated that the MMI ranking score and cumulative GPA were the only two admissions variables identified as affecting odds of a student experiencing attrition within the first semester of 2016.

These findings echo multiple studies that address the dichotomy of focus between admissions criteria. For example, a systematic review of the usefulness of the MMI in health professions training conducted by Pau et al. (2013) found very little correlation between pre-entry academic qualifications (e.g., GPA and standardized testing scores) and MMI performance. Similarly, several studies indicated that the MMI was the best predictor of what could be considered experiential and contextual intellects (i.e., clinical performance) whereas GPA was the most consistent predictor of ability to acquire knowledge (e.g., cognitive intellect) (Burkhardt et al., 2015; Eva, Reiter et al., 2009; Reiter et al., 2007). This indicates that there is a discernable need for multimodal, holistic selection processes that more adequately aligns with program values (Lemay et al., 2007). The significance of these findings implies that there is a recognizable and useful relationship between candidate performance on the MMI and academic achievement in the first semester of this respiratory care program.

The overall findings of this investigation in relation to question 1 were much the same as several studies that identified the MMI as an effective method of predicting clinical performance (Eva et al., 2012; Knorr & Hissbach, 2014; Lemay et al., 2007). Although most of the research on this topic was conducted in the advanced practice or graduate settings, the findings of this investigation add to the limited findings regarding the usefulness of the MMI into the admissions processes of undergraduate health programming by reiterating that performance on the MMI is a promising measure of student ability to adapt and apply knowledge in changing contexts. Knorr and Hissbach (2014) discussed that the focus of the MMI stations is the context-specific relationship between characteristics of the candidate and the characteristics of the situation. These findings are supported by Sternberg's triarchic theory of intelligence (1984), in that such a relationship is influenced by each of the three types of intellect and is developable through continued exposure and application.

Research Question 2

The second central question in this investigation aimed to understanding the relationships between cognitive admissions variables (e.g., GPA) and academic performance in the first semester of selected respiratory care curriculum. This investigation found an inconsistency among cognitive variables and academic performance both within each cohort as well as among cohort groups. This finding was consistent in the literature that the sole evaluation of the ability to acquire information has limited use in evaluating candidate fit for programs with high contextual variability, like most health care programs (Brouwers & van de Vijver, 2015).

In addition to the overarching limitations outlined for each of the research questions, findings that address the second research question may be limited by candidate's academic history. This limitation is applicable to each of the cohort groups included in this investigation. That is, the use of cumulative GPA as a measure of learning ability does not account for the influence of lived experience on the learning process. Sperle (2013) found that the number of credits taken prior to acceptance to a respiratory care program was not significantly associated with academic performance within the program. This may be because although averaged grades in various courses over a length of time may indicate learning patterns, the fact that the value is an average of that performance is heavily impacted by outliers. Findings of this investigation were consistent with those of Sperle (2013) in that no significant associations were identified among previous education and performance in the select respiratory care curriculum.

The inconsistency of relationships between GPAs and academic performance epitomizes the main issue in the over reliance on cognitive variables as adequate and reliable predictors of student performance in a clinical environment. Sperle (2013) noted that although there is an association between GPA and clinical performance, academic criteria alone may not consistently predict successful completion of a respiratory care program.

Although no one cognitive criterion was consistently indicative of performance in the program, several studies have noted the correlation between past and future academic performance (Al Alwan et al., 2012; Sperle, 2013). However, several authors have warned against the sole consideration of GPA in the admissions process. Siu and Reiter (2009) acknowledged that although correlations between GPA and future academic performance are well documented in the literature, correlations tend to trend downwards as time from admission increases; potentially indicating a shift away from cognitive emphases throughout a program's curriculum.

In the context of Sternberg's (1984) triarchic theory, as the focus of content shifts away from the concrete foundational phase of information gathering towards the more abstract concept of application in new contexts, more higher order learning processes are required. The evaluation of whether students can make the transition from acquiring information to applying information in new contexts successfully is the prime objective of assessing noncognitive attributes prior to entering a program that requires such a skill. The lack of consistent associations between GPA, especially cumulative GPA, and academic performance identified in this investigation may reiterate this point.

Research Question 3

The final research question of this study sought to investigate the effectiveness of admissions variables in predicting the rates of attrition within the first semester of the participating program. Cohort specific logistic regressions were conducted and models identified several variables that affected the likelihood of attrition. Regression models were similar between the 2013 and 2014 cohorts in that several of the identified coefficients were consistent between cohort groups. These included cumulative GPA, combined math/science GPA, and averaged essay score. It is important to note that none of the coefficients in either year had a significant effect on the likelihood of attrition when isolated. Regression analysis for the 2016 cohort data set indicated two coefficients within the model. These included cumulative GPA and MMI ranking points; however, like the other cohort groups, neither variable was significantly impactful when isolated.

The 2013 and 2014 cohort groups experienced uncharacteristically low rates of attrition that made correlational analysis regarding attrition difficult. Although each of these cohort groups experienced lower than expected attrition rates during the first semester each also experienced higher than expected rates in the second semester. Therefore, in order to best assess the relationships among performance and attrition, second semester performance was included in the correlational analyses for both the 2013 and 2014 cohort groups. There were significant relationships identified among performances in the first semester core respiratory care curriculum (i.e., RESPCARE 203, RESPCARE 204, and RESPCARE 208) and performances in the subsequent courses in the curricular sequence (i.e., RESPCARE 223, RESPCARE 224, and RESPCARE 228) in both cohort groups. These relationships indicated a pattern in predicting academic achievement between semesters and may provide useful in predicting future attrition.

In addition to the overarching limitations outlined for each of the research questions, there were some analytical limitations inherent to question 3. Due to the low rates of first semester attrition seen in both the 2013 and 2014 cohorts, relationships between admissions variables and rates of attrition could only be inferred indirectly by evaluating relationships between admissions variables and first semester performance and then between first semester and second semester performance (i.e., attrition). These inferential relationships are weak indicators of actual relationships among variables assessed during the admissions processes and academic performances and are to be interpreted as such.

Additional limitations included the small sample size used in the logistic regression analyses. The small sample sizes impacted the investigation into the relationships among admissions variables, course performances, and rates of attrition. In all regression analyses, the dependent variable (attrition) had fewer than 10 observations, meaning the results of the regression should be interpreted with caution and are not likely generalizable. Nevertheless, the pattern shown regarding first and second semester performances may provide useful information to instructors on how to identify students who are at risk for attrition in the future.

Regression analyses identified the combinations of variables that most significantly affected the likelihood of attrition. Although more data is required for a more definitive analysis, the findings of this investigation not only indicated that, for this program, admissions processes prior to the integration of the MMI were primarily focused on cognitive indicators of academic ability (i.e., GPA's) but also that the reliance on such associations was perhaps overemphasized.

Relatively few studies have addressed relationships between either individual admissions variables or groups of admissions variables in a small, cohort-based program such as this. Wittenbel et al. (2009) used logistic regression on retrospective admissions data to predict performance in a respiratory program with the goal of addressing high program attrition. Like the findings of this investigation, regression models had to be reduced to reach significance. The model identified by Wittenbel et al. (2009) required a reduction from four predictors to two, finding that prerequisite GPA added only a small, but significant increment in explained variance. This investigation contributes to the gap in the existing literature regarding the application and assessment of the MMI in a small undergraduate respiratory care program to impact attrition rates.

The MMI and Triarchic Theory of Intelligence

This study was framed using Sternberg's (1984) triarchic theory of intelligence. This theory was selected primarily because Sternberg's (1984) definition of intelligence best matched the mission and vision of the department of respiratory care at the participating institution. That is, the notion that to be successful in both the baccalaureate respiratory care program and in the workplace, students must be able to purposefully adapt to, select, and shape the environments in which they find themselves. Thereby, any measure of intelligence should subsume each of these abilities (Sternberg, 1984).

Sternberg's (1984) triarchic theory posited that the three primary domains of intellect–componential, experiential, and contextual–are all developed and nurtured through the continued exposure to both information-gathering processes and application to situations wherein the information can be applied. This theory parallels the prime objective of the respiratory care program, which is to graduate students who exhibit key competencies of a successful clinician.

Sternberg (1984) also argued that his theory was unique in the perspective that each of the domains were interrelated, even cyclical, rather than linear. For example, the metacomonents that guide the acquisition of knowledge were also responsible for interpreting feedback gleaned from application of that knowledge to situational experience. This feedback loop of information-gathering and application to contexts of varying novelty continue until the response is automatically shaped to best respond to the demands of the context.

To best achieve the primary program objective of developing competent and desirable practitioners, the respiratory care curriculum at this institution is structured in a stepwise fashion. That is, introductory courses introduce content skills considered novel, and progressive courses advance towards mastery of both concept and skill. Although the formal curriculum model appears linear, the model is not concrete. Rather, both content and skills are intentionally reiterated throughout the curriculum. Again, this reiteration of content aligns with emphasis on interrelatedness among intellectual domains of Sternberg’s (1984) triarchic theory.

In exploring the relationships between performance and attrition, this study found that performance in the fall (i.e., introductory) sequence of core respiratory care courses was an indicator of performance in subsequent core curriculum (i.e., performance in RESPCARE 203 was significantly related to subsequent performance in RESPCARE 223). This finding indicated that although both content and skill were reiterated in the program, performance was unchanged. Given the constructs of Sternberg’s (1984) triarchic theory, it may be deduced that students unable to perform the novice level tasks adequately were unable to adequately respond to the external environment.

The descriptive analyses conducted in this study revealed that although students typically entered the program exhibiting adequate componential intellect, as indicated by an above average GPA (i.e., greater than a 3.0 on a 4.0 scale), those who experienced attrition typically did so at a very novel stage in the program (i.e., within the first year). This finding indicated that perhaps those students at the novice level who experienced attrition may have lacked the ability to adapt to this feedback loop and respond appropriately to the environmental expectations of the program.

The MMI was integrated into the admissions processes of this program to better identify those students unable to adapt to new contexts appropriately. As the focus of evaluation when using the MMI instrument was not componential in nature (i.e., not oriented to specific subject matter), evaluation of student performance was assessed solely on the candidate's ability to apply a baseline understanding of existing knowledge to new, albeit unfamiliar, contexts. Thus, a student who did not respond appropriately to the scenario likely received a low station score. A low station score likely meant that the interviewer ranked the student lower than a student who responded more appropriately, with subjective perceptions of student performance discriminating only between students with like scores.

The significant correlations among MMI ranking score and performances in RESPCARE 203, 204, and 208 were promising indications of the MMI's ability to identify those students better able to adapt knowledge and experiences gleaned in prerequisite courses to curriculum in the respiratory care program that required higher order learning processes such as application, analysis, and synthesis. This finding was supported by the differentiation of candidate ranking MMI scores and admitting cumulative GPA's into percentile rankings. This differentiation revealed that most of the students who experienced attrition in the Fall of 2016 ($N = 2$) fell somewhere near the twenty-fifth percentile in both MMI ranking score and GPA values, indicating that these students were unable to acquire the knowledge necessary to be successful in the first semester, but also lacked the ability to adapt to or shape their new environment in an appropriate way. This hypothesis was underscored by the findings of the logistic regression analysis for the 2016 cohort, which revealed that MMI ranking score and cumulative GPA were the only two variables that had a significant effect on likelihood of attrition.

Perhaps the most significant finding for the respiratory care department regarding the utility of the MMI as an adjunct method of student selection, framed by Sternberg's (1984) triarchic theory of intelligence, is the significant relationship among performance scores on the MMI and performance in the introductory clinical course, RESPCARE 208. Sternberg (1984) argued that any theory of intelligence should address intelligence in terms of the interaction between the internal and external worlds of a person. Nowhere in the respiratory care curriculum was this philosophy underscored more heavily than in the introductory clinical experience of students. Ability to successfully perform in the clinical environment of this program required students to react and respond to the demands of high-risk environment at a lower rate of novelty than did the low risk environment of the classroom. Students were introduced to the clinical environment within the first 8 weeks of beginning program curriculum, which drastically reduced the time students had to adapt, select, and shape information internally to adequately respond to the demands of the external, clinical environment. Essentially, these students had to hit the proverbial ground running.

Because of quick start it is imperative that the admissions committee identify students who best demonstrate the level of novelty required to be successful in this curriculum component during the admissions process. Findings of this study indicate that MMI total points and MMI ranking points were the only variables in the 2016 cohort that were significantly associated with performance in RESPCARE 208. Indicating that in this case, the MMI was effective in identifying success in the clinical environment for the 2016 cohort and given the program objectives, this finding justified the integration of the MMI as a method of evaluating the experiential and contextual domains of intelligence. Given the data available, the evaluation of these intellectual domains was as equally essential to identifying successful students as was the assessment of intelligence through more traditional componential criteria (e.g., cumulative GPA).

Recommendations

In practice, the findings of this study suggest that there is some utility in the MMI in the admissions processes of small baccalaureate respiratory care programs, especially in identifying students who will be successful in the clinical environment. The nature of this investigation makes increasing the sample size to reach significant power difficult; however, it is unclear whether simply increasing the number of participants would increase the significance of the findings. Due to the constraints of this investigation, no specific recommendations can be made regarding the implementation of the MMI to specifically impact rates of attrition in the first semester of this baccalaureate respiratory care program. However, research regarding the value of noncognitive attributes as measured by the MMI should continue in the undergraduate health setting. Such studies will contribute to the literature about the value of noncognitive assessment in the admissions process towards a more holistic practice that values intelligence as a multifaceted phenomenon. Such studies will likely benefit potential health care students, undergraduate health care programs, and ultimately, the future patients for whom these students will care for.

Concerning this research, several recommendations are proposed. First, additional cohorts should be studied using this methodology. Increasing the number of students in comparable cohorts would increase the sample size and would result in not only more definitive results, but also limit the likelihood of Type II errors. Future studies seeking to answer similar research questions to the ones posed in this investigation should consider using instrumentation that has not only been used in other studies, but that also reflects the values of the respective department. If possible, faculty or committee members should participate in the MMI process consistently to eliminate inconsistent performance scores, and admissions practices should be held consistent between cohort groups to eliminate the potential limitations in this study.

To enhance the design of this study, a qualitative component could be added. A mixed methods design could address perceptions and attitudes of the faculty who participate in the MMI, as well as those faculty responsible for teaching courses, regarding the utility of the tool in the admissions process. Understanding how faculty perceive the usefulness of the MMI to best identify those students who not only excel in a rigorous clinical program but also graduate as competent and caring clinicians would be useful in further justifying a multimodal approach to the evaluation of candidates. It seems that although the paradigm regarding the value of noncognitive competencies like critical thinking and interpersonal skill seems to be shifting slightly, more evidence regarding the utility of adjunct admission tools, like the MMI, to identify these key competencies is warranted.

The finding of this study that identified a significant relationship between performance on the MMI and performance in the clinical environment underscores emerging literature regarding the value of these competencies in the workplace. As the landscape of health care delivery changes towards the model of patient-centered care and performance-based reimbursement, academic institutions must respond by revising curriculum to aid in the development of the skills both required of successful healthcare practitioners and desired by organizational stakeholders.

However, it may be unrealistic to expect that any one program be responsible for instilling every desirable quality of a successful practitioner. Therefore, to best meet the demands of the profession as well as to advocate for those students who are perhaps marginalized by standardized measures of intelligence, a shift towards the perception of intelligence as a multifaceted phenomenon is needed. In order to foster both program/candidate fit and student success admission practices should be designed to identify candidates with the qualities that best align with program objectives. One way to do this is through an evaluation of baseline skills that are both cognitive and noncognitively oriented. Identifying those students who are not only able to acquire and recall information, but who also have the developable ability to cope and adapt to novel situations prior to admission, may be the best strategy to not only decrease program specific rates of attrition, but also to graduate well-rounded providers.

To address underlying behaviors, an assessment of emotional intelligence could be added to this investigation. An assessment of emotional intelligence through a standardized tool, such as the Emotional Quotient Inventory (EQ-i: Short) could be conducted just prior to the beginning of the first semester. This assessment may help to explain potential gaps in the ability of the three facets of Sternberg's triarchic theory to explain performance in a clinically-focused health program.

An additional recommendation is to explore the potential for contextual development through alternate modalities of instruction throughout the program curriculum. Techniques such as patient-based scenario simulation may help to decrease the degree of novelty experienced by students in the clinical environment. For example, increasing the frequency of simulation-based patient interactions in a low-stakes classroom environment may be a helpful way to support development of key noncognitive competencies while in the program. Additionally, exposing students to more low-stakes, high-fidelity simulation opportunities throughout the first semester may help to enhance the efficiency of the feedback loop between metacognitive direction and both knowledge acquisition and performance components–impacting the rate of progression from novice towards mastery of first semester content.

Per Sternberg (1984), continued exposure to novel tasks or content and reflection of said experience with that exposure is required to best select, shape, and adapt an appropriate, perhaps even automatized, response to a new context. Findings of this study identified that performance in introductory courses was significantly associated with performance in subsequent courses in a content-specific sequence (e.g., performance in RESPCARE 203 was indicative of performance in RESPCARE 223). It may be inferred then, that offering those students who struggle with the novelty of first semester content more exposure to the clinical context may positively impact future performance.

Since the integration of the MMI into the undergraduate setting is relatively unique, the following research questions could be considered in future studies:

- What is the relationship between self-reported, perceived learning styles and performance on specific MMI stations and course performance?
- What relationships exist among demographic data (e.g., age, gender, socioeconomic status), performance on the MMI, and academic success in the respiratory care program?
- What relationships exist between performance on the MMI and semester-specific interval performances throughout the program?
- Do faculty value this type of admissions assessment?
- What is the perception of the impact of simulation experiences on performance in the clinical environment?

Summary

Investigation into the utility of the MMI in selecting candidates who are well suited for success in this specific respiratory care program revealed that performance on the MMI was significantly associated with achievement in the clinical component of the introductory curriculum. This finding supports the integration of the MMI as an adjunct method of student selection in a program that views intelligence and potential as a multifaceted phenomenon, rather than simply as the demonstration of the ability to acquire knowledge.

Further studies involving a larger student population are recommended to provide baccalaureate respiratory care departments with a more comprehensive understanding about how the MMI can be utilized to identify key noncognitive competencies inherent to successful clinicians. Finally, this study provides some evidence that the MMI is better able to predict achievement in clinical requirements than are other, cognitively-oriented, admissions criteria such as GPA. Although the cohort sample sizes affected the reliability of the logistic regression analyses, the finding that ranking MMI score, along with cumulative GPA, significantly affected the likelihood of attrition is a promising addition to the growing base of evidence supporting a multimodal, holistic approach to the admissions processes of undergraduate health programs, like respiratory care.

REFERENCES

Al Alwan, I., Al Kusi, M., Tamim, T., Magzoub, M., & Elzubeir, M. (2012). Health sciences and medical college preadmission criteria and prediction of in-course academic performance: A longitudinal study. *Advances in Health Science Education, 18*, 427-438. doi:10.1007/s10459-012-9380-1

Alon, S., & Tienda, M. (2007). Diversity, opportunity, and the shifting meritocracy in higher education. *American Sociological Review, 72*, 487-511. Retrieved from http://inequality.stanford.edu/_media/pdf/Reference%20Media/Alon%20and%20Tienda_2007_Education.pdf

American Association of Respiratory Care (AARC). (2016a). Transitioning from an associate's degree program to a baccalaureate degree program. Retrieved from http://www.aarc.org/education/educator-resources/transitioning-associate-to-baccalaureate-degree-program/

American Association of Respiratory Care (AARC). (2016b). AARC Board of directors sets 80% bachelor degree goal by 2020. Retrieved from http://www.aarc.org/aarc-bod-sets-80-bachelor-degree-goal-by-2020/

American Institutes for Research. (2012). The institutional costs of student attrition. Delta Cost Project at American Institutes for Research. Retrieved from http://www.deltacostproject.org/sites/default/files/products/Delta-Cost-Attrition-Research-Paper.pdf

Apple Inc. (2016). FaceTime (iOS 10.2.1) [Mobile application software]. Retrieved from http://itunes.apple.com

Association of American Colleges and Universities. (2015, April 29,). Optimistic about the future, but how well prepared? College students' views on college learning and career success. Retrieved from https://www.aacu.org/leap/public-opinion-research/2015-students

Au, W. W. (2008). Devising inequality: A Bernsteinian analysis of high-stakes testing and social reproduction in education. *British Journal of Sociology of Education, 29*(6), 639-651. doi:10.1080/01425690802423312

Barnes, T. A., Gale, D. D., Kacmerek, R. M., & Kageler, W. V. (2010). Competencies needed by graduate respiratory therapists in 2015 and beyond. *Respiratory Care, 55*(5), 601-616. Retrieved from http://www.cobgrte.org/images/Competencies_Needed_by_Graduate_Respiratory_Therapists.pdf

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Theories of intelligence predict achievement across an adolescent transition: A longitudinal study. *Child Development, 78*(1), 246-263. doi:0009-3920/2007/7801-0014

Boshuizen, H. P. A., & Schmidt, H. G. (2008) The development of clinical reasoning expertise. In J. Higgs (Ed.), *Clinical Reasoning in the Health Professions* (3rd ed., pp. 113-121). Boston, MA: Elsevier

Burkhardt, J., Stansfield, R., Vohra, T., Losman, E., Turner-Lawrence, D., & Hopson, L. (2015). Prognostic value of the multiple mini-interview for emergency medicine residency performance. *The Journal of Emergency Medicine, 49*(2), 196-202. doi:10.1016/j.jemermed.2015.02.008

Brouwers, S. A., & van de Vijver, F. J. R. (2015). Contextualizing intelligence in assessment: The next step. *Human Resource Management Review, 25,* 38-46. doi:10.1016/j.hrmr.2014.09.0061053-4822

Camara, W.J. (2005). Broadening predictors of college success. In W. J. Camara and E.W. Kimmel, *Choosing students higher education admissions tools for the 21st century* (pp. 81-105). Mahwah, NJ: Lawrence Erlbaum Associates.

Cheng, A. (2015, January 15th). What does ACT stand for? The complete story. Retrieved from http://blog.prepscholar.com/what-does-act-stand-for

Christopherson, N. (2004). Attrition and admissions criteria. Office of Institutional Research, Whitman College. Retrieved from https://www.whitman.edu/Documents/Offices/Institutional%20Research/Withdraw_Rates_Report.pdf

Collins, A., & Halverson, R. (2009). *Rethinking education in the age of technology The digital revolution and schooling in America.* New York, NY: Teachers College Press.

Côté, S., & Miner, C. T. H. (2006). Emotional intelligence, cognitive intelligence, and job performance. *Administrative Science Quarterly, 51,* 1-28. doi:0001-8392/06.5101-0001

Coutinho, S. A., & Neuman, G. (2008). A model of metacognition, achievement goal orientation, learning style and self-efficacy. *Learning Environmental Research, 11,* 131-151. doi:10.1007/s10984-008-9042-7

Cox, W. C., McLaughlin, J. E., Singer, D., Lewis, M., & Dinkins, M. M. (2015). Development and assessment of the multiple mini-interview in a school of pharmacy admissions model. *American Journal of Pharmaceutical Education, 79*(4), 1-9. doi:10.5688/ajpe79453

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Boston, MA: Pearson.

Dennen, V. P., & Jonassen, D. H. (2004). *Handbook of research on educational communications and technology* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Digman, J. M. (1996). The curious history of the five-factor model. In J. Wiggins (Ed.), *The five factor model of personality: Theoretical perspectives* (chapter 1). New York, NY: Guilford Press.

Dinger, F. C., & Dickhäuser, O. (2013). Does implicit theory of intelligence cause achievement goals? Evidence from an experimental study. *International Journal of Educational Research, 61*, 38-47. doi:10.1016/j.ijer.2013.03.008

Duckworth, A. L., Quinn, P. D., & Tsukayama, E. (2012). What no child left behind leaves behind: The roles of IQ and self-control in predicting standardized achievement test scores and report card grades. *Journal of Educational Psychology, 104*(2), 439-451. doi:10.1037/a0026280

Eva, K., Reiter, H., Rosenfeld, J., & Norman, G. (2004). The ability of the multiple mini-interview to predict clerkship performance in medical school. *Academic Medicine, 79*(10), s40-s42. Retrieved from http://journals.lww.com/academicmedicine/Abstract/2004/10001/The_Ability_of_the_Multiple_Mini_Interview_to.12.aspx

Eva, K., Reiter, H., Rosenfeld, J., Trinh, K., Wood, T., & Norman, G. (2012). Association between medical school admission process using multiple mini-interview and national licensing examination scores. *The Journal of the American Medical Association, 308*(21), 2233-2240. doi:10.1001/jama.2012.36914

Eva, K., Rosenfeld, J., Reiter, J., & Norman, G. (2004). An admissions OSCE: The multiple mini-interview. *Medical Education, 38,* 314-326. doi:10.1046/j.1365-2923.2004.01776.x

Fazio, S. B., Papp, K. K., Torre, D. M., & DeFer, T. M. (2013). Grade inflation in the internal medicine clerkship: A national survey. *Teaching and Learning in Medicine, 25*(1), 71-76. doi:10.1080/10401334.2012.741541

Field, D. W., Freeman, S. A., & Dyrenfurth. (2004). Holistic assessment of students in undergraduate industrial technology programs. *The Journal of Technology Studies*, *30*(4), 78-85.. Retrieved from lib.dr.iastate.edu/abe_eng_pubs/48/

Fraher, E., Belsky, D. W., Gaul, K., & Carpenter, J. (2010). Factors affecting attrition from associate degree nursing programs in North Carolina. *Cah Sociol Demogr Med*, *50*(2), 213-246. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/20653220

Gagné, M., & Deci, E. L. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior*, *26*(4), 331-362. doi:10.1002/job.322/full

Garner, H. (2011). *Frames of mind: The theory of multiple intelligences*. New York, NY: Basic Books.

Girotti, J. A., Park, Y. S., & Tekian, A. (2015). Ensuring a fair and equitable selection of students to serve society’s health care needs. *Medical Education*, *49*, 84-92. doi:10.1111/medu.12506

Gliner, J. A., Morgan, G. A., & Leech, N. L. (2017). *Research methods in applied settings: An integrated approach to design and analysis* (3rd ed.). New York, NY: Routledge.

Goodwin, B. (2011). Grade inflation: Killing with kindness. *Educational Leadership*, 69(3), 80-81. Retrieved from http://www.educationalleadership-digital.com/educationalleadership/201111?pg=82#pg82

Harris, P., Smith B. M., & Harris, J. (2011). The tests don't measure achievement adequately. In P. Harris, B. M. Smith, & J. Harris (Eds.), *The myths of standardized tests* (ch. 3). Lanham, MD: Rowman & Littlefield.

Hart Research Associates. (2015). Optimistic about the future, but how well prepared? College students' views on college learning and career success: Selected findings from an online survey of college students conducted on behalf of the Association of American Colleges and Universities. Retrieved from https://www.aacu.org/sites/default/files/files/LEAP/2015StudentSurveyReport.pdf

HIPAA.com. (2016). Health care provider (definition). Retrieved from http://www.hippa.com/hcfa-healthcare-hipaa/health-care-provider.html

Helmes, E. & Pachana, N.A. (2008). Value of interviews for admission to clinical training programs: Perspective of program directors. *Australian Psychologist, 43*(4), 249-256. doi:10.1080/00050060802413362

Hubbell, L. (2015). Students aren't consumers. *Academic Questions, 28*(1), 82-89. doi:10.1007/s12129-015-9473-4

Hyde, J., & Bravo, A. (2015). Students think they're ready for the real world; employers, not so much. Forbes. Retrieved from http://www.forbes.com/sites/realspin/2015/09/21/students-think-theyre-ready-for-the-real-world-employers-not-so-much/#554ec75a3e81

Intellectus Statistics. (2017). Intellectus Statistics [Online computer software]. Retrieved from https://analyze.intellectusstatistics.com/

Irby, D. M., Cooke, M., & O'Brien, B. C. (2010). Calls for reform of medical education by the Carnegie Foundation for the advancement of teaching: 1910 and 2010. *Academic Medicine, 85*(2), 220-227. doi:10.1097/ACM.0b013e3181c88449

Jackson, K., Lower, C. L., & Rudman, W. J. (2016). The crossroads between workforce and education. *Perspectives in Health Information Management, 2016*, 1-11. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4832131/pdf/phim0013-0001g.pdf

Jerant, A., Griffin, E., Rainwater, J., Henderson, M., Sousa, F., Bertakis, . . . Franks, P. (2012). Does applicant personality influence multiple mini-interview performance and medical school acceptance offers? *Academic Medicine*, *87*(9), 1250-1258. Retrieved from https://www.researchgate.net/profile/Erin_Griffin5/publication/230573514_Does_applicant_personality_influence_multiple_mini-interview_performance_and_medical_school_acceptance_offers/links/54dcf1760cf282895a3b35dc.pdf

Joyner, P. U., Cox, W. C., White-Harris, C., & Blalock, S. J. (2007). The structured interview and interviewer training in the admissions process. *American Journal of Pharmaceutical Education, 71*(5), 1-5. Retrieved from http://www.ajpe.org/doi/pdf/10.5688/aj710583

Khanna, T. (2014). Contextual intelligence. *Harvard Business Review.* Retrieved from https://hbr.org/2014/09/contextual-intelligence

Knorr, M., & Hissbach, J. (2014). Multiple mini-interview: Same concept, different approaches. *Medical Education, 48*, 1157-1175. doi:10.1111/medu. 12535

Koenig, T. W, Parrish, S. K., Terregino, C. A., Williams, J. P., Dunleavy, D. M., & Volsch, J. M. (2013). Core personal competencies important to entering student' success in medical school: What are they and how could they be assessed early in the admission process? *Academic Medicine, 88*(5), 603-613. doi:10.1097/ACM.0b013e31828b3389

Koenig, J. A., Sireci, S. G., & Wiley, A. (1998). Evaluating the predictive validity of MCAT scores across diverse applicant groups. *Academic Medicine, 73*(10), 1095- 1106. Retrieved from http://journals.lww.com/academicmedicine/abstract/1998/10000/evaluating_the_predictive_validity_of_mcat_scores.21.aspx

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice Hall. Retrieved from http://academic.regis.edu/ed205/kolb.pdf

Krisberg, K. (2015). Situational judgment tests gain traction in medical school admissions. WashingtonNewsCloud.com. Retrieved from http://www.washingtonnewscloud.com/associations/situational-judgment-tests-gain-traction-in-medical-school-admissions

Kulatunga-Moruzi, C., & Norman, G. R. (2002). Validity of admissions measures in predicting performance outcomes: The contribution of cognitive and non-cognitive dimensions. *Teaching and Learning in Medicine, 14*(1), 34-42. doi:10.1207/S15328015TLM1401_9

Lemay, J. Lockyer, J.M., Collin, V.T., & Brownell, A.K.W. (2007). Assessment of non-cognitive traits through the admissions multiple mini-interview. *Medical Education, 41*, 573-579. doi:10.1111/j.1365-2923.2007.02767.x

Lievens, F., & Sackett, P.R. (2012). The validity of interpersonal skills assessment via situational judgment tests for predicting academic success and job performance. *Journal of Applied Psychology, 97*(2), 460-468. doi:10.1037/a0025741.

Livingston, J.A. (1997). Metacognition: An overview. Retrieved from http://gse.buffalo.edu/fas/shuell/cep564/metacog.htm

Louviere, J. J., Hensher, D. A., & Swait, J. D. (2000). *Stated choice methods: Analysis and applications.* Cambridge, UK: Cambridge University Press.

Lubinski, D. (2004). Introduction to the special section on cognitive abilities: 100 years after Spearman's (1904) "'general intelligence,' objectively determined and measured". *Journal of Personality and Social Psychology, 86(*1), 96-111. doi:10.1037/0022-3514.86.1.96

McDaniel, M. A., & Whetzel, D. L. (2005). Situational judgment tests: An IPMAAC workshop. IPMA-HR Assessment Council. Retrieved from http://annex.ipacweb.org/library/conf/05/mcdaniel.pdf

Menard, S. (2009). *Logistic regression: From introductory to advanced concepts and applications.* Thousand Oaks, CA: Sage.Merriam-Webster.com. (n.d.). Intelligence. Retrieved from http://www.merriam-webster.com/dictionary/intelligence

Moruzi, C. K., & Norman, G. R. (2009). Validity of admissions measures in predicting performance outcomes: The contribution of cognitive and non-cognitive dimensions. *Teaching and Learning in Medicine, 14*(1), 34-42. doi:10.1207/S15328015TLM1401_9

Newton, S. E. & Moore, G. (2009). Use of aptitude to understand bachelor of nursing student attrition and readiness for the national council licensure examination-registered nurse. *Journal of Professional Nursing, 25*(5), 273-278. doi:10.1016/j.profnurs.2009.01.016

Newton, S. E., Smith, L. H., Moore, G., & Magnan, M. (2007). Predicting early academic achievement in a baccalaureate nursing program. *Journal of Professional Nursing, 23*(3), 144-149. doi:10.1016/j.profnurs.2006.07.001

Nicholson, L., Putwain, D., Connors, L., & Hornby-Atkinson, P. (2013). The key to successful achievement as an undergraduate student: confidence and realistic expectations? *Studies in Higher Education, 38*(2), 285-298.

Noonan, B. M., Sedlacek, W. E., & Veerasamy, S. (2005). Employing noncognitive variables in admitting and advising community college students. *Community College Journal of Research and Practice, 29*, 463-469. doi:10.1080/10668920590934170.

Nursinglicensure.org. (n.d.). The future of the associate degree in nursing program. NursingLicensure.org. Retrieved from http://www.nursinglicensure.org/articles/adn-program-future.html

Nusche, D. (2008). Assessment of learning outcomes in higher education: A comparative review of selected practices. *OECD Working Papers, 15*, 1-50. doi:10.1787/244257272573

Olani, A. (2009). Predicting first year university students' academic success. *Electronic Journal of Research in Educational Psychology, 7*(3), 1052-1072. Retrieved from http://web.b.ebscohost.com.libproxy.boisestate.edu/ehost/pdfviewer/pdfviewer?vid=2&sid=36383492-d79e-4479-acc1-f31411305360%40sessionmgr101

Onyekuru, B. U., & Njoku, J. (2015). Metacognition, intelligence, motivation and students' academic achievement: A theoretical review. *Journal of Educational Review, 8*(2), 195-204.

Oranye, N. O. (2016). The validity of standardized interviews used for university admission into health professional programs: A Rasch analysis. *Sage Open,* 1-10. doi:10.1177/2158244016659119

Pattinson, E., Grodsky, E., & Muller, C. (2013). Is the sky falling? Grade inflation and the signaling power of grades. *Educational Researcher*, *42*(5), 259-265. doi:10.3102/0013189X13481382

Pau, A., Jeevaratnam, K., Chen, Y. S., Fall, A. A., Khoo, C., & Nadarajah, V. D. (2013). The multiple mini-interview (MMI) for student selection in health professions training-a systematic review. *Medical Teacher, 35*, 1027-1041. doi:10.3109/0142159X.2013.829912

Poole, P., Shulruf, B., Rudland, J., & Wilkinson, T. (2012). Comparison of UMAT scores and GPA in prediction of performance in medical school: A national study. *Medical Education, 46,* 163-171. doi:10.1111/j.1365-2923.2011.04078.x

Prideaux, D., Roberts, C., Eva, K., Centeno, A., McCrorie, P., Mcmanus, C., . . . Wilkinson, D. (2011). Assessment for selection for the health care professions and specialty training: Consensus statement and recommendations from the Ottawa 2010 conference. *Medical Teacher, 33*(3), 215-223. doi:10.3109/0142159X.2011.551560

Pruitt, S. D., & Epping-Jordan, J. E. (2005). Preparing the 21st century global healthcare workforce. *BMJ*, 330, 637-639. Retrieved from http://www.bmj.com/content/bmj/330/7492/637.full.pdf

Rahn, M. (2015). The analysis factor. Retrieved from http://www.theanalysisfactor.com/factor-analysis-1-introduction/

Raisman, N.A. (2013). The cost of college attrition at four-year colleges & universities. *Policy Perspectives, 2013*, 1-269. Retrieved from https://eric.ed.gov/?id=ED562625

Reiter, H. I., Eva, K. W., Rosenfeld, J., & Norman, G. R. (2007). Multiple mini-interviews predict clerkship and licensing examination performance. *Medical Education, 41*(4), 378-384. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/17430283

Rooks, N. M. (2012, October 11). Why it's time to get rid of standardized tests. *Time Magazine Online*. Retrieved from http://ideas.time.com/2012/10/11/why-its-time-to-get-rid-of-standardized-tests/

Rose, J. (2012). How to break free of our 19th-century-factory model of education system. *The Atlantic*. Retrieved from http://www.theatlantic.com/business/archive/2012/05/how-to-break-free-of-our-19th-century-factory-model-education-system/256881/

Sacks, P. (2009*). Standardized minds the high price of America's testing culture and what we can do to change it*. New York, NY: De Capo Press.

Salvatori, P. (2001). Reliability and validity of admissions tools used to select students for the health professions. *Advances in Health Sciences Education, 6*(2), 159-175. doi:10.1023/A:1011489618208

Schmitt, N., Keeny, J., Oswald, F. L., Pleskac, T. J., Billington, A. Q., Sinha, R., & Zorzie, M. (2009). Prediction of 4-year college student performance using cognitive and noncognitive predictors and the impact on demographic status of admitted students. *Journal of Applied Psychology, 94*(6), 1479-1497. doi:10.1037/a0016810

Sedlacek, W. E. (2004). *Beyond the big test*. San Francisco, CA: Jossey-Bass.

Sedlacek, W. E. (2005). The case for noncognitive measures. In W. Camara & E. Kimmel (Eds.), *Choosing students: Higher education admission tools for the 21st century* (pp. 177-193). Mahwah, NJ: Lawrence Erlbaum Associates.

Sedlacek, W. E. (2011). Using noncognitive variables in assessing readiness for higher education. *Readings on Equal Education*, *25*, 187-205. Retrieved from https://cerpp.usc.edu/files/2013/11/UsingNCV-Sedlacek.pdf

Siu, E., & Reiter, H. I. (2009). Overview: What's worked and what hasn't as a guide towards predictive admission tool development. *Advances in Health Science Education, 14*, 759-775. doi:10.1007/s10459-009-9160-8

Smith, M. K. (2008). Howard Garner and multiple intelligences. *Encyclopedia of Informal Education.* Retrieved from http://www.infed.org/mobi/howard-gardner-multiple-intelligences-and-education.

Sparkman, L. A., Maulding, W. S., & Roberts, J. G. (2012). Non-cognitive predictors of student success in college. *College Student Journal*, 642-652. Retrieved from http://www.ingentaconnect.com/contentone/prin/csj/2012/00000046/00000003/art00018

Spearman, C. (1904). General intelligence, objectively determined and measured. *American Journal of Psychology*, *15*, 201-203. Retrieved from http://psychclassics.yorku.ca/Spearman/

Sperle, C. K. (2013). Predictors of success in a baccalaureate respiratory therapy program. *Respiratory Care Education Annual*, *23*, 28-33. Retrieved from https://www.aarc.org/app/uploads/2015/05/rcea14.pdf

Stanford School of Medicine. (2016). Core competencies. Retrieved from http://med.stanford.edu/gme/current_residents/corecomp.html

Sternberg, R. J. (1984). *The triarchic mind*. New York, NY: Penguin Group.

Sternberg, R. J. (1997). *Successful intelligence*. New York, NY: Penguin Group.

Sternberg, R. J. (2007). Who are the bright children? The cultural context of being and acting intelligent. *Educational Researcher*, *36*(3), 148-155. doi:10.3102/0013189X07299881.

Sternberg, R. J. (2009). The rainbow and kaleidoscope projects a new psychological approach to undergraduate admissions. *European Psychologist*, *14*(4), 279-287. doi:10.1027/1016-9040.14.4.279

Sternberg, R. J. (2015). Multiple intelligences in the new age of thinking. In S. Golstein, J. A. Naglieri, & D. Princiotta (Eds.), *Handbook of intelligence: Evolutionary theory, historical perspective, and current concepts (*pp. 229-241). New York, NY: Springer.

Stiggins, R. (2005). From formative assessment to assessment for learning: A path to success in standards-based schools. *Phi Delta Kappan, 87*(4), 324-328. Retrieved from http://bibliotecadigital.academia.cl/jspui/bitstream/123456789/586/1/Rick%20Stiggins.pdf

Tekian, A. (1998). Predicting performance and satisfaction: Beyond the crystal ball. *Academic Medicine, 73*(10), s38-s40. doi:10.1097/00001888-199810000-00039

Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of Educational Research, 45*(1), 89-125. Retrieved from https://www.jstor.org/stable/1170024

Trinh, K., & Edge, W. (2012). *Manual for interviewers 2012/2013.* Hamilton, Ontario, Canada: Admissions Undergraduate Medical Program, Michael G. DeGroote School of Medicine. Retrieved from http://mdprogram.mcmaster.ca/docs/default-source/admissions/interviewermanualfull2012-13forwebsite.pdf

Tucker, J., & Courts, B. (2010). Grade inflation in the college classroom. *Foresight: The Journal of Futures Studies, Strategic Thinking and Policy, 12*(1), 45-53. doi:10.1108/14636681011020155

University of Calgary. (2008). MMI Scenarios. Retrieved from http://www.ucalgary.ca/mdprogram/files/mdprogram/2008_09-mmi-cases.pdf

Urban Universities for Health. (2014). *Holistic admissions in the health professions: Findings from a national survey*. Retrieved from http://urbanuniversitiesforhealth.org/media/documents/holisticadmissionsinthehealthprofessions.pdf

U.S. Department of Labor. (2015). *Occupational outlook handbook, 2016-2017 edition: Respiratory therapists*. Retrieved from https://www.bls.gov/ooh/healthcare/respiratory-therapists.htm

Watts, L. K., & Winters, R. (2016). Examining grade inflation and considerations for radiologic sciences: A literature review. *Journal of Medical Imaging and Radiation Sciences*. doi:10.1016/j.jmir.2016.08.002

Weaver, C. S., Humbert, A. J., Besinger, B. R., Graber, J. A., & Brizendine, E. J. (2007). A more explicit grading scale decreases grade inflation in a clinical clerkship. *Academic Emergency Medicine, 14*(3), 283-286. doi:10.1197/j.aem.2006.09.055

Weissbourd, R. (2014). Turing the tide: Inspiring concern for others and the common good through college admissions. Harvard Making Caring Common Project. Retrieved from http://mcc.gse.harvard.edu/files/gse-mcc/files/20160120_mcc_ttt_report_interactive.pdf

Wheatley, M. J. (2006). *Leadership and the new science: Discovering order in a chaotic world* (3rd ed.). San Francisco, CA: Berrett-Koehler.

Wilson, M. B., Sedlacek, W. E., & Lowery, B. L. (2014). An approach to using noncognitive variables in dental school admissions. *Journal of Dental Education*, *78*(4), 567-574. Retrieved from http://www.jdentaled.org/content/78/4/567.full.pdf+html

Wittenbel, L. D., Murphy, D. L., & Vines, D. L. (2009). Factors that predict performance in a respiratory care program. *Respiratory Care Educational Annual*, *18*, 1-10. Retrieved from http://www.aarc.org//app/uploads/2015/05

APPENDIX A

CANDIDATE FILE REVIEW SCORING CRITERIA

(INSTITUTION)

Department of Respiratory Care

Selection Criteria for Admission to the Respiratory Care Program

Revised: Fall 2015

A maximum of 26 students will be accepted for each fall semester. However, the respiratory care program reserves the right to vary this number.

Qualified applicants must have:

- Completed, be in the process of completing, or have only one class left to complete in the summer prior to beginning the program, the pre-professional curriculum with a GPA of 2.0 or higher
- Submitted a completed program application packet
- Adequate health status to ensure performance of hospital activities in accordance with ADA guidelines.

1. Cumulative GPA
   Points awarded equal to cumulative GPA, i.e., GPA of 4.0 receives 4 points)

2. Calculated GPA average for **all** of the following classes: anatomy, physiology, core math and chemistry.
   Points equal average GPA x 2

3. Math/Science courses beyond "required course level" **completed with a grade of "B" or better**. Examples include MATH *above* 143, 200 or greater CHEM or BIO, Microbiology, etc.
   One additional class = 1 point
   Two or more courses = 2 points

4. Health Care Experience: (examples can include but are not limited to: CNA, EMT, corpsman).
   One-point maximum.
   Experience in Health care = 1

5. Senior level credits completed in the BS Respiratory Care professional program curriculum with a B or better.

One-point maximum
3 credits = 1

6. Evidence of ability to carry a full semester load successfully (12 credits or more/semester. Success defined as grades of A and B). Within the last 4 semesters. Double check transfer students transcript.

Up to three points maximum
1 year with 12 or more credits; grades of A or B = 3 points
1 semester with 12 or more credits; grades of A or B = 2 points
Note: semesters do not have to be consecutive

7. Evidence of career investigation (examples can include but are not limited to health occupations class, introduction to allied health class, respiratory therapy tour or job shadow)

One point maximum.
Evidence = 1

8. Application essay

Up to three points maximum

9. Applicants who are second-semester Freshmen may receive up to 4 points.
   a. Rationale:

      Item 3: Second-semester Freshmen have not had the opportunity to take math/science courses beyond the “required course level”, and therefore, may receive up to 2 points.

      Item 5: Second-semester Freshmen have not had the opportunity to take Senior level BS Respiratory Care courses, and therefore, may receive up to 1 point.

      Item 6: Second semester Freshmen are not able to get full credit for carrying a Full Semester Load for two semesters, and therefore, they receive up to 1 point.

APPENDIX B

VARIABLES INCLUDED IN DATA ANALYSIS

Cognitive Variables	Scale Range	Weighted Value
Anatomy and Physiology I Course Grade	0.0-4.0 (13 intervals)	45%
DLM Course Grade (Foundational Math Course)	0.0-4.0 (13 intervals)	
Math/Science GPA	0.0-4.0 (13 intervals)	
Science Courses above and Beyond Foundational Requirements	0-2 points	
Cumulative GPA	0.0-4.0 (13 intervals)	
HLTHST 220	0.0-4.0 (13 intervals)	
RESPCARE 203	0.0-4.0 (13 intervals)	
RESPCARE 204	0.0-4.0 (13 intervals)	
RESPCARE 208	0.0-4.0 (13 intervals)	
Experiential Variables		
Health Care Experience	0-1 Point	
Senior Year Courses Taken Early	0-1 Point	
Evidence of Full Academic Load	0-3 Points	
Exploration into Field	0-1 Point	
Total Essay Points	0-9 Points	5%
Contextual Variables		50%
MMI Total Points	0-60 Points	
MMI Individual Station Score	0-20 Points	
MMI Ranking Total Points	1-35	
Cumulative Applicant Score	1-100 Points	100%

APPENDIX C

INSTITUTIONAL MMI INSTRUMENT

(INSTITUTION) MULTIPLE MINI-INTERVIEW SCENARIOS

ADAPTED FROM UNIVERSITY OF CALGARY MEDICAL SCHOOL

STATION 1: INTERVIEWER NAME

Target: Ethics/interpersonal skill

STUDENT NAME: -

____

INTERVIWER INITIALS: ____

POTENTIAL CONFLICT OF INTEREST: Yes No

If 'Yes', Please explain:

____

____

____

____

Every week your classmates gather at the local coffee house to review the lessons from that week. In the last month, everyone has been working on a major paper on Roman history, which accounts for 40 percent of the course grade. One of your classmates has copies of two of the papers that last years' students wrote for the same course. Your classmate has emailed copies of the papers to you and the other people in the group. What would you do in this situation and explain why?

Probing questions:

- Discuss what values and choices are relevant in this situation
- What are the implications if you decide to read the papers from last year?
- What are the implications if you decline the offer to read the papers from last year?
- What would you do if one of the classmates decided to draw upon the material from the two papers in developing their submission? Please explain why?
- Do you have any additional comments before we end this discussion?

PLEASE USE THE FOLLOWING SCALE TO EVALUATE CANDIDATE RESPONSE:

Factor	Rank 1-4
Ability to understand and address the objectives of the scenario	
Communication skills displayed	
Strength of arguments presented	
Suitability for a career in Respiratory Care	
Overall Performance	
TOTAL STATION SCORE	

1	2	3	4
Unsatisfactory	Satisfactory	Good	Excellent

<u>Factor considerations:</u>

Ability to understand and address objectives of the scenario:

- Does student ask multiple clarification questions?

- Does the student seem to understand the topic as it is presented?
- Does the student take a moment to consider the question?
- Does the student reply appropriately to the question?

Communication skills displayed:

- Does the student make eye contact while speaking?
- Does the student appear comfortable speaking with the interviewer?
- Does the student clearly articulate his or her arguments/opinions regarding the scenario?
- Does the student's response stay on 'track' to answer the question posed?
- Does the student speak professionally and politely?

Strength of arguments presented:

- Does the student logically explain their rationale for their answer?
- Does the student appear calm when prompted?
- Does the student appear upset when prompted?
- Is the student able to logically present thoughts related to the scenario?
- Can the student successfully demonstrate rhetoric?

Suitability for a career in Respiratory Care:

- Is this person personable?
- Would this student be able to communicate effectively with patients?
- Would you let this student work with a loved one?
- Would you like to work with this student?
- Will this student be a good representative for the field?

Overall Performance:

- Did this student appear engaged?

- Was this person appear confident/collected
- Would you feel comfortable having this student in clinical/class?
- Do you feel that this student will be a good clinician?

STATION 2: INTERVIEWER NAME

Target: Critical thinking/time management/interpersonal skill/empathy

STUDENT NAME: -

____

INTERVIWER INITIALS: ____

POTENTIAL CONFLICT OF INTEREST: Yes No

If 'Yes', Please explain:

____

____

____

____

In this scenario, you are a physician who provides full service family medicine.

It is late in the afternoon and you still have 4 patients left to be seen in the waiting room. You expect that you can comfortably see them and head home. You are not on call; your medical partners will look after any of your patients that require medical assistance.

You have promised your significant other that you will be home in time to attend a family event

Just before seeing one of these 4 patients, the local nursing home calls to tell you that Mrs. Andrews' health is deteriorating dramatically. You have looked after Mrs. Andrews and her family for several years. Mrs. Andrews and her family had previously agreed to a 'Do Not Resuscitate' (DNR) order so that when she got ill again, she would be allowed to die comfortably, but without intervention. The family is now questioning whether they made the correct decision and wants to discuss it with you as soon as possible.

How will you manage your time?

Probing questions:

- What will you take into consideration and why?
- A professional ethics organization states that clinicians should set up priorities and manage time to balance patient care, practice requirements, outside activities and personal life. Why do you think they recommend this?
- Why is time management critical for clinicians?
- What strategies do you think successful clinicians adopt to manage their time effectively?
- Do you have any additional comments before we end this discussion?

PLEASE USE THE FOLLOWING SCALE TO EVALUATE CANDIDATE RESPONSE:

Factor	Rank 1-4
Ability to understand and address the objectives of the scenario	
Communication skills displayed	
Strength of arguments presented	
Suitability for a career in Respiratory Care	

Overall Performance	
TOTAL STATION SCORE	

1	2	3	4
Unsatisfactory	Satisfactory	Good	Excellent

<u>Factor considerations:</u>

Ability to understand and address objectives of the scenario:

- Does student ask multiple clarification questions?
- Does the student seem to understand the topic as it is presented?
- Does the student take a moment to consider the question?
- Does the student reply appropriately to the question?

Communication skills displayed:

- Does the student make eye contact while speaking?
- Does the student appear comfortable speaking with the interviewer?
- Does the student clearly articulate his or her arguments/opinions regarding the scenario?
- Does the student's response stay on 'track' to answer the question posed?
- Does the student speak professionally and politely?

Strength of arguments presented:

- Does the student logically explain their rationale for their answer?
- Does the student appear calm when prompted?
- Does the student appear upset when prompted?
- Is the student able to logically present thoughts related to the scenario?

- Can the student successfully demonstrate rhetoric?

Suitability for a career in Respiratory Care:

- Is this person personable?
- Would this student be able to communicate effectively with patients?
- Would you let this student work with a loved one?
- Would you like to work with this student?
- Will this student be a good representative for the field?

Overall Performance:

- Did this student appear engaged?
- Was this person appear confident/collected
- Would you feel comfortable having this student in clinical/class?
- Do you feel that this student will be a good clinician?

STATION 3: INTERVIEWER NAME

Target: Self-evaluation/communication

STUDENT NAME: -

____

INTERVIWER INITIALS: __________________________________

POTENTIAL CONFLICT OF INTEREST: Yes No

If 'Yes', Please explain:

____

____

You are half way through your first year of the Respiratory Care Program. Your school has a peer professionalism assessment program that requires that six (6) of your classmates assess you each year. You also do a self-assessment.

The results of your performance evaluation done by yourself and your peers as well as the class mean are presented below.

Discuss your results with the interviewer:

Low Neutral High

12 3 4 5

Behavior	Score by Self	Score by Peers	Class average (N = 150)
Takes on extra work willingly to help out colleagues	5.0	4.4	4.8
Encourages communication and collaboration among colleagues	4.0	4.5	4.5
Manages conflict in a collegial and respectful manner	4.0	3.5	4.5
Displays empathy towards patients appropriately	4.0	3.8	4.8
Listens and responds to others receptively	5.0	4.8	4.2
Acknowledges limits of own knowledge or ability	4.0	4.4	4.6

Probing questions:

- Based on the results, what will you do differently?
- What other information might you seek to guide your academic development?
- How would you create an action plan so that next year's results will be different?
- How will you monitor your performance to ensure that you are making progress?
- Do you have any additional comments before we end this discussion?

PLEASE USE THE FOLLOWING SCALE TO EVALUATE CANDIDATE RESPONSE:

Factor	Rank 1-4
Ability to understand and address the objectives of the scenario	
Communication skills displayed	
Strength of arguments presented	
Suitability for a career in Respiratory Care	
Overall Performance	
TOTAL STATION SCORE	

1	2	3	4
Unsatisfactory	Satisfactory	Good	Excellent

<u>Factor considerations:</u>

Ability to understand and address objectives of the scenario:

- Does student ask multiple clarification questions?
- Does the student seem to understand the topic as it is presented?
- Does the student take a moment to consider the question?
- Does the student reply appropriately to the question?

Communication skills displayed:

- Does the student make eye contact while speaking?
- Does the student appear comfortable speaking with the interviewer?
- Does the student clearly articulate his or her arguments/opinions regarding the scenario?
- Does the student's response stay on 'track' to answer the question posed?
- Does the student speak professionally and politely?

Strength of arguments presented:

- Does the student logically explain their rationale for their answer?
- Does the student appear calm when prompted?
- Does the student appear upset when prompted?
- Is the student able to logically present thoughts related to the scenario?
- Can the student successfully demonstrate rhetoric?

Suitability for a career in Respiratory Care:

- Is this person personable?
- Would this student be able to communicate effectively with patients?
- Would you let this student work with a loved one?
- Would you like to work with this student?
- Will this student be a good representative for the field?

Overall Performance:

- Did this student appear engaged?
- Was this person appear confident/collected
- Would you feel comfortable having this student in clinical/class?
- Do you feel that this student will be a good clinician?

APPENDIX D

DEPARTMENTAL MMI TRAINING DOCUMENTATION

(INSTITUTION) MMI Interviewer Training Documents

Preface

This guideline is prepared for all interviewers/assessors taking part in the Multiple Mini Interview (MMI) for candidates applying for admission to the Boise State University Respiratory Care Program. This guideline is a culmination of several different methodologies (McMaster, 2002; Eva2004; Bingham and Scharf 2011; Knorr and Hissbach2014) that have been adapted to identify attributes of students considered fundamentally necessary for success in this program as defined by the faculty and staff of the Boise State University Department of Respiratory Care.

This guideline contains brief descriptions of:

- The rationale for integration of MMI into the selection process
- The teaching philosophy of the Department of Respiratory Care and the rationale for student selection
- The function of the interviewer/assessor throughout the MMI process

Rationale for Integration of MMI into Selection Process

Cognitive variables (GPA) take into account only one type of intellect (componential), however our profession relies heavily on acuity in other intellectual domains (contextual and experiential). Evaluating noncognitive variables provides a more holistic approach to student evaluation; several medical schools are implementing this approach to student selection in order to assess students in a more defensible way (Bingham & Ruth, 2011; Lemay et al., 2007). The empiric research done on the adaptation of the Multiple Mini Interview (MMI) process is the best corollary to provide rationale for implementation to other clinically-based health care programs (e.g., respiratory care).

Boise State University Department of Respiratory Care Philosophy

The Department of Respiratory Care provides respiratory care students with an education that emphasizes evidence-based care, promotes critical thinking and research, develops health advocacy and ethical behavior. We encourage interdisciplinary collaboration in the clinical setting. Faculty and students enhance the resources available to the community, region, state and nation by providing education, professional service expertise and research related to respiratory care.

The faculty and staff within the Department of Respiratory Care are dedicated to advancing the profession through student education and practice. Faculty and staff are dedicated to ensuring that students who apply to the Respiratory Care Program are selected through a selection methodology that best matches the department philosophy. As such, candidates applying for admission to the Respiratory Care Program will be assessed not only the demonstration of componential intellect, but also the demonstration of experiential and contextual intellect. This holistic approach to student evaluation includes an evaluation of cognitive factors, including but not limited to GPA and the demonstration of ability to carry a heavy academic course load. Students will also be required to demonstrate appropriate noncognitive skills such as empathy, interpersonal skill, communication and critical thinking ability. It is our philosophy that candidate ability for both academic and professional success is best represented through a selection process that highlights and fairly distributes weight to multiple aspects of intellect.

Candidate Application Process Guideline

MMI's are designed to assess noncognitive attributes of student personality. These attributes have been shown to be positive predictors to student and clinician success when used as an adjunct selection tool. In order to incorporate the MMI into the selection process into the Respiratory Care Program at Boise State, the following protocol will be implemented.

1. Candidates applying to the program will submit a traditional file. This file includes standard demographic information as well as answers to the most current version of application to the Respiratory Care Department.
2. Respiratory Care staff will pull student transcripts and add to the candidate file
3. Respiratory Care staff/faculty will input student information from student application and transcripts into existing formulated spreadsheet. The information contained in this spreadsheet is known as the 'file review' portion of the total student score and will be weighted at 45 percent of total applicant score. See Appendix A for file review scoring criteria.
    a. Additional information on this spreadsheet will include 3 columns for each student's individual score at each station and a total MMI score column. The total MMI score column will be weighted 50 percent of total student score
    b. Additional information includes 3 columns for student essay review and one column for total essay score. The total essay score column will be weighted 5 percent of total student score.
        i. Respiratory Care staff will code the essays so that the essay review (to be conducted after the MMI's) will be blinded to the selection committee.

4. Students will sign up for MMI times. MMI's are to be conducted on two separate days with varying times offered to accommodate student's availability. Interviewers and stations are to be identical though each interview day.
5. On interview days and at their designated times, students will meet with interviewers one-on-one in an office environment. MMI's will be 8 minutes long with the following time break down:
    a. 1-2 minute(s) to read scenario
    b. 4-5 minutes to present answer
    c. 2-3 minutes to transition stations (there is a little buffer time here)
        i. Interviewers are to score student immediately following the interview using the provided scale.
        ii. ALL students will be ranked on a scale from 1-35 at the end of day two; however, at the end of the first day, interviewers may 'pencil in' day 1 candidates. Notes and comments are encouraged for interviewers so that fine designations (e.g., candidate ranking 7^{th} versus 8^{th}) can be made.
            1. No two students can have the same FINAL rank. Again, notes and comments are encouraged. Interviewers will have time to finalize scores at the end of the interviewing process.
            2. Interviewers may use the attached Excel spreadsheet to rank candidates. Please let the department administration staff or the training coordinator know if you would like a paper copy of this ranking document.
6. The total MMI score for a student is the sum of each station's FINAL score

7. The total ‘file review’ score, the total MMI score, and the total essay score will be added to determine students final overall score
    a. The students with the top 26 final overall scores will be considered for admission to the Respiratory Care Program

The Role of Interviewers/Assessors throughout MMI Process

Interviewers/Assessors are identified as individuals who are faculty in the Department of Respiratory Care or have been personally selected by the faculty of the Department of Respiratory Care as having valuable input or vested interest into candidate selection (e.g., clinical site representative, adjunct faculty, faculty, or staff).

Interviewers/assessors will be provided their respective scenarios and made aware of the process in a timely manner in order for them to feel comfortable asking the initial question and scenario prompts. Interviewers are also to become comfortable with the scale and MMI process. Interviewers are asked to participate in a pilot scenario with fellow interviewers to establish a baseline comfort with the process as well as to evaluate inter-rater reliability among interviewers.

During the interviews, interviewers are not to engage in casual conversation with the candidates aside from greeting/welcoming the candidate to the scenario. The reason for this is so that interviewers focus on the candidate’s answers and not begin to establish a rapport with the candidate that may influence the scoring process. Interviewers are also to indicate on the scoring form if there is a conflict of interest with a participant and explain.

Students are to speak for their entire allotted time (5 minutes), and may not leave the room early. Interviewers have been provided question prompts if the interview should stall or if the candidate appears ‘stuck’. As such, please allow the candidate time to speak first and only use a prompt if it is required. All candidates are to be asked the final prompt of "Do you have any additional comments before we end this discussion?"

Interviewer Practice

Included in this interview training is a pilot scenario. Each interviewer is to conduct the pilot scoring scenario using the link provided. Please pay attention to the instructions provided when viewing the scenario. Please become familiar with the scoring mechanism and subscales prior to watching the video. The scores of this pilot scenario will be evaluated by the training coordinator to evaluate the degree of variability in scoring between raters as a measure of inter-rater reliability. If very little variability is present, no further action is needed. If there is a high degree of variability, interviewers will be contacted to discuss scoring issues.

PILOT TEST SCENARIO: Adapted from the University of Calgary MMI Mock Interview https://youtu.be/DOVbDD9lNjE

You live in an apartment complex with a state of the art facility available to the tenants. The door to the fitness facility is locked with a numerical keypad to prevent non-tenants from using the facility. Your best friend from childhood, a single mother, asks for your code so that she can get back into shape. What do you do?

INSTRUCTIONS FOR INTERVIEWERS:

Please review the scoring system provided BEFORE watching the video. Ensure that you are familiar with what aspects you are watching for in the interview scenario.

The first time you watch the video: Please assess the candidate's response to the prompt using the scale below. Please remember that you are to assign a score of 1-4 for EACH of the subscales provided. A score of 1 is unsatisfactory and a score of 4 is excellent. Once you have assigned a score for each subscale, you are to total the score. Please return your score to the training coordinator, so that he/she may evaluate inter-rater reliability between interviewers.

- The training coordinator will evaluate the given scores between the three interviewers for consistency. If the scores are consistent we will adjourn and prepare for student interviews. If there is a large degree of variability between scores, the committee will convene to discuss potential reasons for the variability.

<u>You are encouraged to then re-watch the video to familiarize yourself with the process. If this is your first interview process, please pay attention to the following</u>:

- How and when the interviewer interjected with prompts
- The lack of communication between interviewer/interviewee until prompts were given
- The total time for the scenario
- Notice the candidate did not receive feedback, this is difficult but is very important! The MMI is designed specifically not to provide feedback or form attachments to candidates.

PLEASE USE THE FOLLOWING SCALE TO EVALUATE CANDIDATE RESPONSE:

Factor	Rank 1-4
Ability to understand and address the objectives of the scenario	
Communication skills displayed	
Strength of arguments presented	
Suitability for a career in Respiratory Care	
Overall Performance	

TOTAL STATION SCORE

1	2	3	4
Unsatisfactory	Satisfactory	Good	Excellent

<u>Factor considerations:</u>

Ability to understand and address objectives of the scenario:

- Does student ask multiple clarification questions?
- Does the student seem to understand the topic as it is presented?
- Does the student take a moment to consider the question?
- Does the student reply appropriately to the question?

Communication skills displayed:

- Does the student make eye contact while speaking?
- Does the student appear comfortable speaking with the interviewer?
- Does the student clearly articulate his or her arguments/opinions regarding the scenario?
- Does the student's response stay on 'track' to answer the question posed?
- Does the student speak professionally and politely?

Strength of arguments presented:

- Does the student logically explain their rationale for their answer?
- Does the student appear calm when prompted?
- Does the student appear upset when prompted?
- Is the student able to logically present thoughts related to the scenario?
- Can the student successfully demonstrate rhetoric?

Suitability for a career in Respiratory Care:

- Is this person personable?
- Would this student be able to communicate effectively with patients?
- Would you let this student work with a loved one?
- Would you like to work with this student?
- Will this student be a good representative for the field?

Overall Performance:

- Did this student appear engaged?
- Was this person appear confident/collected
- Would you feel comfortable having this student in clinical/class?
- Do you feel that this student will be a good clinician?

APPENDIX E

2013 COHORT CORRELATIONAL ANALYSIS

Table E1

2013 Admission Variable Correlations Group 1

Variables	Analyses	recodedDLM	recoded227grade	recodedCUMGPA	recodedMATHSCIGPA	recodedextrascience	recodedHCExperience	recodedRCcoursesextra	recodedpreveducation	recodedload	recodedcareerexploration	recodedJAEssay
recodedDLM	Pearson Correlation	1	.274	.312	.554*	.029	-.287	-.121	.248	.356	-.028	.269
	Sig. (2-tailed)		.287	.207	.017	.908	.249	.632	.321	.147	.911	.281
	N	18	17	18	18	18	18	18	18	18	18	18
recoded227grade	Pearson Correlation	.274	1	.277	.882**	-.307	-.308	.025	-.092	.434	-.094	-.231
	Sig. (2-tailed)	.287		.238	.000	.188	.187	.916	.699	.056	.694	.327
	N	17	20	20	20	20	20	20	20	20	20	20
recodedCUMGPA	Pearson Correlation	.312	.277	1	.287	.235	.037	.238	.049	.259	.073	.127
	Sig. (2-tailed)	.207	.238		.207	.305	.874	.299	.833	.258	.754	.585
	N	18	20	21	21	21	21	21	21	21	21	21
recodedMATHSCIGPA	Pearson Correlation	.554*	.882**	.287	1	-.101	-.331	-.081	-.070	.523*	-.064	-.204
	Sig. (2-tailed)	.017	.000	.207		.662	.143	.727	.763	.015	.783	.376
	N	18	20	21	21	21	21	21	21	21	21	21

Table E1 (continued)

Variables	Analyses	recoded DLM	recoded227grade	recodedCUMGPA	recodedMATHSCIGPA	recodedextrascience	recodedHCExperience	recodedRCcoursesextra	recodedpreveducation	recodedload	recodedcareerexploration	recodedJAEssay
recodedextrascience	Pearson Correlation	.029	-.307	.235	-.101	1	-.159	.056	.200	.153	.321	.205
	Sig. (2-tailed)	.908	.188	.305	.662		.491	.809	.386	.508	.156	.373
	N	18	20	21	21	21	21	21	21	21	21	21
recodedHCExperience	Pearson Correlation	-.287	-.308	.037	-.331	-.159	1	-.292	-.249	.047	.175	.076
	Sig. (2-tailed)	.249	.187	.874	.143	.491		.200	.276	.838	.448	.742
	N	18	20	21	21	21	21	21	21	21	21	21
recodedRCcoursesextra	Pearson Correlation	-.121	.025	.238	-.081	.056	-.292	1	.261	-.034	.017	-.105
	Sig. (2-tailed)	.632	.916	.299	.727	.809	.200		.254	.884	.941	.651
	N	18	20	21	21	21	21	21	21	21	21	21
recodedpreveducation	Pearson Correlation	.248	-.092	.049	-.070	.200	-.249	.261	1	.076	-.073	.032
	Sig. (2-tailed)	.321	.699	.833	.763	.386	.276	.254		.743	.755	.892
	N	18	20	21	21	21	21	21	21	21	21	21
recodedload	Pearson Correlation	.356	.434	.259	.523*	.153	.047	-.034	.076	1	-.228	-.054
	Sig. (2-tailed)	.147	.056	.258	.015	.508	.838	.884	.743		.321	.816
	N	18	20	21	21	21	21	21	21	21	21	21

Table E1 (continued)

Variables	Analyses	recoded DLM	recoded227grade	recodedCUMGPA	recodedMATHSCIGPA	recodedextrascience	recodedHCExperience	recodedRCcoursesextra	recodedpreveducation	recodedload	recodedcareerexploration	recodedJAEssay
recodedcareerexploration	Pearson Correlation	-.028	-.094	.073	-.064	.321	.175	.017	-.073	-.228	1	.505*
	Sig. (2-tailed)	.911	.694	.754	.783	.156	.448	.941	.755	.321		.020
	N	18	20	21	21	21	21	21	21	21	21	21
recodedJA Essay	Pearson Correlation	.269	-.231	.127	-.204	.205	.076	-.105	.032	-.054	.505*	1
	Sig. (2-tailed)	.281	.327	.585	.376	.373	.742	.651	.892	.816	.020	
	N	18	20	21	21	21	21	21	21	21	21	21
recodedLA Essay	Pearson Correlation	-.038	-.525*	.151	-.562**	.226	.210	.138	.112	-.277	.355	.827**
	Sig. (2-tailed)	.880	.017	.515	.008	.325	.361	.550	.628	.224	.115	.000
	N	18	20	21	21	21	21	21	21	21	21	21
recodedMS Essay	Pearson Correlation	.074	-.381	.078	-.368	.316	.065	.018	-.195	-.290	.481*	.849**
	Sig. (2-tailed)	.770	.098	.737	.101	.163	.780	.937	.397	.203	.027	.000
	N	18	20	21	21	21	21	21	21	21	21	21
recodedessayavg	Pearson Correlation	.111	-.394	.120	-.394	.260	.123	.012	-.015	-.217	.484*	.952**
	Sig. (2-tailed)	.660	.086	.603	.077	.254	.597	.957	.949	.345	.026	.000
	N	18	20	21	21	21	21	21	21	21	21	21

Table E1 (continued)

Variables	Analyses	recoded DLM	recoded2 27grade	recodedC UMGPA	recodedMAT HSCIGPA	recodedextr ascience	recodedHCE xperience	recodedRCco ursesextra	recodedprev education	recode dload	recodedcareer exploration	recodedJ AEssay
recodedove ralltotalpts	Pearson Correlation	.448	.382	.454*	.486*	.433	-.053	.314	.280	.688**	.306	.340
	Sig. (2-tailed)	.062	.097	.039	.026	.050	.820	.165	.219	.001	.177	.132
	N	18	20	21	21	21	21	21	21	21	21	21
recodedFall 2013CUM GPA	Pearson Correlation	.357	.796**	.098	.635**	-.306	-.318	.197	-.205	.330	.078	.046
	Sig. (2-tailed)	.146	.000	.671	.002	.178	.160	.393	.373	.144	.736	.843
	N	18	20	21	21	21	21	21	21	21	21	21
recodedFall 2013Term GPA	Pearson Correlation	.127	.483*	-.121	.368	.060	-.373	-.222	-.252	.193	.186	.132
	Sig. (2-tailed)	.615	.031	.602	.100	.796	.096	.333	.270	.403	.420	.569
	N	18	20	21	21	21	21	21	21	21	21	21
recodedHL TST220Gra de	Pearson Correlation	.312	.359	.162	.330	.018	-.171	-.262	-.050	.153	.168	.332
	Sig. (2-tailed)	.207	.120	.484	.144	.938	.459	.250	.830	.508	.468	.142
	N	18	20	21	21	21	21	21	21	21	21	21
recodedRE SPCARE20 3Grade	Pearson Correlation	.302	.624**	-.228	.527*	-.128	-.543*	-.079	.025	.238	-.089	-.118
	Sig. (2-tailed)	.223	.003	.320	.014	.579	.011	.732	.916	.299	.700	.610
	N	18	20	21	21	21	21	21	21	21	21	21

Table E1 (continued)

Variables	Analyses	recoded DLM	recoded2 27grade	recodedC UMGPA	recodedMAT HSCIGPA	recodedextr ascience	recodedHCE xperience	recodedRCco ursesextra	recodedprev education	recode dload	recodedcareer exploration	recodedJ AEssay
recodedRE SPCARE20 4Grade	Pearson Correlation	.338	.575**	.008	.530*	.256	-.552**	.077	.140	.267	.107	-.104
	Sig. (2-tailed)	.170	.008	.972	.013	.262	.009	.740	.544	.243	.643	.652
	N	18	20	21	21	21	21	21	21	21	21	21
recodedRE SPCARE20 8Grade	Pearson Correlation	.091	.351	-.267	.249	-.076	-.263	-.009	-.081	.230	-.032	-.051
	Sig. (2-tailed)	.721	.129	.242	.276	.743	.249	.971	.729	.316	.890	.827
	N	18	20	21	21	21	21	21	21	21	21	21
Spring14R ESPCARE 223Grade	Pearson Correlation	.632**	.602**	-.010	.695**	.111	-.414	-.169	.026	.544*	-.142	-.008
	Sig. (2-tailed)	.005	.005	.966	.000	.631	.062	.464	.912	.011	.539	.971
	N	18	20	21	21	21	21	21	21	21	21	21
Spring14R ESPCARE 224gGrade	Pearson Correlation	.496*	.692**	-.094	.675**	.038	-.412	-.165	-.043	.448*	-.011	-.031
	Sig. (2-tailed)	.036	.001	.685	.001	.871	.064	.474	.853	.041	.961	.895
	N	18	20	21	21	21	21	21	21	21	21	21
Spring14R ESPCARE 208Grade	Pearson Correlation	.218	.335	.143	.388	.230	-.151	.012	-.194	.309	.219	.059
	Sig. (2-tailed)	.385	.149	.537	.083	.315	.514	.958	.400	.173	.340	.800
	N	18	20	21	21	21	21	21	21	21	21	21

Table E2

2013 Admission Variable Correlations Group 2

Variables	Analyses	recodedLAEssay	recodedMSEssay	recodedessayavg	recodedoveralltotalpts	recodedFall2013CUMGPA	recodedFall2013TermGPA	recodedHLTST220Grade	recodedRESPCARE203Grade	recodedRESPCARE204Grade	recodedRESPCARE208Grade	Spring14RESPCARE223Grade
recodedDLM	Pearson Correlation	-.038	.074	.111	.448	.357	.127	.312	.302	.338	.091	.632**
	Sig. (2-tailed)	.880	.770	.660	.062	.146	.615	.207	.223	.170	.721	.005
	N	18	18	18	18	18	18	18	18	18	18	18
recoded227grade	Pearson Correlation	-.525*	-.381	-.394	.382	.796**	.483*	.359	.624**	.575**	.351	.602**
	Sig. (2-tailed)	.017	.098	.086	.097	.000	.031	.120	.003	.008	.129	.005
	N	20	20	20	20	20	20	20	20	20	20	20
recodedCUMGPA	Pearson Correlation	.151	.078	.120	.454*	.098	-.121	.162	-.228	.008	-.267	-.010
	Sig. (2-tailed)	.515	.737	.603	.039	.671	.602	.484	.320	.972	.242	.966
	N	21	21	21	21	21	21	21	21	21	21	21
recodedMATHSCIGPA	Pearson Correlation	-.562**	-.368	-.394	.486*	.635**	.368	.330	.527*	.530*	.249	.695**
	Sig. (2-tailed)	.008	.101	.077	.026	.002	.100	.144	.014	.013	.276	.000
	N	21	21	21	21	21	21	21	21	21	21	21
recodedextrascience	Pearson Correlation	.226	.316	.260	.433	-.306	.060	.018	-.128	.256	-.076	.111
	Sig. (2-tailed)	.325	.163	.254	.050	.178	.796	.938	.579	.262	.743	.631
	N	21	21	21	21	21	21	21	21	21	21	21

Table E2 (continued)

Variables	Analyses	recodedLA Essay	recodedMS Essay	recodedessayavg	recodedoveralltotalpts	recodedFall2013CUM GPA	recodedFall2013Term GPA	recodedHLTST220Grade	recodedRESPCARE203Grade	recodedRESPCARE204Grade	recodedRESPCARE208Grade	Spring14RESPCARE223Grade
recodedHCExperience	Pearson Correlation	.210	.065	.123	-.053	-.318	-.373	-.171	-.543*	-.552**	-.263	-.414
	Sig. (2-tailed)	.361	.780	.597	.820	.160	.096	.459	.011	.009	.249	.062
	N	21	21	21	21	21	21	21	21	21	21	21
recodedRCcoursesextra	Pearson Correlation	.138	.018	.012	.314	.197	-.222	-.262	-.079	.077	-.009	-.169
	Sig. (2-tailed)	.550	.937	.957	.165	.393	.333	.250	.732	.740	.971	.464
	N	21	21	21	21	21	21	21	21	21	21	21
recodedpreveducation	Pearson Correlation	.112	-.195	-.015	.280	-.205	-.252	-.050	.025	.140	-.081	.026
	Sig. (2-tailed)	.628	.397	.949	.219	.373	.270	.830	.916	.544	.729	.912
	N	21	21	21	21	21	21	21	21	21	21	21
recodedload	Pearson Correlation	-.277	-.290	-.217	.688**	.330	.193	.153	.238	.267	.230	.544*
	Sig. (2-tailed)	.224	.203	.345	.001	.144	.403	.508	.299	.243	.316	.011
	N	21	21	21	21	21	21	21	21	21	21	21
recodedcareerexploration	Pearson Correlation	.355	.481*	.484*	.306	.078	.186	.168	-.089	.107	-.032	-.142
	Sig. (2-tailed)	.115	.027	.026	.177	.736	.420	.468	.700	.643	.890	.539
	N	21	21	21	21	21	21	21	21	21	21	21

Table E2 (continued)

Variables	Analyses	recodedLAEssay	recodedMSEssay	recodedessayavg	recodedoveralltotalpts	recodedFall2013CUMGPA	recodedFall2013TermGPA	recodedHLTST220Grade	recodedRESPCARE203Grade	recodedRESPCARE204Grade	recodedRESPCARE208Grade	Spring14RESPCARE223Grade
recodedJAEssay	Pearson Correlation	.827**	.849**	.952**	.340	.046	.132	.332	-.118	-.104	-.051	-.008
	Sig. (2-tailed)	.000	.000	.000	.132	.843	.569	.142	.610	.652	.827	.971
	N	21	21	21	21	21	21	21	21	21	21	21
recodedLAEssay	Pearson Correlation	1	.818**	.933**	.138	-.281	-.211	.016	-.478*	-.331	-.216	-.375
	Sig. (2-tailed)		.000	.000	.550	.218	.359	.945	.028	.142	.347	.094
	N	21	21	21	21	21	21	21	21	21	21	21
recodedMSEssay	Pearson Correlation	.818**	1	.941**	.166	-.001	.155	.162	-.196	-.062	-.041	-.159
	Sig. (2-tailed)	.000		.000	.473	.997	.503	.484	.395	.789	.859	.490
	N	21	21	21	21	21	21	21	21	21	21	21
recodedessayavg	Pearson Correlation	.933**	.941**	1	.232	-.076	.034	.187	-.271	-.173	-.107	-.186
	Sig. (2-tailed)	.000	.000		.312	.742	.883	.417	.234	.454	.644	.419
	N	21	21	21	21	21	21	21	21	21	21	21
recodedoveralltotalpts	Pearson Correlation	.138	.166	.232	1	.410	.158	.216	.153	.392	.139	.443*
	Sig. (2-tailed)	.550	.473	.312		.065	.494	.347	.509	.079	.547	.044
	N	21	21	21	21	21	21	21	21	21	21	21

Table E2 (continued)

Variables	Analyses	recodedLAEssay	recodedMSEssay	recodedessayavg	recodedoveralltotalpts	recodedFall2013CUMGPA	recodedFall2013TermGPA	recodedHLTST220Grade	recodedRESPCARE203Grade	recodedRESPCARE204Grade	recodedRESPCARE208Grade	Spring14RESPCARE223Grade
recodedFall2013CUMGPA	Pearson Correlation	-.281	-.001	-.076	.410	1	.643**	.379	.737**	.604**	.558**	.559**
	Sig. (2-tailed)	.218	.997	.742	.065		.002	.090	.000	.004	.009	.008
	N	21	21	21	21	21	21	21	21	21	21	21
recodedFall2013TermGPA	Pearson Correlation	-.211	.155	.034	.158	.643**	1	.517*	.784**	.772**	.717**	.632**
	Sig. (2-tailed)	.359	.503	.883	.494	.002		.017	.000	.000	.000	.002
	N	21	21	21	21	21	21	21	21	21	21	21
recodedHLTST220Grade	Pearson Correlation	.016	.162	.187	.216	.379	.517*	1	.370	.331	.253	.359
	Sig. (2-tailed)	.945	.484	.417	.347	.090	.017		.099	.143	.268	.110
	N	21	21	21	21	21	21	21	21	21	21	21
recodedRESPCARE203Grade	Pearson Correlation	-.478*	-.196	-.271	.153	.737**	.784**	.370	1	.802**	.627**	.797**
	Sig. (2-tailed)	.028	.395	.234	.509	.000	.000	.099		.000	.002	.000
	N	21	21	21	21	21	21	21	21	21	21	21
recodedRESPCARE204Grade	Pearson Correlation	-.331	-.062	-.173	.392	.604**	.772**	.331	.802**	1	.657**	.752**
	Sig. (2-tailed)	.142	.789	.454	.079	.004	.000	.143	.000		.001	.000
	N	21	21	21	21	21	21	21	21	21	21	21

Table E2 (continued)

Variables	Analyses	recodedLAEssay	recodedMSEssay	recodedessayavg	recodedoveralltotalpts	recodedFall2013CUMGPA	recodedFall2013TermGPA	recodedHLTST220Grade	recodedRESPCARE203Grade	recodedRESPCARE204Grade	recodedRESPCARE208Grade	Spring14RESPCARE223Grade
recodedRESPCARE208Grade	Pearson Correlation	-.216	-.041	-.107	.139	.558**	.717**	.253	.627**	.657**	1	.521*
	Sig. (2-tailed)	.347	.859	.644	.547	.009	.000	.268	.002	.001		.016
	N	21	21	21	21	21	21	21	21	21	21	21
Spring14RESPCARE223Grade	Pearson Correlation	-.375	-.159	-.186	.443*	.559**	.632**	.359	.797**	.752**	.521*	1
	Sig. (2-tailed)	.094	.490	.419	.044	.008	.002	.110	.000	.000	.016	
	N	21	21	21	21	21	21	21	21	21	21	21
Spring14RESPCARE224gGrade	Pearson Correlation	-.409	-.123	-.192	.388	.701**	.737**	.286	.883**	.845**	.644**	.925**
	Sig. (2-tailed)	.066	.596	.405	.082	.000	.000	.209	.000	.000	.002	.000
	N	21	21	21	21	21	21	21	21	21	21	21
Spring14RESPCARE208Grade	Pearson Correlation	-.118	.133	.028	.389	.373	.639**	.100	.394	.617**	.474*	.572**
	Sig. (2-tailed)	.610	.566	.904	.081	.096	.002	.667	.077	.003	.030	.007
	N	21	21	21	21	21	21	21	21	21	21	21

Table E3

2013 Admission Variable Correlations Group 3

Variables	Analyses	Spring14RESPCARE 224gGrade	Spring14RESPCAR E208Grade
recodedDLM	Pearson Correlation	.496*	.218
	Sig. (2-tailed)	.036	.385
	N	18	18
recoded227grade	Pearson Correlation	.692**	.335
	Sig. (2-tailed)	.001	.149
	N	20	20
recodedCUMGPA	Pearson Correlation	-.094	.143
	Sig. (2-tailed)	.685	.537
	N	21	21
recodedMATHSCIGPA	Pearson Correlation	.675**	.388
	Sig. (2-tailed)	.001	.083
	N	21	21
recodedextrascience	Pearson Correlation	.038	.230
	Sig. (2-tailed)	.871	.315
	N	21	21
recodedHCExperience	Pearson Correlation	-.412	-.151
	Sig. (2-tailed)	.064	.514
	N	21	21
recodedRCcoursesextra	Pearson Correlation	-.165	.012
	Sig. (2-tailed)	.474	.958
	N	21	21
recodedpreveducation	Pearson Correlation	-.043	-.194
	Sig. (2-tailed)	.853	.400
	N	21	21

Table E3 (continued)

Variables	Analyses	Spring14RESPCARE 224gGrade	Spring14RESPCAR E208Grade
recodedload	Pearson Correlation	.448*	.309
	Sig. (2-tailed)	.041	.173
	N	21	21
recodedcareerexploration	Pearson Correlation	-.011	.219
	Sig. (2-tailed)	.961	.340
	N	21	21
recodedJAEssay	Pearson Correlation	-.031	.059
	Sig. (2-tailed)	.895	.800
	N	21	21
recodedLAEssay	Pearson Correlation	-.409	-.118
	Sig. (2-tailed)	.066	.610
	N	21	21
recodedMSEssay	Pearson Correlation	-.123	.133
	Sig. (2-tailed)	.596	.566
	N	21	21
recodedessayavg	Pearson Correlation	-.192	.028
	Sig. (2-tailed)	.405	.904
	N	21	21
recodedoveralltotalpts	Pearson Correlation	.388	.389
	Sig. (2-tailed)	.082	.081
	N	21	21
recodedFall2013CUMGPA	Pearson Correlation	.701**	.373
	Sig. (2-tailed)	.000	.096
	N	21	21

Table E3 (continued)

Variables	Analyses	Spring14RESPCARE 224gGrade	Spring14RESPCAR E208Grade
recodedFall2013TermGPA	Pearson Correlation	.737**	.639**
	Sig. (2-tailed)	.000	.002
	N	21	21
recodedHLTST220Grade	Pearson Correlation	.286	.100
	Sig. (2-tailed)	.209	.667
	N	21	21
recodedRESPCARE203 Grade	Pearson Correlation	.883**	.394
	Sig. (2-tailed)	.000	.077
	N	21	21
recodedRESPCARE204 Grade	Pearson Correlation	.845**	.617**
	Sig. (2-tailed)	.000	.003
	N	21	21
recodedRESPCARE208 Grade	Pearson Correlation	.644**	.474*
	Sig. (2-tailed)	.002	.030
	N	21	21
Spring14RESPCARE223Grade	Pearson Correlation	.925**	.572**
	Sig. (2-tailed)	.000	.007
	N	21	21
Spring14RESPCARE224gGrad e	Pearson Correlation	1	.550**
	Sig. (2-tailed)		.010
	N	21	21
Spring14RESPCARE208Grade	Pearson Correlation	.550**	1
	Sig. (2-tailed)	.010	
	N	21	21

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

APPENDIX F

2014 COHORT CORRELATIONAL ANALYSIS

Table F1

2014 Admission Variable Correlations Group 1

Variables	Analyses	RecodedBIO227grade	recodedDLMGrade	RecodedCumGPA	RecodedScienceGradePointAverage	Extra Science ≤ 2 pts	HC exp ≤ 2 pts	RC courses ≤ 2 pts	Prev Ed 1-3 pts	Load ≤ 3 pts	Explor ≤ 2 pts	Essay LH ≤ 6 pts
RecodedBIO227grade	Pearson Correlation	1	.180	.250	.850**	.289	.068	-.106	.117	.091	-.075	-.376
	Sig. (2-tailed)		.461	.262	.000	.192	.763	.640	.603	.689	.741	.084
	N	22	19	22	22	22	22	22	22	22	22	22
recodedDLMGrade	Pearson Correlation	.180	1	.481*	.416	.218	.130	-.402	-.419	-.027	.104	-.092
	Sig. (2-tailed)	.461		.037	.076	.370	.595	.088	.074	.913	.671	.707
	N	19	19	19	19	19	19	19	19	19	19	19
RecodedCumGPA	Pearson Correlation	.250	.481*	1	.274	.168	-.039	-.203	-.241	.344	.033	.097
	Sig. (2-tailed)	.262	.037		.205	.445	.859	.353	.267	.108	.881	.661
	N	22	19	23	23	23	23	23	23	23	23	23
RecodedScienceGradePointAverage	Pearson Correlation	.850**	.416	.274	1	.331	-.004	-.247	-.007	.105	.067	-.305
	Sig. (2-tailed)	.000	.076	.205		.122	.985	.256	.974	.635	.762	.157
	N	22	19	23	23	23	23	23	23	23	23	23

Table F1 (continued)

Variables	Analyses	RecodedBIO227grade	recodedDLMGrade	RecodedCumGPA	RecodedScienceGradePointAverage	Extra Science ≤ 2 pts	HC exp ≤ 2 pts	RC courses ≤ 2 pts	Prev Ed 1-3 pts	Load ≤ 3 pts	Explor ≤ 2 pts	Essay LH ≤ 6 pts
Extra Science ≤ 2 pts	Pearson Correlation	.289	.218	.168	.331	1	.183	-.327	.117	.122	-.016	-.413
	Sig. (2-tailed)	.192	.370	.445	.122		.405	.127	.595	.580	.943	.050
	N	22	19	23	23	23	23	23	23	23	23	23
HC exp ≤ 2 pts	Pearson Correlation	.068	.130	-.039	-.004	.183	1	-.100	.025	-.055	.252	-.447*
	Sig. (2-tailed)	.763	.595	.859	.985	.405		.651	.910	.803	.247	.033
	N	22	19	23	23	23	23	23	23	23	23	23
RC courses ≤ 2 pts	Pearson Correlation	-.106	-.402	-.203	-.247	-.327	-.100	1	-.303	-.076	-.237	.292
	Sig. (2-tailed)	.640	.088	.353	.256	.127	.651		.159	.731	.277	.176
	N	22	19	23	23	23	23	23	23	23	23	23
Prev Ed 1-3 pts	Pearson Correlation	.117	-.419	-.241	-.007	.117	.025	-.303	1	.089	-.070	-.217
	Sig. (2-tailed)	.603	.074	.267	.974	.595	.910	.159		.685	.752	.320
	N	22	19	23	23	23	23	23	23	23	23	23
Load ≤ 3 pts	Pearson Correlation	.091	-.027	.344	.105	.122	-.055	-.076	.089	1	-.131	-.009
	Sig. (2-tailed)	.689	.913	.108	.635	.580	.803	.731	.685		.552	.968
	N	22	19	23	23	23	23	23	23	23	23	23

Table F1 (continued)

Variables	Analyses	RecodedBIO227grade	recodedDLMGrade	RecodedCumGPA	RecodedScienceGradePointAverage	Extra Science ≤ 2 pts	HC exp ≤ 2 pts	RC courses ≤ 2 pts	Prev Ed 1-3 pts	Load ≤ 3 pts	Explor ≤ 2 pts	Essay LH ≤ 6 pts
Explor ≤ 2 pts	Pearson Correlation	-.075	.104	.033	.067	-.016	.252	-.237	-.070	-.131	1	.166
	Sig. (2-tailed)	.741	.671	.881	.762	.943	.247	.277	.752	.552		.449
	N	22	19	23	23	23	23	23	23	23	23	23
Essay LH ≤ 6 pts	Pearson Correlation	-.376	-.092	.097	-.305	-.413	-.447*	.292	-.217	-.009	.166	1
	Sig. (2-tailed)	.084	.707	.661	.157	.050	.033	.176	.320	.968	.449	
	N	22	19	23	23	23	23	23	23	23	23	23
Essay LA ≤ 6 pts	Pearson Correlation	-.239	-.125	-.051	-.176	-.170	-.482*	.047	-.179	-.255	.428*	.702**
	Sig. (2-tailed)	.284	.611	.816	.423	.437	.020	.833	.415	.240	.041	.000
	N	22	19	23	23	23	23	23	23	23	23	23
Essay MS ≤ 6 pts	Pearson Correlation	-.109	.171	.453*	-.234	-.243	-.085	-.050	-.048	.342	.009	.486*
	Sig. (2-tailed)	.629	.484	.030	.283	.264	.699	.821	.829	.111	.966	.019
	N	22	19	23	23	23	23	23	23	23	23	23
Recodedessayaverage	Pearson Correlation	-.286	.004	.240	-.293	-.339	-.399	.098	-.176	.062	.245	.893**
	Sig. (2-tailed)	.197	.988	.269	.174	.114	.060	.656	.422	.779	.259	.000
	N	22	19	23	23	23	23	23	23	23	23	23

Table F1 (continued)

Variables	Analyses	RecodedBIO227grade	recodedDLMGrade	RecodedCumGPA	RecodedScienceGradePointAverage	Extra Science ≤ 2 pts	HC exp ≤ 2 pts	RC courses ≤ 2 pts	Prev Ed 1-3 pts	Load ≤ 3 pts	Explor ≤ 2 pts	Essay LH ≤ 6 pts
RecodedTotalPoints	Pearson Correlation	.390	.029	.356	.385	.401	.185	-.051	.348	.566**	.291	.052
	Sig. (2-tailed)	.073	.906	.095	.069	.058	.398	.817	.104	.005	.178	.812
	N	22	19	23	23	23	23	23	23	23	23	23
FALL 2014 Cum GPA	Pearson Correlation	.382	.321	.817**	.417*	.130	-.091	-.468*	.204	.385	-.024	-.022
	Sig. (2-tailed)	.079	.180	.000	.048	.554	.678	.024	.351	.069	.915	.921
	N	22	19	23	23	23	23	23	23	23	23	23
Fall 2014 Term GPA	Pearson Correlation	.261	.106	.447*	.213	.088	.044	-.456*	.112	.506*	.138	.110
	Sig. (2-tailed)	.241	.666	.033	.328	.689	.840	.029	.611	.014	.531	.616
	N	22	19	23	23	23	23	23	23	23	23	23
RecodedRESPCARE204grade	Pearson Correlation	.263	.003	.331	.197	.066	.200	-.443*	.270	.609**	.034	-.127
	Sig. (2-tailed)	.238	.990	.123	.369	.766	.359	.034	.213	.002	.879	.562
	N	22	19	23	23	23	23	23	23	23	23	23
RecodedRESPCARE208grade	Pearson Correlation	.084	-.200	.258	-.027	.070	.142	-.148	.180	.713**	-.100	.066
	Sig. (2-tailed)	.711	.412	.235	.902	.751	.518	.502	.410	.000	.651	.766
	N	22	19	23	23	23	23	23	23	23	23	23

Table F1 (continued)

Variables	Analyses	RecodedBIO227grade	recodedDLMGrade	RecodedCumGPA	RecodedScienceGradePointAverage	Extra Science ≤ 2 pts	HC exp ≤ 2 pts	RC courses ≤ 2 pts	Prev Ed 1-3 pts	Load ≤ 3 pts	Explor ≤ 2 pts	Essay LH ≤ 6 pts
Spring15RESPCARE223Grade	Pearson Correlation	.443*	.182	.479*	.403	.394	.098	-.151	.105	.326	.145	.011
	Sig. (2-tailed)	.044	.470	.024	.063	.070	.665	.502	.642	.139	.520	.962
	N	21	18	22	22	22	22	22	22	22	22	22
Spring15RESPCARE224Grade	Pearson Correlation	.455*	.196	.541**	.346	.463*	.193	-.136	.078	.321	.081	-.106
	Sig. (2-tailed)	.038	.435	.009	.114	.030	.390	.547	.731	.146	.722	.639
	N	21	18	22	22	22	22	22	22	22	22	22
Spring15RESPCARE228Grade	Pearson Correlation	.187	-.074	.222	.143	.425*	-.007	.134	.069	.403	-.091	-.031
	Sig. (2-tailed)	.417	.771	.322	.527	.049	.977	.551	.759	.063	.687	.889
	N	21	18	22	22	22	22	22	22	22	22	22

Table F2

2014 Admission Variable Correlations Group 2

Variables	Analyses	Essay LA ≤ 6 pts	Essay MS ≤ 6 pts	Recodedes sayaverage	RecodedT otalPoints	FALL 2014 Cum GPA	Fall 2014 Term GPA	HLTHST 220	RecodedR ESPCARE 203grade	RecodedR ESPCARE 204grade	RecodedR ESPCARE 208grade	Spring15R ESPCARE 223Grade
RecodedBIO227grade	Pearson Correlation	-.239	-.109	-.286	.390	.382	.261	.586**	.365	.263	.084	.443*
	Sig. (2-tailed)	.284	.629	.197	.073	.079	.241	.004	.095	.238	.711	.044
	N	22	22	22	22	22	22	22	22	22	22	21
recodedDLMGrade	Pearson Correlation	-.125	.171	.004	.029	.321	.106	.128	-.023	.003	-.200	.182
	Sig. (2-tailed)	.611	.484	.988	.906	.180	.666	.602	.925	.990	.412	.470
	N	19	19	19	19	19	19	19	19	19	19	18
RecodedCumGPA	Pearson Correlation	-.051	.453*	.240	.356	.817**	.447*	.343	.453*	.331	.258	.479*
	Sig. (2-tailed)	.816	.030	.269	.095	.000	.033	.109	.030	.123	.235	.024
	N	23	23	23	23	23	23	23	23	23	23	22
RecodedScienceGradePointAverage	Pearson Correlation	-.176	-.234	-.293	.385	.417*	.213	.564**	.328	.197	-.027	.403
	Sig. (2-tailed)	.423	.283	.174	.069	.048	.328	.005	.127	.369	.902	.063
	N	23	23	23	23	23	23	23	23	23	23	22
Extra Science ≤ 2 pts	Pearson Correlation	-.170	-.243	-.339	.401	.130	.088	.417*	.102	.066	.070	.394
	Sig. (2-tailed)	.437	.264	.114	.058	.554	.689	.047	.643	.766	.751	.070
	N	23	23	23	23	23	23	23	23	23	23	22

Table F2 (continued)

Variables	Analyses	Essay LA ≤ 6 pts	Essay MS ≤ 6 pts	Recodedes sayaverage	RecodedT otalPoints	FALL 2014 Cum GPA	Fall 2014 Term GPA	HLTHST 220	RecodedR ESPCARE 203grade	RecodedR ESPCARE 204grade	RecodedR ESPCARE 208grade	Spring15R ESPCARE 223Grade
HC exp ≤ 2 pts	Pearson Correlation	-.482*	-.085	-.399	.185	-.091	.044	.001	.069	.200	.142	.098
	Sig. (2-tailed)	.020	.699	.060	.398	.678	.840	.997	.753	.359	.518	.665
	N	23	23	23	23	23	23	23	23	23	23	22
RC courses ≤ 2 pts	Pearson Correlation	.047	-.050	.098	-.051	-.468*	-.456*	-.145	-.503*	-.443*	-.148	-.151
	Sig. (2-tailed)	.833	.821	.656	.817	.024	.029	.510	.014	.034	.502	.502
	N	23	23	23	23	23	23	23	23	23	23	22
Prev Ed 1-3 pts	Pearson Correlation	-.179	-.048	-.176	.348	.204	.112	.353	.009	.270	.180	.105
	Sig. (2-tailed)	.415	.829	.422	.104	.351	.611	.099	.966	.213	.410	.642
	N	23	23	23	23	23	23	23	23	23	23	22
Load ≤ 3 pts	Pearson Correlation	-.255	.342	.062	.566**	.385	.506*	-.090	.406	.609**	.713**	.326
	Sig. (2-tailed)	.240	.111	.779	.005	.069	.014	.683	.055	.002	.000	.139
	N	23	23	23	23	23	23	23	23	23	23	22
Explor ≤ 2 pts	Pearson Correlation	.428*	.009	.245	.291	-.024	.138	.079	.124	.034	-.100	.145
	Sig. (2-tailed)	.041	.966	.259	.178	.915	.531	.721	.573	.879	.651	.520
	N	23	23	23	23	23	23	23	23	23	23	22

Table F2 (continued)

Variables	Analyses	Essay LA ≤ 6 pts	Essay MS ≤ 6 pts	Recodedessayaverage	RecodedTotalPoints	FALL 2014 Cum GPA	Fall 2014 Term GPA	HLTHST 220	RecodedRESPCARE 203grade	RecodedRESPCARE 204grade	RecodedRESPCARE 208grade	Spring15RESPCARE 223Grade
Essay LH ≤ 6 pts	Pearson Correlation	.702**	.486*	.893**	.052	-.022	.110	-.194	-.073	-.127	.066	.011
	Sig. (2-tailed)	.000	.019	.000	.812	.921	.616	.375	.742	.562	.766	.962
	N	23	23	23	23	23	23	23	23	23	23	22
Essay LA ≤ 6 pts	Pearson Correlation	1	.169	.749**	.004	-.137	.195	-.048	.026	-.129	-.009	.005
	Sig. (2-tailed)		.442	.000	.986	.533	.372	.828	.907	.559	.966	.984
	N	23	23	23	23	23	23	23	23	23	23	22
Essay MS ≤ 6 pts	Pearson Correlation	.169	1	.742**	.250	.386	.544**	-.209	.386	.366	.373	.220
	Sig. (2-tailed)	.442		.000	.249	.069	.007	.338	.069	.086	.080	.324
	N	23	23	23	23	23	23	23	23	23	23	22
Recodedessayaverage	Pearson Correlation	.749**	.742**	1	.147	.130	.393	-.186	.176	.084	.204	.113
	Sig. (2-tailed)	.000	.000		.504	.554	.063	.395	.422	.703	.349	.615
	N	23	23	23	23	23	23	23	23	23	23	22
RecodedTotalPoints	Pearson Correlation	.004	.250	.147	1	.427*	.485*	.416*	.313	.460*	.499*	.613**
	Sig. (2-tailed)	.986	.249	.504		.042	.019	.048	.146	.027	.015	.002
	N	23	23	23	23	23	23	23	23	23	23	22

Table F2 (continued)

Variables	Analyses	Essay LA ≤ 6 pts	Essay MS ≤ 6 pts	Recodedes sayaverage	RecodedT otalPoints	FALL 2014 Cum GPA	Fall 2014 Term GPA	HLTHST 220	RecodedR ESPCARE 203grade	RecodedR ESPCARE 204grade	RecodedR ESPCARE 208grade	Spring15R ESPCARE 223Grade
FALL 2014 Cum GPA	Pearson Correlation	-.137	.386	.130	.427*	1	.603**	.497*	.613**	.591**	.385	.553**
	Sig. (2-tailed)	.533	.069	.554	.042		.002	.016	.002	.003	.070	.008
	N	23	23	23	23	23	23	23	23	23	23	22
Fall 2014 Term GPA	Pearson Correlation	.195	.544**	.393	.485*	.603**	1	.140	.818**	.814**	.803**	.586**
	Sig. (2-tailed)	.372	.007	.063	.019	.002		.523	.000	.000	.000	.004
	N	23	23	23	23	23	23	23	23	23	23	22
HLTHST 220	Pearson Correlation	-.048	-.209	-.186	.416*	.497*	.140	1	.069	.155	.031	.440*
	Sig. (2-tailed)	.828	.338	.395	.048	.016	.523		.753	.480	.888	.040
	N	23	23	23	23	23	23	23	23	23	23	22
RecodedRESPCARE 203grade	Pearson Correlation	.026	.386	.176	.313	.613**	.818**	.069	1	.688**	.635**	.596**
	Sig. (2-tailed)	.907	.069	.422	.146	.002	.000	.753		.000	.001	.003
	N	23	23	23	23	23	23	23	23	23	23	22
RecodedRESPCARE 204grade	Pearson Correlation	-.129	.366	.084	.460*	.591**	.814**	.155	.688**	1	.809**	.746**
	Sig. (2-tailed)	.559	.086	.703	.027	.003	.000	.480	.000		.000	.000
	N	23	23	23	23	23	23	23	23	23	23	22

Table F2 (continued)

Variables	Analyses	Essay LA ≤ 6 pts	Essay MS ≤ 6 pts	Recodedes sayaverage	RecodedT otalPoints	FALL 2014 Cum GPA	Fall 2014 Term GPA	HLTHST 220	RecodedR ESPCARE 203grade	RecodedR ESPCARE 204grade	RecodedR ESPCARE 208grade	Spring15R ESPCARE 223Grade
RecodedRESPCARE 208grade	Pearson Correlation	-.009	.373	.204	.499*	.385	.803**	.031	.635**	.809**	1	.698**
	Sig. (2-tailed)	.966	.080	.349	.015	.070	.000	.888	.001	.000		.000
	N	23	23	23	23	23	23	23	23	23	23	22
Spring15RESPCAR E223Grade	Pearson Correlation	.005	.220	.113	.613**	.553**	.586**	.440*	.596**	.746**	.698**	1
	Sig. (2-tailed)	.984	.324	.615	.002	.008	.004	.040	.003	.000	.000	
	N	22	22	22	22	22	22	22	22	22	22	22
Spring15RESPCAR E224Grade	Pearson Correlation	-.102	.252	.043	.596**	.573**	.595**	.479*	.562**	.745**	.714**	.956**
	Sig. (2-tailed)	.651	.257	.848	.003	.005	.003	.024	.007	.000	.000	.000
	N	22	22	22	22	22	22	22	22	22	22	22
Spring15RESPCAR E228Grade	Pearson Correlation	-.055	-.124	-.093	.447*	.243	.158	.344	.123	.544**	.672**	.780**
	Sig. (2-tailed)	.808	.583	.681	.037	.276	.484	.117	.586	.009	.001	.000
	N	22	22	22	22	22	22	22	22	22	22	22

Table F3

2014 Admission Variable Correlations Group 3

Variables	Analyses	Spring15RESPCARE 224Grade	Spring15RESPCARE 228Grade
RecodedBIO227grade	Pearson Correlation	.455*	.187
	Sig. (2-tailed)	.038	.417
	N	21	21
recodedDLMGrade	Pearson Correlation	.196	-.074
	Sig. (2-tailed)	.435	.771
	N	18	18
RecodedCumGPA	Pearson Correlation	.541**	.222
	Sig. (2-tailed)	.009	.322
	N	22	22
RecodedScienceGradePointAverage	Pearson Correlation	.346	.143
	Sig. (2-tailed)	.114	.527
	N	22	22
Extra Science ≤ 2 pts	Pearson Correlation	.463*	.425*
	Sig. (2-tailed)	.030	.049
	N	22	22
HC exp ≤ 2 pts	Pearson Correlation	.193	-.007
	Sig. (2-tailed)	.390	.977
	N	22	22
RC courses ≤ 2 pts	Pearson Correlation	-.136	.134
	Sig. (2-tailed)	.547	.551
	N	22	22
Prev Ed 1-3 pts	Pearson Correlation	.078	.069
	Sig. (2-tailed)	.731	.759
	N	22	22

Table F3 (continued)

Variables	Analyses	Spring15RESPCARE 224Grade	Spring15RESPCARE 228Grade
Load ≤ 3 pts	Pearson Correlation	.321	.403
	Sig. (2-tailed)	.146	.063
	N	22	22
Explor ≤ 2 pts	Pearson Correlation	.081	-.091
	Sig. (2-tailed)	.722	.687
	N	22	22
Essay LH ≤ 6 pts	Pearson Correlation	-.106	-.031
	Sig. (2-tailed)	.639	.889
	N	22	22
Essay LA ≤ 6 pts	Pearson Correlation	-.102	-.055
	Sig. (2-tailed)	.651	.808
	N	22	22
Essay MS ≤ 6 pts	Pearson Correlation	.252	-.124
	Sig. (2-tailed)	.257	.583
	N	22	22
Recodedessayaverage	Pearson Correlation	.043	-.093
	Sig. (2-tailed)	.848	.681
	N	22	22
RecodedTotalPoints	Pearson Correlation	.596**	.447*
	Sig. (2-tailed)	.003	.037
	N	22	22
FALL 2014 Cum GPA	Pearson Correlation	.573**	.243
	Sig. (2-tailed)	.005	.276
	N	22	22

Table F3 (continued)

Variables	Analyses	Spring15RESPCARE 224Grade	Spring15RESPCARE 228Grade
Fall 2014 Term GPA	Pearson Correlation	.595**	.158
	Sig. (2-tailed)	.003	.484
	N	22	22
HLTHST 220	Pearson Correlation	.479*	.344
	Sig. (2-tailed)	.024	.117
	N	22	22
RecodedRESPCARE203grade	Pearson Correlation	.562**	.123
	Sig. (2-tailed)	.007	.586
	N	22	22
RecodedRESPCARE204grade	Pearson Correlation	.745**	.544**
	Sig. (2-tailed)	.000	.009
	N	22	22
RecodedRESPCARE208grade	Pearson Correlation	.714**	.672**
	Sig. (2-tailed)	.000	.001
	N	22	22
Spring15RESPCARE223Grade	Pearson Correlation	.956**	.780**
	Sig. (2-tailed)	.000	.000
	N	22	22
Spring15RESPCARE224Grade	Pearson Correlation	1	.766**
	Sig. (2-tailed)		.000
	N	22	22
Spring15RESPCARE228Grade	Pearson Correlation	.766**	1
	Sig. (2-tailed)	.000	
	N	22	22

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

APPENDIX G

2016 COHORT CORRELATIONAL ANALYSIS

Table G1

2016 Admission Variable Correlations Group 1

Variables	Analyses	BIO227 Grade	DLMG rade	recoded science gpa	Extra Science ≤ 2 pts	recodec umgpa	HC exp ≤ 1 pt	400 Level RC courses ≤ 1 pt	Load ≤ 3 pts	Explor ≤ 1 pts	Second Semest er Freshm an ≤ 4 pts	recoded totalfile points	recoded essayJL	recoded essayL A	Essay MK ≤ 3 pts	Essay Total Points
BIO227Grade	Pearson Correlation	1	.438*	.885**	.031	.683**	-.430*	.297	.368	.038	.126	.683**	.477*	.232	.024	.311
	Sig. (2-tailed)		.029	.000	.882	.000	.032	.149	.070	.857	.548	.000	.016	.265	.909	.130
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
DLMGrade	Pearson Correlation	.438*	1	.796**	-.236	.613**	-.399*	.425*	.517**	.163	.020	.621**	.178	.447*	.155	.368
	Sig. (2-tailed)	.029		.000	.256	.001	.048	.034	.008	.436	.923	.001	.395	.025	.458	.071
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedsciencegpa	Pearson Correlation	.885**	.796**	1	-.103	.749**	-.457*	.398*	.473*	.110	.092	.757**	.383	.388	.117	.398*
	Sig. (2-tailed)	.000	.000		.626	.000	.022	.048	.017	.602	.662	.000	.059	.055	.576	.049
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

Table G1 (continued)

Variables	Analyses	BIO227 Grade	DLMGrade	recoded science gpa	Extra Science ≤ 2 pts	recodecumgpa	HC exp ≤ 1 pt	400 Level RC courses ≤ 1 pt	Load ≤ 3 pts	Explor ≤ 1 pts	Second Semester Freshman ≤ 4 pts	recoded totalfile points	recoded essayJL	recoded essayLA	Essay MK ≤ 3 pts	Essay Total Points
Extra Science ≤ 2 pts	Pearson Correlation	.031	-.236	-.103	1	-.016	.201	-.147	.043	-.514**	-.299	.000	.027	-.071	.241	.083
	Sig. (2-tailed)	.882	.256	.626		.938	.334	.482	.839	.009	.146	.999	.896	.736	.247	.692
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodecumgpa	Pearson Correlation	.683**	.613**	.749**	-.016	1	-.465*	.133	.532**	-.084	.282	.756**	.293	.239	.253	.349
	Sig. (2-tailed)	.000	.001	.000	.938		.019	.528	.006	.689	.172	.000	.155	.249	.222	.087
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
HC exp ≤ 1 pt	Pearson Correlation	-.430*	-.399*	-.457*	.201	-.465*	1	-.116	-.537**	-.080	-.236	-.412*	-.038	-.019	.064	.005
	Sig. (2-tailed)	.032	.048	.022	.334	.019		.580	.006	.704	.256	.040	.855	.928	.760	.982
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
400 Level RC courses ≤ 1 pt	Pearson Correlation	.297	.425*	.398*	-.147	.133	-.116	1	.592**	.242	-.167	.497*	.277	.415*	.075	.352
	Sig. (2-tailed)	.149	.034	.048	.482	.528	.580		.002	.244	.425	.011	.179	.039	.720	.084
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Load ≤ 3 pts	Pearson Correlation	.368	.517**	.473*	.043	.532**	-.537**	.592**	1	.238	-.004	.742**	.264	.549**	.298	.518**
	Sig. (2-tailed)	.070	.008	.017	.839	.006	.006	.002		.252	.986	.000	.202	.004	.148	.008
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

Table G1 (continued)

Variables	Analyses	BIO227 Grade	DLMGrade	recoded science gpa	Extra Science ≤ 2 pts	recodecumgpa	HC exp ≤ 1 pt	400 Level RC courses ≤ 1 pt	Load ≤ 3 pts	Explor ≤ 1 pts	Second Semester Freshman ≤ 4 pts	recoded totalfile points	recoded essayJL	recoded essayLA	Essay MK ≤ 3 pts	Essay Total Points
Explor ≤ 1 pts	Pearson Correlation	.038	.163	.110	-.514**	-.084	-.080	.242	.238	1	-.055	.146	-.120	.237	-.134	.015
	Sig. (2-tailed)	.857	.436	.602	.009	.689	.704	.244	.252		.796	.486	.567	.255	.524	.943
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Second-Semester Freshman ≤ 4 pts	Pearson Correlation	.126	.020	.092	-.299	.282	-.236	-.167	-.004	-.055	1	.442*	.236	.277	.335	.384
	Sig. (2-tailed)	.548	.923	.662	.146	.172	.256	.425	.986	.796		.027	.256	.179	.101	.058
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedtotalfilepoints	Pearson Correlation	.683**	.621**	.757**	.000	.756**	-.412*	.497*	.742**	.146	.442*	1	.468*	.653**	.446*	.716**
	Sig. (2-tailed)	.000	.001	.000	.999	.000	.040	.011	.000	.486	.027		.018	.000	.025	.000
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedessayJL	Pearson Correlation	.477*	.178	.383	.027	.293	-.038	.277	.264	-.120	.236	.468*	1	.374	.070	.603**
	Sig. (2-tailed)	.016	.395	.059	.896	.155	.855	.179	.202	.567	.256	.018		.066	.741	.001
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedessayLA	Pearson Correlation	.232	.447*	.388	-.071	.239	-.019	.415*	.549**	.237	.277	.653**	.374	1	.462*	.866**
	Sig. (2-tailed)	.265	.025	.055	.736	.249	.928	.039	.004	.255	.179	.000	.066		.020	.000
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

Table G1 (continued)

Variables	Analyses	BIO227 Grade	DLMGrade	recoded science gpa	Extra Science ≤ 2 pts	recodecumgpa	HC exp ≤ 1 pt	400 Level RC courses ≤ 1 pt	Load ≤ 3 pts	Explor ≤ 1 pts	Second Semester Freshman ≤ 4 pts	recoded totalfile points	recoded essayJL	recoded essayLA	Essay MK ≤ 3 pts	Essay Total Points
Essay MK ≤ 3 pts	Pearson Correlation	.024	.155	.117	.241	.253	.064	.075	.298	-.134	.335	.446*	.070	.462*	1	.718**
	Sig. (2-tailed)	.909	.458	.576	.247	.222	.760	.720	.148	.524	.101	.025	.741	.020		.000
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Essay Total Points	Pearson Correlation	.311	.368	.398*	.083	.349	.005	.352	.518**	.015	.384	.716**	.603**	.866**	.718**	1
	Sig. (2-tailed)	.130	.071	.049	.692	.087	.982	.084	.008	.943	.058	.000	.001	.000	.000	
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedMMIPointsJL	Pearson Correlation	.363	.316	.430*	-.382	.075	-.293	.083	-.017	.214	.022	.098	-.044	.091	-.182	-.053
	Sig. (2-tailed)	.074	.124	.032	.060	.722	.155	.694	.937	.304	.918	.641	.834	.664	.384	.803
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedMMIPointsLA	Pearson Correlation	.259	.275	.316	.022	.188	-.031	.111	.085	-.107	.202	.304	-.021	.511**	.221	.355
	Sig. (2-tailed)	.212	.184	.123	.916	.369	.883	.598	.687	.609	.334	.139	.922	.009	.288	.082
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedMMIPointsGG	Pearson Correlation	.016	.252	.143	-.464*	.251	.058	-.142	-.225	-.148	.362	.043	.238	.077	.206	.224
	Sig. (2-tailed)	.939	.224	.494	.020	.226	.784	.499	.279	.481	.075	.839	.252	.715	.322	.283
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

Table G1 (continued)

Variables	Analyses	BIO227 Grade	DLMGrade	recoded science gpa	Extra Science ≤ 2 pts	recodecumgpa	HC exp ≤ 1 pt	400 Level RC courses ≤ 1 pt	Load ≤ 3 pts	Explor ≤ 1 pts	Second Semester Freshman ≤ 4 pts	recoded totalfile points	recoded essayJL	recoded essayLA	Essay MK ≤ 3 pts	Essay Total Points
MMI Total Points	Pearson Correlation	.310	.384	.416*	-.286	.237	-.109	.055	-.028	-.042	.265	.251	.052	.396	.149	.291
	Sig. (2-tailed)	.132	.058	.038	.166	.253	.605	.795	.895	.841	.200	.226	.805	.050	.477	.158
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Ranking Points JL	Pearson Correlation	.325	.348	.427*	-.382	.086	-.295	.110	.048	.304	.030	.146	-.069	.143	-.116	-.005
	Sig. (2-tailed)	.113	.088	.033	.059	.682	.153	.600	.819	.139	.888	.487	.743	.495	.581	.980
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Ranking Points LA	Pearson Correlation	.251	.251	.296	.031	.151	-.026	.129	.100	-.097	.153	.280	-.033	.471*	.259	.347
	Sig. (2-tailed)	.226	.225	.151	.885	.472	.902	.538	.634	.645	.464	.176	.875	.017	.211	.089
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Ranking Points GG	Pearson Correlation	.007	.267	.142	-.497*	.242	.043	-.100	-.205	-.112	.375	.057	.275	.069	.172	.218
	Sig. (2-tailed)	.973	.197	.499	.011	.243	.840	.633	.325	.594	.065	.786	.183	.744	.410	.295
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Ranking Total Points	Pearson Correlation	.303	.434*	.441*	-.415*	.232	-.152	.078	-.017	.063	.263	.244	.071	.344	.146	.270
	Sig. (2-tailed)	.141	.030	.027	.039	.265	.470	.710	.936	.763	.204	.239	.736	.092	.486	.191
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

Table G1 (continued)

Variables	Analyses	BIO227 Grade	DLMGrade	recoded science gpa	Extra Science ≤ 2 pts	recodecumgpa	HC exp ≤ 1 pt	400 Level RC courses ≤ 1 pt	Load ≤ 3 pts	Explor ≤ 1 pts	Second Semester Freshman ≤ 4 pts	recoded totalfile points	recoded essayJL	recoded essayLA	Essay MK ≤ 3 pts	Essay Total Points
recodedOverallTotal Points	Pearson Correlation	.190	.291	.282	-.293	.199	-.045	.367	.246	.381	.378	.482*	.059	.529**	.278	.420*
	Sig. (2-tailed)	.364	.158	.172	.155	.341	.832	.071	.236	.060	.063	.015	.780	.007	.178	.036
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Scaled HLTST 220 Grade	Pearson Correlation	.089	.442*	.230	-.469*	.439*	-.202	.104	.288	.343	.164	.281	.261	.126	-.164	.089
	Sig. (2-tailed)	.672	.027	.268	.018	.028	.333	.622	.162	.094	.435	.173	.207	.548	.432	.671
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Scaled RESPCARE 203 Grade	Pearson Correlation	.364	.728**	.591**	-.373	.541**	-.364	.251	.354	.075	.253	.506**	.215	.229	.110	.249
	Sig. (2-tailed)	.073	.000	.002	.066	.005	.073	.225	.083	.723	.222	.010	.302	.271	.600	.229
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedRESPCARE 204gradefa16	Pearson Correlation	.176	.462*	.335	-.391	.269	-.365	.045	.098	-.043	.291	.214	.141	-.041	-.049	.010
	Sig. (2-tailed)	.401	.020	.101	.053	.194	.073	.831	.641	.838	.158	.304	.501	.847	.817	.960
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Scaled RESPCARE 208 Grade	Pearson Correlation	.237	.331	.307	-.244	.267	-.361	-.157	-.158	-.155	.103	-.014	-.141	-.271	-.337	-.346
	Sig. (2-tailed)	.253	.106	.136	.240	.198	.077	.454	.450	.461	.624	.947	.501	.190	.100	.090
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

Table G1 (continued)

Variables	Analyses	BIO227 Grade	DLMGrade	recoded science gpa	Extra Science ≤ 2 pts	recodecumgpa	HC exp ≤ 1 pt	400 Level RC courses ≤ 1 pt	Load ≤ 3 pts	Explor ≤ 1 pts	Second Semester Freshman ≤ 4 pts	recoded totalfile points	recoded essayJL	recoded essayLA	Essay MK ≤ 3 pts	Essay Total Points
recodedFall2016CumGPA	Pearson Correlation	.611**	.691**	.748**	-.268	.924**	-.398*	.201	.524**	.172	.298	.747**	.250	.313	.175	.335
	Sig. (2-tailed)	.001	.000	.000	.195	.000	.048	.336	.007	.410	.148	.000	.227	.128	.404	.102
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
RecodedFall2016TermGPA	Pearson Correlation	.286	.586**	.449*	-.443*	.611**	-.313	.057	.258	.113	.306	.407*	.186	.069	-.045	.086
	Sig. (2-tailed)	.166	.002	.025	.027	.001	.128	.788	.213	.591	.137	.044	.372	.742	.830	.683
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table G2

2016 Admission Variable Correlations Group 2

Variables	Analyses	recodedMMIPointsJL	recodedMMIPointsLA	recodedMMIPointsGG	MMI Total Points	Ranking Points JL	Ranking Points LA	Ranking Points GG	Ranking Total Points	recoded Overall TotalPoints	Scaled HLTST 220 Grade	Scaled RESPCARE 203 Grade	recoded RESPCARE204gradefa16	Scaled RESPCARE 208 Grade	recoded Fall2016CumGPA	RecodedFall2016TermGPA
BIO227Grade	Pearson Correlation	.363	.259	.016	.310	.325	.251	.007	.303	.190	.089	.364	.176	.237	.611**	.286
	Sig. (2-tailed)	.074	.212	.939	.132	.113	.226	.973	.141	.364	.672	.073	.401	.253	.001	.166
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
DLMGrade	Pearson Correlation	.316	.275	.252	.384	.348	.251	.267	.434*	.291	.442*	.728**	.462*	.331	.691**	.586**
	Sig. (2-tailed)	.124	.184	.224	.058	.088	.225	.197	.030	.158	.027	.000	.020	.106	.000	.002
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedsciencegpa	Pearson Correlation	.430*	.316	.143	.416*	.427*	.296	.142	.441*	.282	.230	.591**	.335	.307	.748**	.449*
	Sig. (2-tailed)	.032	.123	.494	.038	.033	.151	.499	.027	.172	.268	.002	.101	.136	.000	.025
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Extra Science ≤ 2 pts	Pearson Correlation	-.382	.022	-.464*	-.286	-.382	.031	-.497*	-.415*	-.293	-.469*	-.373	-.391	-.244	-.268	-.443*
	Sig. (2-tailed)	.060	.916	.020	.166	.059	.885	.011	.039	.155	.018	.066	.053	.240	.195	.027
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

Table G2 (continued)

Variables	Analyses	recodedMMIPointsJL	recoded MMIPointsLA	recoded MMIPointsGG	MMI Total Points	Ranking PointsJL	Ranking PointsLA	Ranking PointsGG	Ranking Total Points	recoded Overall TotalPoints	Scaled HLTST 220 Grade	Scaled RESPCARE 203 Grade	recoded RESPCARE204gradefa16	Scaled RESPCARE 208 Grade	recoded Fall2016CumGPA	RecodedFall2016Term GPA
recodecumgpa	Pearson Correlation	.075	.188	.251	.237	.086	.151	.242	.232	.199	.439*	.541**	.269	.267	.924**	.611**
	Sig. (2-tailed)	.722	.369	.226	.253	.682	.472	.243	.265	.341	.028	.005	.194	.198	.000	.001
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
HC exp ≤ 1 pt	Pearson Correlation	-.293	-.031	.058	-.109	-.295	-.026	.043	-.152	-.045	-.202	-.364	-.365	-.361	-.398*	-.313
	Sig. (2-tailed)	.155	.883	.784	.605	.153	.902	.840	.470	.832	.333	.073	.073	.077	.048	.128
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
400 Level RC courses ≤ 1 pt	Pearson Correlation	.083	.111	-.142	.055	.110	.129	-.100	.078	.367	.104	.251	.045	-.157	.201	.057
	Sig. (2-tailed)	.694	.598	.499	.795	.600	.538	.633	.710	.071	.622	.225	.831	.454	.336	.788
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Load ≤ 3 pts	Pearson Correlation	-.017	.085	-.225	-.028	.048	.100	-.205	-.017	.246	.288	.354	.098	-.158	.524**	.258
	Sig. (2-tailed)	.937	.687	.279	.895	.819	.634	.325	.936	.236	.162	.083	.641	.450	.007	.213
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Explor ≤ 1 pts	Pearson Correlation	.214	-.107	-.148	-.042	.304	-.097	-.112	.063	.381	.343	.075	-.043	-.155	.172	.113
	Sig. (2-tailed)	.304	.609	.481	.841	.139	.645	.594	.763	.060	.094	.723	.838	.461	.410	.591
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

Table G2 (continued)

Variables	Analyses	recodedMMIPointsJL	recodedMMIPointsLA	recodedMMIPointsGG	MMI Total Points	Ranking Points JL	Ranking Points LA	Ranking Points GG	Ranking Total Points	recoded Overall TotalPoints	Scaled HLTST 220 Grade	Scaled RESPCARE 203 Grade	recoded RESPCARE204gradefa16	Scaled RESPCARE 208 Grade	recoded Fall2016CumGPA	RecodedFall2016TermGPA
Second-Semester Freshman ≤ 4 pts	Pearson Correlation	.022	.202	.362	.265	.030	.153	.375	.263	.378	.164	.253	.291	.103	.298	.306
	Sig. (2-tailed)	.918	.334	.075	.200	.888	.464	.065	.204	.063	.435	.222	.158	.624	.148	.137
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedtotalfilepoints	Pearson Correlation	.098	.304	.043	.251	.146	.280	.057	.244	.482*	.281	.506**	.214	-.014	.747**	.407*
	Sig. (2-tailed)	.641	.139	.839	.226	.487	.176	.786	.239	.015	.173	.010	.304	.947	.000	.044
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedessayJL	Pearson Correlation	-.044	-.021	.238	.052	-.069	-.033	.275	.071	.059	.261	.215	.141	-.141	.250	.186
	Sig. (2-tailed)	.834	.922	.252	.805	.743	.875	.183	.736	.780	.207	.302	.501	.501	.227	.372
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedessayLA	Pearson Correlation	.091	.511**	.077	.396	.143	.471*	.069	.344	.529**	.126	.229	-.041	-.271	.313	.069
	Sig. (2-tailed)	.664	.009	.715	.050	.495	.017	.744	.092	.007	.548	.271	.847	.190	.128	.742
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Essay MK ≤ 3 pts	Pearson Correlation	-.182	.221	.206	.149	-.116	.259	.172	.146	.278	-.164	.110	-.049	-.337	.175	-.045
	Sig. (2-tailed)	.384	.288	.322	.477	.581	.211	.410	.486	.178	.432	.600	.817	.100	.404	.830
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

Table G2 (continued)

Variables	Analyses	recodedMMIPointsJL	recoded MMIPointsLA	recoded MMIPointsGG	MMI Total Points	Ranking Points JL	Ranking Points LA	Ranking Points GG	Ranking Total Points	recoded Overall TotalPoints	Scaled HLTST 220 Grade	Scaled RESPCARE 203 Grade	recoded RESPCARE204gradefa16	Scaled RESPCARE 208 Grade	recoded Fall2016CumGPA	RecodedFall2016TermGPA
Essay Total Points	Pearson Correlation	-.053	.355	.224	.291	-.005	.347	.218	.270	.420*	.089	.249	.010	-.346	.335	.086
	Sig. (2-tailed)	.803	.082	.283	.158	.980	.089	.295	.191	.036	.671	.229	.960	.090	.102	.683
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedMMIPointsJL	Pearson Correlation	1	.422*	.186	.710**	.977**	.434*	.131	.801**	.356	-.162	.289	.510**	.485*	.173	.164
	Sig. (2-tailed)		.036	.374	.000	.000	.030	.532	.000	.081	.439	.161	.009	.014	.408	.433
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedMMIPointsLA	Pearson Correlation	.422*	1	.133	.859**	.348	.977**	.072	.709**	.355	-.166	.135	.035	.372	.137	.065
	Sig. (2-tailed)	.036		.525	.000	.089	.000	.732	.000	.081	.429	.519	.868	.067	.513	.756
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedMMIPointsGG	Pearson Correlation	.186	.133	1	.500*	.150	.097	.988**	.576**	.326	.372	.469*	.361	.304	.304	.489*
	Sig. (2-tailed)	.374	.525		.011	.475	.645	.000	.003	.112	.067	.018	.076	.140	.140	.013
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
MMI Total Points	Pearson Correlation	.710**	.859**	.500*	1	.641**	.837**	.436*	.961**	.477*	-.041	.357	.336	.528**	.259	.272
	Sig. (2-tailed)	.000	.000	.011		.001	.000	.030	.000	.016	.846	.080	.101	.007	.211	.188
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

Table G2 (continued)

Variables	Analyses	recodedMMIPointsJL	recodedMMIPointsLA	recodedMMIPointsGG	MMI Total Points	Ranking Points JL	Ranking Points LA	Ranking Points GG	Ranking Total Points	recodedOverallTotalPoints	Scaled HLTST 220 Grade	Scaled RESPCARE 203 Grade	recodedRESPCARE204gradefa16	Scaled RESPCARE 208 Grade	recodedFall2016CumGPA	RecodedFall2016TermGPA
Ranking Points JL	Pearson Correlation	.977**	.348	.150	.641**	1	.360	.099	.761**	.428*	-.142	.293	.518**	.397*	.219	.158
	Sig. (2-tailed)	.000	.089	.475	.001		.077	.638	.000	.033	.497	.155	.008	.049	.294	.452
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Ranking Points LA	Pearson Correlation	.434*	.977**	.097	.837**	.360	1	.033	.709**	.294	-.189	.137	.078	.359	.090	.055
	Sig. (2-tailed)	.030	.000	.645	.000	.077		.877	.000	.154	.364	.514	.710	.078	.668	.794
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Ranking Points GG	Pearson Correlation	.131	.072	.988**	.436*	.099	.033	1	.522**	.324	.412*	.490*	.371	.257	.306	.505**
	Sig. (2-tailed)	.532	.732	.000	.030	.638	.877		.007	.114	.040	.013	.068	.215	.137	.010
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Ranking Total Points	Pearson Correlation	.801**	.709**	.576**	.961**	.761**	.709**	.522**	1	.523**	.016	.448*	.485*	.509**	.301	.341
	Sig. (2-tailed)	.000	.000	.003	.000	.000	.000	.007		.007	.941	.025	.014	.009	.144	.095
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedOverallTotalPoints	Pearson Correlation	.356	.355	.326	.477*	.428*	.294	.324	.523**	1	.041	.238	.199	-.061	.336	.147
	Sig. (2-tailed)	.081	.081	.112	.016	.033	.154	.114	.007		.847	.252	.341	.771	.100	.484
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

Table G2 (continued)

Variables	Analyses	recodedMMIPointsJL	recodedMMIPointsLA	recodedMMIPointsGG	MMI Total Points	Ranking Points JL	Ranking Points LA	Ranking Points GG	Ranking Total Points	recoded Overall TotalPoints	Scaled HLTST 220 Grade	Scaled RESPCARE 203 Grade	recoded RESPCARE204gradefa16	Scaled RESPCARE 208 Grade	recodedFall2016CumGPA	RecodedFall2016TermGPA
Scaled HLTST 220 Grade	Pearson Correlation	-.162	-.166	.372	-.041	-.142	-.189	.412*	.016	.041	1	.593**	.278	.253	.584**	.792**
	Sig. (2-tailed)	.439	.429	.067	.846	.497	.364	.040	.941	.847		.002	.178	.223	.002	.000
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Scaled RESPCARE 203 Grade	Pearson Correlation	.289	.135	.469*	.357	.293	.137	.490*	.448*	.238	.593**	1	.738**	.449*	.661**	.886**
	Sig. (2-tailed)	.161	.519	.018	.080	.155	.514	.013	.025	.252	.002		.000	.024	.000	.000
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedRESPCARE204gradefa16	Pearson Correlation	.510**	.035	.361	.336	.518**	.078	.371	.485*	.199	.278	.738**	1	.491*	.383	.679**
	Sig. (2-tailed)	.009	.868	.076	.101	.008	.710	.068	.014	.341	.178	.000		.013	.059	.000
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Scaled RESPCARE 208 Grade	Pearson Correlation	.485*	.372	.304	.528**	.397*	.359	.257	.509**	-.061	.253	.449*	.491*	1	.300	.564**
	Sig. (2-tailed)	.014	.067	.140	.007	.049	.078	.215	.009	.771	.223	.024	.013		.146	.003
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
recodedFall2016CumGPA	Pearson Correlation	.173	.137	.304	.259	.219	.090	.306	.301	.336	.584**	.661**	.383	.300	1	.747**
	Sig. (2-tailed)	.408	.513	.140	.211	.294	.668	.137	.144	.100	.002	.000	.059	.146		.000
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

Table G2 (continued)

Variables	Analyses	recodedMMIPointsJL	recodedMMIPointsLA	recodedMMIPointsGG	MMI Total Points	Ranking Points JL	Ranking Points LA	Ranking Points GG	Ranking Total Points	recoded Overall TotalPoints	Scaled HLTST 220 Grade	Scaled RESPCARE 203 Grade	recoded RESPCARE204gradefa16	Scaled RESPCARE 208 Grade	recoded Fall2016CumGPA	RecodedFall2016Term GPA
RecodedFall2016TermGPA	Pearson Correlation	.164	.065	.489*	.272	.158	.055	.505**	.341	.147	.792**	.886**	.679**	.564**	.747**	1
	Sig. (2-tailed)	.433	.756	.013	.188	.452	.794	.010	.095	.484	.000	.000	.000	.003	.000	
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25